The "Myths" of Intelligence, Invalidated by Research-Based Investigations. A Multi-Faceted Perspective on Gender Stereotyping

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1. Introduction

Either we call them myths, or folk conceptions of intelligence, historically, there have been multiple misconceptions of the roots and the factors of intelligence, resulting in the **multi-faceted intelligence stereotypes** that have lasted for decades– with notable negative implications on the development of society, the social and psychological interactions between people, and the quality of life at all levels of humanity. Extended research has been done for several decades attempting to elucidate the causes and the leading factors of those wide-spread misconceptions. Rapidly growing research in this area, and the large body of validated studies reporting significantly consistent findings across countries, cultures, and populations, demonstrate the importance that is currently given to elucidating intelligence and disproving the false beliefs that haunted the humankind for centuries. This article presents a research-based perspective of the myths, the facts and the fiction around the conceptions of intelligence.

Most importantly, gender stereotyping holds a central role in the controversies over the understanding of intelligence, with the **gender-related stereotype of intelligence** proving to be one of the most prominent gender stereotypes of the humankind. For centuries, it has been a widely held view that men were more intelligent than women. For all that, a considerable body of research done over the past few decades does not support this view, and strongly invalidates the popular belief of the existence of sex and gender differences in intelligence. Furthermore, self-estimates and the estimates of others can be very confusing and misleading. When people estimate their own intelligence, that may or may not be close to their actual measured intelligence and intellectual performance. Similarly, when people estimate the intelligence of others, deceptive factors related to **sex, gender, or appearance** lead to false perceptions resulting in underestimating or overestimating the intelligence of the people around. Research shows that there is a strong contrast between real measured intelligence and the falsely self-estimated intelligence, as well as the falsely perceived intelligence of other people. As an aftermath, the highest concerns come from the fact that persistent misperceptions and the resulting bias mostly affect human relationships, resulting in prejudicial actions and thoughts, violations of the human rights, dignity and fundamental freedoms, as well as leading to self-degradation processes in girls and women and a significant decrease in self-esteem.

Numerous studies look at potential factors that act as moderators of accuracy in the estimation of intelligence. A frequently occurring factor that misleads people's perception of intelligence (in self and others), shown when their estimates are compared with their actual measured IQ, is the **biologic sex/gender**, which is the gender based on their birth sex. Additionally, the **psychological gender**, which is the gender-role people assume or are psychologically assigned based on conceptions of masculinity and femininity (such as gender-wise appearance features, personality traits, attitudes or behaviours they display) proves to be an important factor leading to false estimates and delusive self-estimates of intelligence. In that regard, substantial research done in many countries points out that males consistently estimate their intelligence significantly higher than females; additionally, highly masculine subjects

(both men and women characterised by more masculine features) tend to rate their intelligence higher. These findings clearly show that males and the more masculine people have a higher "intellectual self-image" than the females and the feminine people, although that difference is not justified by their real measured IQ. Furthermore, cross-culture validated research indicates that, when people are asked to estimate the intelligence of others, higher scores are consistently awarded to males and the masculine targets (both men and more masculine women), which demonstrates the effect of both the gender and the gender role in the perception of intelligence in others. Overall, intelligence is generally perceived by people as a more masculine than feminine attribute, which is significantly contradicted by the research findings that show virtually no difference in general intelligence between men and women.

Another prevalent factor currently misleading people's perception of intelligence is the **stereotype of an "intelligent-looking face"**. There is a popular expectation that one could tell how a smart face should look like and, therefore, people hold a pre-existing mental image of a presumed intelligent face that they subconsciously use to judge the intelligence of people they interact with. As the first impression usually matters in most of our social interactions, forming an opinion about someone based solely on the face perception – without conscious thought and on the basis of no evidence – is a manifestation of bias regarding people's physical appearance which often results in deceptive, false perceptions of the essential nature of who we really are. Interestingly, across cultures, populations and environments, this bias can go both ways: either people perceived as attractive are expected to be less intelligent or, the opposite, they are expected to be more intelligent. For all that, a large body of research results disprove the hypothesis that facial attractiveness and intelligence are correlated at all. Although a series of studies have identified the false belief that a correlation must exist between the facial features of attractiveness and general intelligence, the results of the studies demonstrate there is no such correlation between the physical attractiveness and actual intelligence, either in children or in adults.

It is worth noting that, as regards the face perception, gender plays an important role in the variation of impressions and the degree to which they mislead people's perception of others, especially women. When female faces are watched, the more masculine looking faces are generally perceived as more intelligent than the very feminine ones. Through this, the **intelligence face stereotype** intersects the **intelligence gender stereotype**, and the level of bias affecting feminine women is cumulated. For all that, research findings emphasize the fact that the face features are not at all a relevant factor in assessing the intelligence of a woman, the perceived intelligence of the face not being a correct indicator of her real intelligence and not accurately predicting her level of cognition, considering that no relation was found between women's intellect and either their face shape/morphology or attractiveness.

Furthermore, the **brain size** was a long-lasting **gender-related stereotype of intelligence**. Since the early 20th Century, when anatomists and anthropologists believed that the level of intelligence of a person depended on the size of their brain, the speculation was born that women had to be less intelligent than men considering that, in majority, women had smaller scalps, which implied they had smaller brains. Nevertheless, the neuroscience and genetics discoveries of the late 20th and 21st Centuries disproved the hypothesis that the bigger the brain, the more intelligent a person was, and strongly discredited the old belief that brain volume was a determinant of intelligence. Instead, research findings point to the brain's information-processing capacity to be a strong determinant of the cognitive abilities of a person, which in turn depends on the brain's underlying structure and organization, the wiring diagram, the pattern of connections, brain's efficiency at the level of the network, neurons and dendrites, the molecular activity at synapses and even the gene expression– with proven gene influences on intelligence. As all recent research studies come to the same conclusion, these factors are significant for the development of cognition, and that is equally true for both men and women.

Finally, the **body mass index (BMI)** is a factor that, indeed, proves to be associated with the cognitive function. Researchers have investigated the relationship between the BMI and intelligence, in large population cohorts, from childhood through to late adulthood, and the results showed a **negative correlation** – which means that higher intelligence was related to slimmer bodies, while lower intelligence was related to higher body mass. The correlation factors, nevertheless, may vary at various stages of life. Particularly in late adulthood, higher BMI appears to be correlated with neurodegeneration and cognitive decline. However, in adolescence and adulthood as well, a clear association was identified between obesity and lower intellectual abilities, both ways, such that an association was found between becoming obese during childhood and scoring lower IQ in adulthood, as compared to the lean controls, while on the other hand, childhood intelligence was found to have a direct effect on adult obesity, with more intelligent children being at lower risk to develop obesity. Overall, there is an emphasis on education, and it is suggested that people of higher intelligence may be more inclined towards a healthier lifestyle and thereby may maintain a more normal BMI. In any case, opposite to the **gender stereotypical beliefs** regarding females maintaining thinner figures, as research reports, a slender body is not a predictor of lower intellect.

Nowadays, there is still a strong **social bias and gender prejudice** born from the popular belief that someone's wisdom, intelligence and intellectual competence could accurately be predicted by superficially observing their gender-specific features, face appearance and figure, only resulting in false impressions of the people's traits– formed without conscious thought and based on no evidence. Predominantly affecting women, this bias is a direct expression of **gender stereotyping**, impacting how women are perceived, judged, valued, addressed, and assigned roles in society, the quality of social relationships and the development of society overall. In an era when the survival and the evolution of the human race are rapidly becoming worldwide concerns, demystifying the myths of intelligence is nowadays a crucial objective in the view to helping people develop their awareness, discernment, and a clear vision into our essential nature and the authentic valuable qualities that might be hidden within surprising layers of the humankind.

2. Disproving Sex-Related Stereotypes of Intelligence. A Research-Based Approach

Historically, the folk conception that men were the "smarter sex" and women were to be regarded as intellectually inferior to men led to a long-lasting misconception related to intelligence, as being dependent on the birth-sex. This belief has persisted as one of the most prominent **gender stereotypes** of the humankind. With the development of objective assessment tools of intelligence, the **sex-based myths of intelligence** were invalidated, showing that men and women were not different in their actual IQ. More recently, a debate among researchers and psychologists has lasted for several decades regarding how gender may, or may not, impact intelligence– in the attempt to reach a consensus about the existence or non-existence of gender/sex differences in general intelligence, overall cognitive capacity, broad factors, or specific cognitive abilities. The current worldwide challenge addresses this controversy from multiple angles and considers the evolving perspectives which, eventually, should lead all people around the world to share a common view on the evidence-based intelligence equality between genders.

The Cambridge Handbook of Intelligence published by Cambridge University Press in 2020 addresses the topic of "Sex Differences in Intelligence" [1] as being "among psychology's most heated controversies" (in Part III - Intelligence and Group Differences). The overall conclusion is that "there are no sex differences in general intelligence", based on

standardized IQ tests and separate assessments that generated large amounts of data in support to this result. While investigating for differences in specific cognitive abilities between men and women, particular average between-sex differences have been found– such as, "some mathematical and visuospatial" abilities (which where a male advantage) and "reading and writing" abilities (a female advantage). For all that, there is considerable overlap as well as significant cross-cultural variation in these male/female distributions [1]. Similarly, The Cambridge Handbook of the International Psychology of Women (published the same year) raises questions about the relationships between "Sex, Gender, and Intelligence" [2] (in Section 3 - Cognitive and Social Factors), concluding that "there are no overall (average) differences between women and men in general intelligence". Some persistent differences in cognitive abilities are, again, specified; on average, such differences appear to be in favour of males as regards some "mathematics, mental rotation, mechanical" factors, and in favour of females in regard to "verbal ability, most tests of memory" [2].

An important aspect to consider when assessing how women and men differ in intelligence, in the context of the advancement of the measuring tools, is the worldwide perspective on intelligence and the evolution of its different concepts of in the 21st century, as a result of the impact of globalization [3]. First of all, traditionally, the cultural variations show a different weight on different aspects; as compared to people from Western Europe and North America, the people from Asia, Africa, and South America place more emphasis on moral, emotional, and social aspects of intelligence. Nevertheless, there are "core views" in the interpretation of intelligence that are shared by all people, such as cognitive competences (verbal/nonverbal) and social-emotional competences. The Cambridge Handbook of Intelligence concludes, on this topic, that "as the concept of intelligence has become increasingly inclusive, so do the measurements of intelligences" [3].

Furthermore, there is a relationship between intelligence and wisdom, the concept of wisdom being regarded as an "allied construct" of intelligence [4]. Being far more than "just intelligence", as confirmed by empirical evidence and widely accepted theoretical perspectives – people manifesting wisdom become sources of guidance in finding purpose and living a good life, through comprehensive and profound knowledge and understanding of the human nature and human existence. In addition to encompassing some aspects of intelligence, according to the Cambridge Handbook of Intelligence, "wisdom integrates the ability to think about complex issues in a complex way with certain personality facets such as openness to experience and empathy with others, motivational facets such as a deep curiosity about the fundamental questions of the human existence, and a willingness to critically reflect upon oneself, and ethical facets, such as a concern for a greater good that is strong enough to overrule more egoistical or self-enhancing goals" [4].

Finally, another "allied construct" of intelligence is motivation, described as "the vehicle through which intellectual skills are successfully acquired, expressed, and built upon" [5] – the understanding of intelligence depending, to some extent, on understanding its motivational grounds. From this perspective, the gradual ways in which motivation affects intelligence, favourably or unfavourably, start with setting the initial goals of acquiring and displaying intellectual skills, continue with tenaciously pursuing those goals (through study and training of intellectual abilities), advance to attaining intellectual performance and may actually lead to accomplishment over time. The Cambridge Handbook of Intelligence stresses that "motivational factors can have systematic and meaningful effects" on intelligence– such viewpoint supporting the idea of a possible degree of "malleability of intelligence" [5].

Coming back to the concept of general intelligence in its plain original sense, from the research perspective, the results of a multitude of studies closely align with the hypothesis that women and men don't differ in intelligence and their overall cognitive ability in any significant way, based on their birth sex.

A recent meta-analysis – published by the Educational Psychology Review (Springer Nature) in 2022 – has reviewed a total of 79 studies that examined "the existence of gender difference on intelligence in school-aged children" [6]. The studies included were conducted in Western Countries, East Asia, Africa, East-Europe, Middle East, South America, and were published between 1961-2019, comprising a total number of 46,605 of children (23,404 males and 23,201 females). Testing in all the studies was based on the WISC scale (Wechsler Intelligence Scales for Children) and the meta-analysis "collected all the available evidence on female/male differences on the WISC" [6]. It is worth noting that the WISC is known to be the most widely used assessment tool for children's intelligence and, moreover, it has been adapted and standardized for its correct application in various countries and populations [7].

The results of the meta-analysis emphasize that "no gender difference was observed in overall estimates of general intellectual ability" and "female/male differences on fluid intelligence were negligible", although some specific patterns were observed in the broad cognitive abilities– such as, "males performing generally better on tasks requiring some spatial manipulation of the materials, and females outperforming males on speeded tasks" [6]. These outcomes are noted to be very close to the much earlier ones obtained by Arthur Jensen, published in his book "The g factor: The science of mental ability" in 1998 [8]. Namely, after analysing tests that load heavily on the general mental ability (the g-factor) in order to assess for any female/male differences in intelligence, Jensen concluded that "no evidence was found for gender differences in the mean level of g or in the variability of g and that males, on average, excel on some factors, while females excel on others" [6,8]. The meta-analysis recorded some differences in the context of broad abilities, showing higher males' performance in visual-spatial processing and crystallized intelligence, while showing higher females' performance in the processing speed, as "most studies have reported that females outperformed males in the speed of processing" [6].

In summary, the meta-analysis found that, especially when utilizing the newer and improved version of the WISC, the gender differences on the Full Scale Intelligence Quotient (FSIQ) and fluid intelligence (gF) were negligible, while some specific differences were reported to favour either males or females on some categories of tasks. More precisely, males seem to perform better on the visual processing (gV) and crystallized intelligence (gC) factors; on the other hand, females tend to perform better on the short-term memory (gSM) factor and, to a larger degree, on the processing speed (gS) factor, particularly on the coding subtest [6]. For example, quite often, boys scored better at Block Design, while girls scored better at Matrix Reasoning and Coding.

Within its span, the meta-analysis included studies that assessed the intelligence construct based on the WISC scale (Wechsler Intelligence Scales for Children) [6], the most used intelligence test for children. It is important to mention that, since the first version of the WISC created in 1949 and the revised version of 1974 (WISC-R), several refinements and improvements of the scale were made over the years, resulting in WISC-III, WISC-IV, and finally WISC-V in 2014. All the different versions of the WISC intelligence test batteries were used in this meta-analysis and, moreover, the CHC model approach was adopted– through which the results of different WISC batteries could be compared [6]. The outcomes indicated that the older versions of the scale showed larger differences between groups, as compared to the newer versions which showed a decrease in the gender differences; on the new and improved WISC scale versions, the differences in the overall cognitive ability or general intelligence were reduced to virtually negligible.

A study published by Science Direct in the Personality and Individual Differences journal in 2002 [9] investigated for sex differences in fluid intelligence among high school graduates, based on the PMA Inductive Reasoning Test, the Advanced Progressive Matrices (APM), and the Culture-Fair Intelligence Test. The research study tested over 4,000 high-

school students, reporting the conclusion that "because no systematic difference was found in the measures of fluid intelligence, gender differences in general intelligence are likely non-existent" [6,9]. Similar results were reported by a series of other studies published by Science Direct in Personality and Individual Differences (2020) [10], Journal of School Psychology (2018) [11], and Intelligence (2008) [12], which utilized different test batteries for testing and the results indicated that "gender differences are very small, if not trivial" [6,10,11,12].

The British Journal of Educational Psychology of the British Psychological Society published a study in 2006 [13] that presented an analysis of the sex differences in the Cognitive Abilities Test (CAT) scores of a large representative UK sample of over 320,000 students, age 11–12 years old, administered between 2001-2003. The study aimed to determine if there were any sex differences in the scores of the UK nationally standardized tests for verbal, quantitative, and non-verbal reasoning; the results reported that the mean differences were small [13]. A further study, published in the British Journal of Educational Psychology in 2009 [14], investigated whether the results of the previous study were unique to the UK, or there were consistencies in sex differences on the Cognitive Abilities Test (CAT) "across countries, grades, test forms, and cohorts". The previous research study [13] was replicated and extended by the new one [14] to analyse the scores of three nationally representative US cohorts totalling 318,599 students, grades 3-11, who had been administered the US-version standardizations of the CAT test in 1984, 1992, and 2000, respectively. "The proportions of males and females at each score level" were compared between UK and US, and the results showed a remarkable consistency in sex differences in quantitative reasoning abilities [14]. Given that very small differences in means were found, the overall implications are being discussed.

Note: The theory of multiple intelligences (MI) (proposed by Howard Gardner in 1983), as discussed in The Cambridge Handbook of Intelligence [15], states that "all individuals have several, relatively autonomous intelligences that they deploy in varying combinations" and these intelligences, together, are utilized to solve problems or create products. The theory of multiple intelligences has a divergent perspective from the theories referring to general intelligence (g, or g factor) which state that "a single mental capacity is central to all human problem-solving and that this capacity can be ascertained through psychometric assessment" [15].

To sum up, sex differences found in general intelligence by the outcomes of a large number of thoroughly done research studies are characterised as likely non-existent, virtually negligible, very small, if not trivial. These results are notably consistent across populations from different countries and geographic regions, accounting for cultural perspectives that have evolved and have become more inclusive and uniform, while the measurement tools of intelligence have been adapted and adjusted over time to more standardized forms that accurately report on the factors of intelligence identified in various populations.

3. Deceptive Influences of Biologic Sex and Gender on Self-Estimates and Other-Estimates of Intelligence

There are research findings consistent across many studies showing that, when asked, men often overestimate their own intelligence, while women underestimated their own intelligence, in comparison with their real measured IQ, which points out that how smart people think they are is not justified by their actual intelligence. Likewise, when people are asked to estimate the intelligence of others, males are rated higher than females, although the large body of research into measured intelligence consistently shows there is no difference between men and women in the overall intelligence. Generally, this socio-psychologic phenomenon results in frequently underrating or overrating the intelligence of self and other people, involving a **stereotypical gender prejudice**, which negatively impacts social interactions in our daily life.

Thorough research done on the accuracy of self-estimates and other-estimates of intelligence shows low validity of such estimates (which means that people are wrong in their estimates, as compared to their actual measured IQ), indicating that there are factors which moderate their accuracy; such factors have been investigated by a considerable body of research [16].

3.1. Self-Estimates: How men and women estimate their own intelligence

A clear perspective on this topic is offered by a very interesting recent article published in The Conversation (an academia-supported on-line independent journal) in 2022, where the author, David Reilly (Researcher, School of Applied Psychology, Griffith University), discusses their research findings that "men think they're brighter than they are and women underestimate their IQ" and reflects on the question "Why?" [17]. In their study [18] published in Frontiers in Psychology in 2022, the researchers investigated the "gender differences in self-estimated intelligence" and the factors that influence how men and women estimated their own IQ. The study has identified the "predictors of self-estimated intelligence" and found that the strongest predictor was the biological sex, followed closely by the psychological gender. More precisely, the results showed that "the strongest predictors of overestimating IQ" were being born male (in terms of biological sex) and being highly masculine (in terms of psychological gender). In other words, "having strong masculine traits (both men and women) were associated with an inflated intellectual self-image" [17,18].

A multitude of studies pursuing the same research goal have been completed in over 30 countries and five continents, the results revealing "similar, consistent, and significant differences between males and females in self-estimates of overall (general) intelligence, with males giving higher scores to themselves" [19]. This finding is strongly supported by a multilevel meta-analysis published in the Psychological Bulletin of the American Psychological Association in 2012 [20], which analysed the validity of self-estimates of cognitive ability across 41 published studies by examining "the relationship between self-estimated and psychometrically measured cognitive ability" [20].

A research study published in The Journal of Social Psychology in 2013 analyses the "gender and gender role differences in the self- and other-estimates of multiple intelligences" [19], with the overall aim to investigate how the participants' gender and gender role influenced the perception of: first, their own intelligence; second, their partner's intelligence; and third, the intelligence of hypothetical people who were described as "gender stereotypical" and "gender counter stereotypical" targets. The results of the study show that, when self-assessing their own intelligence, males rated their general intelligent quotient higher than females (especially their mathematic IQ), while females estimated their social and emotional intelligence higher than males [19]. The study was conducted in Great Britain, including a population sample of 261 British participants, in majority British-born; for the results comparison purposes, the authors suggested it would be acceptable to use United States based supporting research, as the United States, United Kingdom, and other English speaking and Anglo Saxon cultures (e.g., Australia, Canada and New Zealand) were regarded as very similar [19].

From a cultural perspective, there are some cross-cultural differences– both in the concept of intelligence itself, and in the variations of the gender-role within the cultural dimensions of masculinity and femininity traits [19]. First, regarding the intelligence concept, in the investigation of "culture and gender differences in self and other estimates" of general intelligence and multiple intelligences, nearly 20 published studies have demonstrated "consistent sex differences with males rating themselves higher than females", with a slight variation among the male population (for example, African and American men rated themselves higher scores than the Chinese and Japanese men did), although still above the

scores awarded by women to themselves [19,21]. Second, regarding the gender-role (psychologic gender), while over 30 studies conducted in different countries have proven "the consistence of the sex differences in self-rated intelligence" (based on the biologic sex), the gender-role "has been shown to be more culturally determined" than the biologic sex, due to the culture-specific definitions of masculinity and femininity, and more research needs to be done on that aspect [19,22,23].

Psychologist Adrian Furnham has introduced the idea of the "male hubris, female humility" problem [24], found to be true in many cultures [17]. The crosscultural study terming this effect, published in the Intelligence journal in 2011 [24], analysed the ratings of intelligence on self and family members in America, Britain, and Japan; the problem was identified in all three countries, although in different degrees. The hubris/humility effect is noted when there is a consistent gender difference effect in the self-estimates of intelligence in populations– which is, the males consistently award themselves higher self-estimates than females, while females consistently award themselves lower self-estimates than males [19,22,23,24,25,26,27]. The concerning conclusion is that "whilst the literature consistently show little or no sex difference in overall intelligence, the hubris-humility effect of sex differences still occurs across time, populations, and ratings" [19].

The practical implications come from the way self-beliefs shape behavior, which may result in self-degradation processes for females, and lower self-esteem. In that view, gender differences in self-esteem have also been assessed, as a factor of significance. Research has highlighted "a strong contribution of general self-esteem to participants' intellectual self-image"; with this gender difference emerging early in adolescence, "girls and women rate their general self-esteem significantly lower than boys and men" [17] and, further, they rate their intelligence lower as well.

3.2. Other-Estimates: How men and women estimate the intelligence of other people

Intelligence estimates of known relatives

Interestingly, the gender differences in estimating the intelligence of other people (other-estimates), according to the findings of multiple studies, showed the same pattern as the gender differences in estimating their own intelligence (self-estimates) [19] – specifically, "people's ratings of their mothers', grandmothers' and daughters' intelligence tend to be significantly lower than those of their fathers', grandfathers' and sons', respectively" [19,24,28,29,30].

Of particular importance is the discussion regarding the parental expectations of their children's intelligence, which are most often influenced by the children's gender. The findings of a 1998 study in social psychology [31] (further replicated with consistency across the world) showed that, when parents were asked to estimate the intelligence of their children, they rated their sons as being significantly more intelligent than their daughters [17,31]. Such judgements were termed as **gender-stereotypical parental perceptions**. In turn, parental expectations have a high potential to strongly influence children's intellectual self-image, and thereby may predict their academic achievement over time [17].

A German study published in Sex Roles (Springer, 2009) investigated what explained "boy's stronger confidence in their intelligence" [32]. A total of 496 German high school students (11th and 12th graders) were tested on intelligence tasks, then their results were compared with their own self-ratings. The boys self-estimated their numerical, figural, and reasoning abilities higher than the girls, regardless the fact that their estimates were not justified by their actual measured intelligence scores on the corresponding tasks. Additionally, the parents were also asked to rate their children's intelligence and "the same pattern appeared in parental intelligence perceptions". The conclusion of the study was that "neither intelligence

nor gender-stereotypical parental perceptions totally explains boys' stronger confidence in their intelligence" [19,32].

Given these worrying circumstance, the **intellectual self-image** – which starts early with the parental expectations of children's intelligence, and further develops with the gendered differences in self-esteem and corresponding differences in self-rated intelligence, between boys and girls – receives special attention from the educational psychologists as a possible predictor of a child's later academic performance [17]. The aspect of self-esteem appears to go both ways: on one hand, an early higher self-esteem makes children regard their intellectual ability more positively, as other aspects of life as well; on the other hand, a higher intellectual self-image may result in a higher general self-esteem and a higher quality of life. As very suggestively characterized, "it's often a self-fulfilling prophecy: if you think you can't, you won't" [17]. The first recommendation that comes to mind, to address this issue, is to help little girls elevate their aspirations and constantly support them to believe in themselves. The sooner, the better.

Intelligence estimates of hypothetical figures

Another sub-category of research into intelligence estimates of other people looks at how **hypothetical figures (**of different genders and gender roles) may be rated in terms of intelligence and personality traits. This 2013 study published in The Journal of Social Psychology [19] took such challenge and investigated the estimates of intelligence of hypothetical people, in order to determine if "perceived masculinity or femininity of a hypothetical person" affects their intelligence ratings. The overall results of the study demonstrated that, when people assessed hypothetical figures, there was a "clear associations between intelligence and gender-related personality traits […] with higher IQ associated with masculinity". As a consequence, "people may rate an imaginary target as being more masculine if he or she is assumed to have a higher IQ and vice-versa" [19].

First, the participants in this study were asked to assess the intelligence of a series of hypothetical figures (male and female targets) who displayed various characteristics of gender role stereotypes (e.g., more masculine or more feminine traits). The results proved a significant gender role effect, with "masculine targets receiving significantly higher intelligence estimates compared to feminine targets"; the masculine targets, both men and women, were judged as "significantly more intelligent compared to the feminine ones" [19].

Second, the participants were provided with descriptions of hypothetical figures (male and female targets) characterized as having very high IQs (particularly very intelligent women) and were asked to rate the targets' personality traits. The results showed that "more intelligent hypothetical figures were judged as more masculine and less feminine". When rating the female targets, the hypothetical intelligent female was believed to be less feminine than the less intelligent female, while the less intelligent female was believed to be "more feminine than all other targets" (more feminine than the intelligent females, intelligent males, and less intelligent males). Further, the intelligent male was believed to be "less feminine than all other targets" (less feminine than the less intelligent males, intelligent females, and less intelligent females). These results clearly reveal that "intelligence is regarded as a more masculine than feminine attribute" [19,22,23].

To clarify the classification of the gender roles, the Bem Sex Role Inventory (BSRI) (which assesses individuals' self-reported masculinity and femininity personality characteristics) was used to assign the subjects into 4 gender role groups: masculine, feminine, androgynous, or undifferentiated. Further, depending on the congruence/incongruence of their biologic gender with their assigned gender role, masculine and feminine individuals are classified as gender-typed or cross-gender typed. The gender-typed people are, clearly, the

masculine males and feminine females (with higher femininity or higher masculinity scores); the non-gender-typed people are the androgynous or undifferentiated persons (as both sexes-typed or neither sex-typed).

Overall, although not related to any real intelligence measurements, superior intelligence is being attributed to males and masculine females, while the personal and social abilities are attributed to females and feminine people. More specifically, particular cognitive abilities such as logical reasoning, mathematical, spatial, and kinaesthetic intelligence tasks are considered to be on the "masculine sphere", while interpersonal and emotional skills are regarded to be "feminine domains". Consequently, more masculine people are believed to have "more cognitive abilities and less personal/social abilities" [19,25,33,34].

To sum up, the multitude of studies that aimed to determine how the participants' biologic gender (birth sex) and psychologic gender (gender role) influenced the perception of intelligence, investigating both the self-estimates and other-estimates of intelligence, found that the significant gender differences were influenced by gender-oriented stereotypes. Of course, these results are mediated by the culture-specific categorization of the gender role traits, which imply specific definitions of masculinity and femininity in different cultures, as well as potential cultural expectations for modesty and humbleness. Nevertheless, overwhelmingly, the male gender was predominantly related to superior cognitive/intellectual abilities, while female gender was related to personal "soft" skills. Furthermore, addressing the gender-role in addition to gender, there was a strong gender effect on estimating general intelligence, the males being rated higher than the females, and a strong gender role effect, the more masculine targets being rated higher than the more feminine targets. In the view of the decades of validated research proving there was virtually no sex difference in people's measured general intelligence, these findings should raise significant concerns.

4. Face Perception as an Intelligence-Stereotype. Misleading Impressions of an "Intelligent-Looking Face"

As early as 1997, in her book "Reading Faces. Window To The Soul?", Leslie Zebrowitz offered us the first scientific account of people's tendency to judge others by their appearance, systematically unmasking the face by asking the question: "What information do faces actually provide?". Dr. Leslie Zebrowitz (PhD, Yale University) was a Manuel Yellen Professor of Social Relations and Professor of Psychology, Emerita, in the Department of Psychology at Brandeis University (Waltham, Massachusetts). Before she retired, she ran the Zebrowitz Face Perception Lab at Brandeis University and her research focused primarily on the gender, age, and race stereotypes related to face perception, with an emphasis on how and why people's physical appearance influences impressions of their traits, social outcomes and psychological development. The overarching message she relayed to us was that we shouldn't "judge a book by its cover…" [35]

Face perception has become a very topical research subject, in an era when, particularly as regards women, appearance was granted more importance than the intrinsic qualities, skills and competences of a person, as well as their social and psychological traits, contributing to the whole gamut of factors that fed into the **gender stereotyping**. For all that, extensive research has proven that the face features give a very deceptive, false, unreal account of the essential nature of who we really are. The questions then arise: Why does appearance matter?[36] How does it mislead people's perception of people, especially women?

One false belief identified by a series of studies is the **stereotype of an "intelligent-looking face"** [37]. There is a popular expectation that a correlation must exist between the facial features of attractiveness and general intelligence, and a general presumption of how a

smart face should look like exists in both men and women. Interestingly, in different environments and cultures, the bias regarding this presumed correlation can go in one of two ways: people perceived as attractive are either expected to be less intelligent or, contrary, are expected to be more intelligent– and the gender plays an important role in this variation. However, the results of multiple research studies fail to support such hypothesis that facial attractiveness and intelligence are correlated at all [37,38,39,40,41,42]. Whichever way the bias goes, it has been proven wrong by thorough research over a few decades.

A study [37] published in 2014 that compared the **"perceived intelligence"** (the impression of intelligence that the raters had when looking at various faces) with the **"measured Intelligence"** (the measured IQ of the people whose faces were observed by the raters) shows that the human raters had a pre-existing mental image of a presumed intelligent face. The **intelligence-stereotype** is a statistically supported description of the facial traits and facial shape space "responsible for an attribution of intelligence" by the human raters, the "predicted stereotype of high-intelligence", as opposed to the depiction of a face that triggers the prediction of low-intelligence [37]. Given the crucial "social signaling function" of the human face, with its complex structure, the study authors point out that the ability to accurately assess the intelligence of other people has strong implications in our daily social interactions. According to the results of this study, the face features are not at all a relevant factor in correctly assessing the intelligence of the women being rated. The perceived intelligence of the face is not an indicator of the measured IQ and doesn't accurately predict high cognition. Additionally, no significant correlation was found between attractiveness and the measured IQ [37]. Contrarily, the intelligence quotient (IQ) is much stronger predicted by the intellectual performance, speech, and general behavior of women, rather than by their face features and attractiveness.

In both genders, the faces that are most often perceived as highly intelligent (giving the impression of intelligence) are prolonged, narrower shaped, with a sharper, thinner, pointing chin, and a larger or prolonged nose. In contrast, the faces that are perceived as less intelligent are rather oval shaped, broader, with a rounded chin, and a smallish nose [37]. In the case of women, in particular, the more masculine looking faces are generally perceived as more intelligent, the intelligent-face stereotype depicting sharper, harder facial shape and features. Additionally, adults that have childlike facial traits (the so-called "babyish" face features), thus perceived as "babyfaced", are also perceived as intellectually, physically and socially weaker than people with more mature face features– who, by contrast, are perceived as stronger and more intelligent. Babyfaceness in adults also creates the impression of people being naïve, warm, and submissive. Childlike features include rounder, less angular faces, larger eyes, smaller nose bridges, thicker lips, lower vertical placement of features, with higher forehead and shorter chin [35,36,43,44]. Overall, when empirically trying to assess the intelligence of people by looking at their faces, there is a strong bias regarding different types of faces that create false impressions of people's traits, often first impressions formed without conscious thought and on no basis of any evidence.

The study that analyzed "perceived intelligence" vs. "measured Intelligence" [37] didn't find any relationship between the perceived intelligence and IQ for women. Moreover, no correlation was found "between morphological traits and real intelligence measured with IQ test, either in men or women". The study used 40 static facial photographs of women and 40 of men (instructed to maintain a neutral, non-smiling expression, avoiding decorations, jewelry, and facial cosmetics) which were judged by all the raters for perceived intelligence or attractiveness. The IQ measurement of all the people whose faces were judged consisted of verbal, numerical, and abstract figural reasoning tasks, as well as memory tasks, and a knowledge test; overall, the IQ test measured fluid, crystallized, and general IQ. The results of this study showed "no relation between intelligence and either attractiveness or face shape",

therefore suggesting that a perceiver viewing faces of women in photographs could not accurately assess the real intelligence of the women photographed. In conclusion, the authors of the study stress that the supposed high and low intelligence faces probably represent "nothing more than a cultural stereotype because these morphological traits do not correlate with the real intelligence of the subjects" [37].

The above-mentioned research study [37], published in 2014, included a group of rated people of similar age, 21.4 years old in average, and did not report any significant correlation between the measured IQ and features of attractiveness. An older study [38], published in Sage Journals (Personality and Social Psychology Bulletin) in 2002, investigated such potential association in middle adulthood (30 to 40) and later adulthood (52 to 60), and the results did not show any significant correlation between intelligence and attractiveness. An interesting approach was given by a study [39] published in Science Direct (Evolution and Human Behavior) in 2015, analyzing a large sample of identical and fraternal twins and their siblings using highly reliable measuring factors of facial attractiveness and IQ, which found no evidence to support the hypothesis of a phenotypic correlation between traits of facial attractiveness and general intelligence.

Other previous studies also show that, in adults, there is rather weak evidence of an association between actual intelligence and physical attractiveness. For example, a meta-analytic study [40] published in Intelligence in 2008 reported their conclusion that physical attractiveness and actual intellectual competence in adults were not correlated. Additionally, some studies published in the Psychological Bulletin of the American Psychological Association in 2000 [41] and 1992 [42] showed close to zero correlation between attractiveness and actual intelligence in adults.

Data collected and analyzed by all the mentioned studies suggest that there is a false belief of cognitive correlates of face perception, a delusory expectation that the face appearance, and especially the features of attractiveness, could accurately predict someone's intelligence, wisdom, and intellectual competence, thereby resulting in social bias and prejudice. Predominantly affecting women, such bias directly relates to **gender stereotyping**, with implication on how correctly women are perceived, judged, valued, addressed, approached, included, assigned roles, and placed among the different layers of society– and the quality of their social interactions. The question, again, arises– why appearance still matters, in an age of humanity when everyone should be aware that an accurate lucid perception of our essential nature is of utmost importance for the survival and the evolution of the human race.

5. Brain Size Has Nothing To Do With Intelligence

The myth of the brain size comes from the early 20th Century, when many anatomists and anthropologists believed that the size of the brain determined the level of intelligence of a person. From this belief, many speculations have been born and lasted for decades– such as, the hypothesis that the bigger the brain, the more intelligent a person was. This, of course, resulted in women being regarded as less intelligent than the men on the account that, generally, women had smaller scalps and, therefore, smaller brains. This hypothesis has been disproved by the new scientific discoveries in neuroscience in the late 20th and 21st Centuries, which strongly disagreed to the old belief that the **brain size** was a determinant of intelligence. Through this, thorough research has, once again, demystified a long-lasting aspect of a **gender-related stereotype of intelligence**.

In 2009, an article in Scientific American [45] discussed the "Fact or Fiction" of the myth of brain size dictating intelligence. The topic of the brain's information-processing capacity is now brought into the spotlight, as a factor of significantly higher importance than

its size when it comes to how intelligent we are. The key determinants to this capacity have been identified to be the brain's underlying organization and the systems within the brain (the manner in which neurons and synapses are organized), as well as the molecular activity at synapses – which are the communication junctions between nerve cells where the nerve impulses pass.

More recently, in December 2023, a BBC article [46] talked about the "connectome" – the brain's wiring diagram – making a point that, when it comes to human intelligence, "it's how your brain is wired rather than size that matters"– and consequently "brain size isn't everything". The article emphasizes that many neuroscientists currently argue that changes to the brain's wiring diagram and connectivity (the pattern of connections and the shapes of the neurons) are of higher importance for the development of cognition than the brain's volume. According to the neuroscientists at Yale University, some parts of the human brain (such as the prefrontal cortex, called "the CEO of the brain") integrate multiple information inputs from many other regions, allowing such region to make decisions, which benefits cognition; therefore, more of this integrative circuitry being put in place leads to higher human cognitive abilities. Moreover, as the article explains, changes in "gene expression" (more precisely, which genes and when and where they are turned on in each cell) can fundamentally modify the shapes and behaviors of the cells.

The Cambridge Handbook of Intelligence (2019), in the chapter "The Biological Basis of Intelligence" [47], refers to neuroimaging studies that have revealed brain connectivity patterns showing "correlations with individual differences in intelligence", as well as brain networks specifically related to intelligence. In addition to exploring the brain structure and function, a new relevant topic is the concept of "brain efficiency", at the levels of the network and the dendrite. Furthermore, the chapter discusses the gene influences on intelligence and the "molecular biology of intelligence" that is currently being developed.

An article of the New York Neurology Associates [48] debates the question whether a genius has a larger brain than ordinary people. It spotlights the case of Albert Einstein (one of the most famous geniuses on the planet) and the testing conducted on his brain, a few decades ago; according to the article, the investigators found that "there was no difference between how large his brain was compared to the brain size of individuals of average intelligence". The article highlights the findings of the more recent studies showing that the size of the brain "has nothing to do with one's intelligence", explaining that the intelligence of a person is rather a result of the structure and the underlying organization of the brain, as well as the molecular activity at the synaptic communication junctions between the neurons. Of course, the article stresses, there is the exception of some medical conditions that can cause a smaller brain size, such as lead exposure which results in the death of neurons, thereby determining poor cognition. However, in healthy individuals, as all recent research studies come to this conclusion, the brain volume doesn't determine the level of intelligence.

6. Body Mass Index (BMI)–Intelligence Quotient (IQ): A Negative Correlation

A series of research studies have investigated the relationship between the body mass index (BMI) and intelligence and have found that intelligence was indeed related to the BMI, from childhood through to late adulthood. More precisely, the research results show that general intelligence is **negatively correlated** to the body mass index (BMI) – which means that, in the large population cohorts studied, a lower level of intelligence was related with a higher body mass, while higher intelligence was related to slimmer bodies, possible correlation factors varying at various stages of life.

According to studies published in scientific publications such as BMC Geriatrics of Springer Nature (2016), Behavioural Brain Research of Science Direct (2015), APA PsychNet of the American Psychological Association (2010) and Neurology of the American Academy of Neurology (2006), BMI and intelligence are proven to be negatively correlated particularly in late adulthood [49,50,51,52], associated with cognitive change at old age. Nevertheless, some studies published in the American Journal of Epidemiology of OXFORD Academic (2013) and Neurology of the American Academy of Neurology (2006) show that obese children and adults too proved lower intelligence quotients (IQs) than the lean controls [52,53]; cross-sectional studies have reported a clear association between obesity and low intellectual abilities in adolescence and adulthood, as well as neuroimaging abnormalities [53], while other studies have assessed that, in healthy men and women, BMI was associated with the cognitive function and correlated with cognitive decline [52].

In regard to the decline of the cognitive ability in late adulthood, some studies assert that obesity generates inflammation and vascular risk factors that result in causing or exacerbating neurodegeneration. Research papers published in BMC Geriatrics (2016), Neurology (2006), International Journal of Obesity (2013) and Frontiers in Neuroscience (2014) suggest that these factors, recorded across midlife, lead to greater cognitive decline in late life as observed in older adults [49,52,54,55].

On the other hand, one research study published in the American Journal of Epidemiology (2013), was specifically focused on the first half of the life course, based on a prospective longitudinal study from childhood to midlife [53]. This study analyzed data from a population-representative cohort of 1,000 children observed and tested along 4 decades, in order to test the hypothesis that becoming obese was associated with a decline in the intelligence quotient during that particular life stage. The results showed that the cohort members who became obese scored lower IQ scores in adulthood. This association was interpreted by some researchers to indicate that obesity caused intellectual decline during the first half of life. However, the IQ deficits of these obese adults were already present in childhood, recorded at as early as 3 years of age. Therefore, the data doesn't prove the hypothesis that obesity caused a decline in IQ in the first half of the life course. Instead, as the study points out, it shows that the children who later developed obesity in adulthood had lower IQ scores since childhood, at baseline, as compared with the children who remained lean for the following 3 decades. The conclusion could be that children with lower IQ are at higher risk to develop obesity by midlife. For all that, the authors acknowledge the limitation that "although our study shows a temporal precedence of low IQ over obesity, it does not establish causation" [53].

Other studies, published by Wiley Online Library in Obesity journal (2013) and Obesity Research (2003), underline their conclusions that "childhood intelligence has a direct effect on adult obesity unmediated by education or earnings" [56] and, respectively, that the test score of intelligence is "inversely related to risk of BMI changes and the risk of development of obesity", in this case pointing to education as possibly acting as "a mediator or indicator of cognitive ability" [57]. Additionally, studies published in Springer Nature (BMC Geriatrics) and Wiley Online Library argue that, generally, people of higher intelligence may maintain a more normal BMI because they are more inclined towards a healthier diet and regular exercise [49,56,57].

7. Conclusion

While research has consistently proven there is no sex difference in general intelligence between men and women, there is still a prevailing belief that males are superior to females in

cognitive abilities. Investigating the overwhelming inaccuracy of the estimates and self-estimated of intelligence in people led to a series of misleading factors being identified – such as the biologic gender, the gender role, the face perception and the brain size – all these factors being falsely presumed to be relevant determinants and predictors of intelligence.

Among the multi-factor intelligence stereotypes, the gender-related stereotype of intelligence proves to be one of the most prominent gender stereotypes of the humankind. Overall, intelligence is generally perceived as a more masculine attribute, higher intelligence estimates being consistently awarded to males and the masculine subjects, while the same pattern was revealed in the self-estimates, with males consistently estimating their intelligence significantly higher than females. For all that, research-based evidence firmly invalidates the folk conceptions of the supposed sex and gender differences in intelligence. As regards the face perception, the facts once more contradict the fiction; neither different types of faces nor the features of attractiveness showed any real correlation with intelligence. The results of many studies have demonstrated that there is no relationship between the physical attractiveness, the perceived intelligence of the face, and the actual measured IQ for women. Furthermore, when it comes to human intelligence, research shows that it's rather how our brains are wired, and not the size that matters. The long-lasting misconception that men were more intelligent than women, solely for having a bigger brain, is strongly contradicted by recent scientific findings pointing out that intelligence is rather the result of the brain structure, organization systems and connectivity patterns, molecular activity at the synaptic junctions, and the gene expression– that result in individual differences in intelligence. This truth is no different in men than women; in fact, particular aspects of intelligence have actually proven to be a female advantage. Finally, as research reports, while higher intelligence is related to lower body mass index along the lifespan of a person, a lean female body does not prove to be a predictor of lower intellect.

In summary, the evidence of such multi-faceted perspective on gender stereotyping related to intelligence should bring us back to the ultimate question: why appearance still matters, at a time when humanity mostly needs discernment, lucidity, conscious perceptions and awareness of our true essential nature – for the survival and the evolution of the human race.

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