Biological Sex Differences in the Workplace: Reports of the End of Men Are Greatly Exaggerated (As Are Claims of Women's Continued Subordination)

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Abstract

Common examples of what is perceived as workplace inequality–such as the "glass ceiling," the "gender gap" in compensation, and occupational segregation–cannot be well understood if the explanation is limited exclusively to such social causes as discrimination and sexist socialization. Males and females have, on average, different sets of talents, tastes, and interests, which cause them to select somewhat different occupations and exhibit somewhat different workplace behaviors. Some of these sex differences have biological roots. Temperamental sex differences are found in competitiveness, dominance-seeking, risk-taking, and nurturance, with females tending to be more "person-oriented" and males more "thing-oriented." The sexes also differ in a variety of cognitive traits, including various spatial, verbal, mathematical, and mechanical abilities. Although social influences can be important, these social influences operate on (and were in fact created by) sexually dimorphic minds.

It is almost axiomatic that substantial changes in the environment of a complex organism will result in changes in its behavior. Therefore, we should not be surprised when changes in the economy or changes in the nature of work are followed by changes in workforce behavior and hence changes in workplace outcomes. For those keeping track of the "numbers," these changes may be characterized as either increasing or decreasing equality, depending upon the particular definition of equality selected. Whether one views a particular outcome as a harbinger of "the end of men" or a reflection of continued sexual inequality of women may be a consequence of whether the focus is on group averages or the tail end of distributions, as it may turn out, for example, that even if women may do better as a group on some measures, men may still dominate at the top.

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INTRODUCTION

In recent years, a spate of publications have chronicled or predicted the so-called decline of males and ascendancy of females. Most recently, Hanna Rosin has contributed *The End of Men*,[2] but at the end of the last century, Lionel Tiger was lamenting The *Decline of Males*[3] and Helen Fisher was celebrating *The First Sex*,[4] based largely on the same kinds of trends that Rosin describes today–changes in the workplace, in education, and in other forces, such as increasing female control over reproduction and increasing societal subsidy of child-raising. A decade ago, I acknowledged these trends but suggested that reports of the demise of males were greatly exaggerated:

> Nonetheless, men will continue to dominate the scarce positions at the top of hierarchies as long as it is necessary to devote decades of intense labor-market activity to obtain them, even if women come to predominate in middle-management positions and even if men also disproportionately occupy the bottom of hierarchies. Men will similarly continue to dominate math-intensive fields, as well as fields that expose workers to substantial physical risks.[5]

These residual areas of perceived inequality are ones commonly invoked to prove the continued existence of sex discrimination against women. It is seldom explained, however, why it is necessary to invoke discrimination to explain areas of continued male dominance while areas of female ascendancy are casually attributed to social forces or, indeed, to inherent female superiority.

The complex nature of sex differences in the evolving workplace cannot be appreciated without an understanding of inherent differences between men and women. It is certainly fair to suggest that in some respects–in many perhaps–changes in the contemporary workplace favor women, but it is probably not correct to characterize this as a sea change that will so overwhelmingly swamp men that any areas of remaining male advantage must be laid at the doorstep of discriminating employers or residual patriarchy. The fact is that the sexes differ somewhat–*on average*–in a number of talents, tastes, and interests, which cause them to select somewhat

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[2] HANNA ROSIN, THE END OF MEN AND THE RISE OF WOMEN (2012).

[3] LIONEL TIGER, THE DECLINE OF MALES (1999).

[4] HELEN FISHER, THE FIRST SEX: THE NATURAL TALENTS OF WOMEN AND HOW THEY ARE CHANGING THE WORLD (1999).

[5] KINGSLEY R. BROWNE, BIOLOGY AT WORK: RETHINKING SEXUAL EQUALITY 216 (2002).

different occupations and exhibit somewhat different workplace behaviors.

Discussions about sex differences in occupational outcomes typically rest, at least implicitly, upon what has been called the "Standard Social Science Model" (SSSM).[6] This model assumes that the sexes are largely identical psychologically and that such differences as do appear are purely products of socialization rather than of a sexually dimorphic mind produced by natural selection. Yet, reflexive assumptions of purely social causes ignore the wealth of information about sex differences revealed in recent decades. Over a decade and a half ago, Alice Eagly could write about the literature on sex differences as follows: "Those who have immersed themselves in this area of science have begun to realize that it is not cultural stereotypes that have been shattered by contemporary psychological research but the scientific consensus forged in the feminist movement of the 1970s."[7] Since that writing, the literature documenting sex differences has ballooned, and psychologists have provided explanations of both their ultimate evolutionary origins[8] and their proximate hormonal causes.[9] Sex differences in temperament, interest, and ability play out in a particularly visible way in the workplace, where such differences can lead to different workplace outcomes for the two sexes.[10] Much attention is paid to these differences in outcome, and when they seem to favor men, they are typically viewed as problems, while when they favor women, they are simply "facts," and ones to be celebrated at that.

Explanations based on purely extrinsic causes provide little insight into the complexity of workplace patterns. To be sure, women are not proportionately represented at the highest corporate levels; however, they

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[6] John Tooby & Leda Cosmides, *The Psychological Foundations of Culture*, *in* THE ADAPTED MIND: EVOLUTIONARY PSYCHOLOGY AND THE GENERATION OF CULTURE 19 (Jerome H. Barkow et al., eds., 1992).

[7] Alice H. Eagly, *The Science and Politics of Comparing Women and Men*, 50 AM. PSYCHOL. 145, 154 (1995).

[8] *See, e.g.*, DAVID C. GEARY, MALE, FEMALE: THE EVOLUTION OF HUMAN SEX DIFFERENCES (2d ed. 2010); DAVID M. BUSS, EVOLUTIONARY PSYCHOLOGY: THE NEW SCIENCE OF THE MIND (4th Ed. 2011).

[9] *See, e.g.*, Sheri A. Berenbaum & Adriene M. Beltz, *Sexual Differentiation of Human Behavior: Effects of Prenatal and Pubertal Organizational Hormones*, 32 FRONTIERS IN NEUROENDOCRINOL. 183 (2011); JILL B. BECKER ET AL. (EDS.), SEX DIFFERENCES IN THE BRAIN: FROM GENES TO BEHAVIOR (2007).

[10] See generally BROWNE, BIOLOGY AT WORK, *supra* note 5; Kingsley R. Browne, *Evolved Sex Differences and Occupational Segregation*, 27 J. ORG. BEHAV. 143 (2006); Kingsley R. Browne, *Women in Science: Biological Factors Should Not Be Ignored*, 11 CARDOZO WOMEN'S L.J. 509 (2005); Kingsley R. Browne, *Sex and Temperament in Modern Society: A Darwinian View of the Glass Ceiling and the Gender Gap*, 37 ARIZ. L. REV. 971 (1995).

have reached near-parity among new lawyers and doctors.[11] Similarly, women do not earn, on average, as much as men do, but women who perform the same work and display the same workplace attachment as men earn approximately the same as comparable men.[12] Women have also not made proportionate inroads in some occupations, with some, such as mechanics, firefighting, and theoretical physics, continuing to have relatively few women.[13] On the other hand, women are rapidly taking over other occupations, such as psychology, pharmacy, and veterinary medicine.[14] An account that recognizes inherent differences between the sexes provides a more complete and nuanced explanation for these patterns than the entirely sociological account, which typically relies on *ad hoc*, inconsistent, and tautological explanations. The purpose of this paper is to describe some of those differences and discuss their possible effects in the workplace, concentrating on those areas in which men are often perceived as having retained an advantage.

I. OCCUPATIONALLY RELEVANT SEX DIFFERENCES

The sexes differ, on average, on a number of both psychological and physical dimensions. Males score higher on measures of competitiveness, dominance-seeking, and risk-taking, while females score higher on measures of nurturance. Males substantially outperform females in mechanical ability and on some spatial and mathematical tasks, while females outperform males on other spatial and computational tasks, as well as in a number of verbal abilities. Moreover, sex differences in physical strength continue to play a role in some occupations, though their importance is greatly diminished in the modern workplace.

A.. Competitiveness and Dominance-Seeking

Males score higher than females on most measures of direct competitiveness, and competition tends to be a more positive experience for males than it is for females.[15] Adding a competitive component to a task increases both the performance and the intrinsic motivation of males but not

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[11] See infra

[12] See infra

[13] See infra

[14] See infra

[15] Joyce F. Benenson et al.,*Greater Discomfort as a Proximate Cause of Sex Differences in Competition,* 48 MERRILL-PALMER Q. 225 (2002); Richard Lynn, *Sex Differences in Competitiveness and the Valuation of Money in Twenty Countries*, 133 J. SOC. PSYCHOL. 507 (1993).

of females.[16] Women also experience higher levels of stress associated with competition.[17] Sex differences in competition appear in early childhood.[18] Boys display a more instrumental approach to competition than girls, being more willing to compete against friends and cooperate with teammates they do not like.[19] As Eleanor Maccoby has observed, "even when with a good friend, boys take pleasure in competing to see who can do a task best or quickest, who can lift the heaviest weight, who can run faster or farther."[20] In contrast, girls often experience negative reactions to out-competing their friends.[21]

Related to competitiveness is dominance-seeking. Males, from childhood, engage in more dominance behaviors, that is, behaviors designed to achieve or maintain a position of high relative status–to obtain power, influence, prerogatives, or resources.[22] When children get together, even in infancy, dominance behaviors occur,[23] and by preschool, boys end up disproportionately at the top of the hierarchy in mixed-sex groups.[24]

B. *Risk-Taking*

The sexes also differ in risk-taking, another difference that exists from childhood.[25] Worldwide, boys have an almost two-fold higher rate of accidental death than girls.[26] By adulthood, the sex difference in risk-taking

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[16] Mark Van Vugt et al., *Gender Differences in Cooperation and Competition: The Male-Warrior Hypothesis*, 18 PSYCHOL. SCI. 19 (2007); Regina Conti et al., *The Impact of Competition on Intrinsic Motivation and Creativity: Considering Gender, Gender Segregation and Gender Role Orientation*, 31 PERS. & INDIV. DIFFS. 1273 (2001).

[17] John Mirowsky & Catherine E. Ross, *Sex Differences in Distress: Real or Artifact?*, 60 AM. SOC. REV. 449 (1995).

[18] ELEANOR E. MACCOBY, THE TWO SEXES: GROWING UP APART, COMING TOGETHER (1998).

[19] John Evans, *Gender Differences in Children's Games: a Look at the Team Selection Process*, 52 CAHPER J. 4 (1986) (finding that when choosing ad hoc teams, boys tend to pick the best players, while girls tend to pick their friends).

[20] MACCOBY, *supra* note 18, at 39.

[21] Joyce F. Benenson & Joy Schinazi, *Sex Differences in Reactions to Outperforming Same-Sex Friends*, 22 BRIT. J. DEV. PSYCHOL. 317 (2004).

[22] Alan Mazur & Allan Booth, *Testosterone and Dominance in Men*, 21 BEHAV. & BRAIN SCI. 352 (1998).

[23] Pierrich Plusquellec et al., *Dominance among Unfamiliar Peers Starts in Infancy*, 28 INFANT MENTAL HEALTH J. 324 (2007).

[24] William R. Charlesworth & Peter J. LaFreniere, *Dominance, Friendship, and Resource Utilization in Preschool Children's Groups*, 4 ETHOL. & SOCIOBIOL. 175 (1983).

[25] James P. Byrnes et al., *Gender Differences in Risk-Taking: A Meta-analysis*, 125 PSYCHOL. BULL. 367 (1999).

[26] H. Marcusson & W. Oehmisch, *Accident Mortality in Childhood in Selected Countries of Different Continents, 1950-1971*, 30 WORLD HEALTH STAT. REP. 57 (1977).

has increased. Men predominate in such risky recreational activities as car racing, skydiving, and hang-gliding.[27] Men are also disproportionately represented in risky employment. From 1992 through 2007, men made up approximately 92 percent of all workplace deaths in the United States each year,[28] a pattern reported in other countries as well.[29] Females are more averse not just to physical risk but also to social risk,[30] including financial risk.[31]

C. *Nurturance and Interest in Children*

Females in all societies exhibit more nurturing behavior than males, both inside and outside the family. Throughout the world, women are the primary caretakers of the young, the sick, and the old.[32] Among young children, girls exhibit more nurturing behavior,[33] and throughout adolescence, girls endorse more caring, personal values.[34] Girls' interest in infants increases substantially with puberty.[35] The more social orientation of females is reflected in a consistently found sex difference in "object versus person" orientation. From infancy, girls are more "people-oriented" and boys more "thing-oriented,"[36] and this difference persists into adulthood.[37] Even among newborns, girls are measurably more "cuddly" than boys.[38]

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[27] Michael P. Schrader & Daniel L. Wann, *High-Risk Recreation: The Relationship Between Participant Characteristics and Degree of Involvement*, 22 J. SPORT BEHAV. 426 (1999).

[28] U.S. Department of Labor., Bureau of Labor Statistics, *Census of Fatal Occupational Injuries All Worker Profile, 1992-2002*, *available at* http://www.bls.gov/iif/oshwc/cfoi/cftb0186.pdf (last visited 9/23/2012).

[29] Suzanne Grazier & Peter J. Sloane, *Accident Risk, Gender, Family Status and Occupational Choice in the UK*, 15 LAB. ECON. 938 (2008); Yen-Hui Lin et al., *Gender and Age Distribution of Occupational Fatalities in Taiwan*, 40 ACCIDENT ANALYSIS & PREVENTION 1604 (2008).

[30] Judith E. Larkin & Harvey A. Pines, *Gender and Risk in Public Performance*, 49 SEX ROLES 197 (2003).

[31] Helga Fehr-Duda et al., *Gender, Financial Risk, and Probability Weights*, 60 THEORY AND DECISION 283 (2006).

[32] GEARY, *supra* note 8.

[33] Judith E.O. Blakemore, *Children's Nurturant Interactions with Their Infant Siblings: An Exploration of Gender Differences and Maternal Socialization*, 22 SEX ROLES 43 (1990).

[34] Kimberly Badger et al., *Age and Gender Differences in Value Orientation among American Adolescents*, 33 ADOLESCENCE 591 (1998).

[35] Susan Goldberg et al., *Menarche and Interest in Infants: Biological and Social Influences*, 53 CHILD DEV. 1544 (1982).

[36] Jennifer Connellan et al., *Sex Differences in Human Neonatal Social Perception*, 23 INFANT BEHAV. & DEV. 113 (2001).

[37] Adriene M. Beltz et al., *Gendered Occupational Interests: Prenatal Androgen Effects on Psychological Orientation to Things Versus People*, 60 HORMONES & BEHAV. 313 (2011).

[38] Joyce F. Benenson et al., *Sex Differences in Neonates' Cuddliness*, 160 J. GENETIC PSYCHOL. 332 (1999).

D. *A Digression on the Magnitude of Sex Differences and Sex Differences in Variability*

Before turning to sex differences in some objectively measurable traits, it is important to say a few words about how group differences are calculated and about sex differences in variability. The magnitude of sex differences is typically reported as the male mean minus the female mean divided by the pooled standard deviation.[39] This number is known as the "effect size" (denoted as *d*). An effect size of 1.0, for example, indicates that the male mean exceeds the female mean by a full standard deviation.[40] In practical terms, this means that the average male exceeds the performance of 84 percent of females, assuming that the two groups are equally variable.

The proportions described above would be different if one group is more variable than the other.[41] On most cognitive measures–especially ones that favor males–male performance is more variable than female performance.[42] If the male and female means are identical but males are more variable than females, then at both the high and low ends of the distribution, males will outnumber females.[43] If the male mean is higher and male variability is greater, the disproportion at the higher end will be even greater.

Different characteristics of the male and female distributions are relevant to different questions. For example, if we want to predict whether a male or female chosen at random would be better along some dimension, say mathematics, we would care primarily about group means. If the means are identical (*i.e.*, *d*=0), there would be no reason to think that a male chosen at random would perform better–or worse–than a female chosen at random, regardless of any sex difference in variability. However, if we wanted to investigate the extent to which sex differences in mathematical ability are responsible for sex differences in math-intensive occupations, we would focus not on the center of the distribution but rather the extreme right tail of the distribution, where the sex ratio is likely to be substantially more affected by differences in variability than in group means.

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39 DIANE F. HALPERN, SEX DIFFERENCES IN COGNITIVE ABILITIES 79-81 (4th ed. 2012).

40 A negative effect size, by convention, indicates that the female mean exceeds the male mean.

41 HALPERN, *supra* note 39, at 71-75.

42 *Id.* at 102-103.

43 *Id.; see also* Rosalind Arden & Robert Plomin, *Sex Differences in Variance of Intelligence Across Childhood*, PERS. & INDIV. DIFFS. 39 (2006); Stephen Machin & Tuomas Pekkarinen, *Global Sex Differences in Test Score Variability*, 322 SCIENCE 1331 (2008) (finding that in most OECD countries, male variance on both mathematics and reading tests is higher than that of females and that the disparity in variance is greater in high-scoring nations than in low-scoring ones).

E. *Spatial, Mathematical, and Mechanical Ability*

Males outperform females on some spatial tasks, especially mental rotation, spatial perception, spatial visualization, and targeting.[44] A meta-analysis of mental-rotation studies found an average effect size of .66 for adults, and the effect size in many studies exceeds 1.0.[45] Spatial rotation is correlated with a variety of other abilities, such as mechanical ability, map reading, way-finding, mathematical reasoning, and success as a pilot.[46] Females, on the other hand, outperform males on the spatial task of "object location," that is, remembering where an object is located and identifying which objects in an array have been moved from their prior location.[47]

The sexes also differ in mathematical performance. Males excel on tests of mathematical reasoning, especially those involving abstract thinking, and females outperform males, although by smaller margins, on tests of computation.[48] The sex difference is relatively small in nationally representative samples, with effect sizes concentrating between .10 and .25.[49] Because males are more variable in performance, however, they outnumber females by almost two-to-one in the top 10 percent of math ability (and the ratio becomes even greater at more rarified heights).[50] Consequently, effect sizes tend to be larger in more select samples. For example, on the mathematics portion of the SAT, the effect size is about 0.3.[51]

The sexes exhibit substantial differences in mechanical ability, as well. On the Differential Aptitude Test, male twelfth-graders outperform females on mechanical comprehension, with an effect size of around .9.[52] Similar results (*d*=.95) have been obtained on the Air Force Officer Qualification Test (AFOQT), which is used in the selection of candidates to be Air Force

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[44] DOREEN KIMURA, SEX AND COGNITION (1999).

[45] Daniel Voyer et al., *Magnitude of Sex Differences in Spatial Abilities: A Meta-Analysis and Consideration of Critical Variables*, 117 PSYCHOL. BULL. 250 (1995).

[46] Mary Hegarty & David Waller, *Individual Differences in Spatial Abilities*, *in* THE CAMBRIDGE HANDBOOK OF VISUOSPATIAL THINKING 121 (Priti Shah & Akira Miyake eds., 2005).

[47] Irwin Silverman & Marion Eals, *Sex Differences in Spatial Abilities: Evolutionary Theory and Data*, *in* BARKOW ET AL., supra note 6, at 533.

[48] KIMURA, *supra* note 44.

[49] THE G FACTOR: THE SCIENCE OF MENTAL ABILITY 535 (1998).

[50] *Id.*

[51] College Board, 2011 *College-Bound Seniors: Total Group Profile Report* (2011), *available at* http://professionals.collegeboard.com/profdownload/cbs2011_total_group_report.pdf (last visited 9/23/2012).

[52] David Lubinski & Camilla P. Benbow, *Gender Differences in Abilities and Preferences among the Gifted: Implications for the Math-Science Pipeline*, 1 CURRENT DIR. PSYCHOL. SCI. 61 (1992).

officers.[53] In the top 10 percent of mechanical reasoning ability, males outnumber females by approximately eight to one.[54]

F. *Verbal Ability*

Females outperform males on a number of verbal tasks, including spelling, grammar, verbal fluency, and verbal memory. In fact, the female advantage in verbal abilities exceeds the male advantage in mathematical ability in broadly representative samples.[55] In more select samples, however, the female advantage often declines or, in some cases, disappears. On the Critical Reading portion of the SAT, males regularly outperform females, although the effect size is very small (ranging from $d \approx .02$ to $d \approx 0.08$ in recent years), and on the new Writing portion, females outperform males by a small amount ($d \approx .10$-$.12$).[56]

G. *Occupational Interests*

Important sex differences are also found in traits more immediately related to the workplace, specifically in occupational interest, as revealed by such instruments as the Strong Interest Inventory. Reliable sex differences are exhibited on at least five of the six Holland General Occupational Themes measured by the Strong, which are aspects of "vocational personality."[57] Males score substantially higher on the *Realistic* (building/working outdoors and with things), *Investigative* (abstract problems/science/math), and *Enterprising* (persuasion/selling/business) themes. Females, in contrast, score higher on *Artistic* (art/drama/language) and *Social* (helping/teaching). The sixth theme, *Conventional* (organizing/clerical/processing data), shows little difference. One large study found effect sizes (absolute values) on the General Occupational Themes ranging from a very large 1.28 to a trivial .06: Realistic (1.28), Investigative (.56), Artistic (-.29), Social (-.29), Enterprising (.19), and Conventional

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[53] Thomas R. Carretta, *Group Differences on US Air Force Pilot Selection Tests*, 5 INT'L J. SELECTION & ASSESSMENT 115 (1997).

[54] Larry V. Hedges & Amy Nowell, *Sex Differences in Mental Test Scores, Variability, and Numbers of High-Scoring Individuals*, 269 SCIENCE 41 (1995).

[55] Catherine E. Freeman, *Trends in Educational Equity of Girls & Women: 2004* 36, U.S. Department of Education, National Center for Education Statistics.

[56] College Board, 2011, *supra* note 51.

[57] *See generally* JOHN L. HOLLAND, MAKING VOCATIONAL CHOICES: A THEORY OF VOCATIONAL PERSONALITIES AND WORK ENVIRONMENTS (3d ed., 1997).

(.06).[58]

Underlying the Holland Occupational Themes are two dimensions: "People-Things" and "Ideas-Data."[59] Although sex differences on the "Ideas-Data" dimension are not consistently found, large differences are found on the "People-Things" dimension, with women tending to cluster toward the "People" end and men toward the "Things" end,[60] mirroring the more people-oriented tendency of females previously described. A recent meta-analysis of studies spanning four decades concluded that "[t]hese sex differences are remarkably consistent across age and over time."[61]

II. ORIGINS OF SEX DIFFERENCES

The existence of the above-described differences, while not without controversy, kindles less debate than their potential causes. Again, the dispute is not about whether social factors play a role; everyone agrees that they do. Instead, the debate centers on whether biology plays anything more than a trivial role. Put another way, it is between those who think the human mind is inherently sexually monomorphic, so that in the absence of different social inputs, the minds of males and females would operate identically, thereby leading them to make the same choices, and those who think the mind is naturally dimorphic. To those who believe the human mind is sexually dimorphic, the ultimate cause is generally thought to be the selective advantage that the sexually disparate traits conferred on members of the two sexes, while the proximate cause is, to a large extent, a story of sex hormones.

A full account of the ultimate evolutionary explanation for temperamental and cognitive sex differences is beyond the scope of this paper.[62] In short, however, the explanation rests on different selective pressures that have acted upon the two sexes. Human males, like most other mammalian males, compete among themselves for access to mates. Therefore, males tend to be physically stronger, more dominance-oriented, more competitive, and more risk oriented than females, and those who succeed in the competition for

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[58] Alan S. Kaufman & James E. Mclean, *An Investigation into the Relationship Between Interests and Intelligence*, 54 J. CLIN. PSYCHOL. 279 (1998).

[59] Dale J. Prediger, *Dimensions Underlying Holland's Hexagon: Missing Link Between Interests and Occupations?*, 21 J. VOC. BEHAV. 259 (1982).

[60] Richard Lippa, *Gender-Related Individual Differences and the Structure of Vocational Interests: the Importance of the People-Things Dimension*, 74 J. PERS. SOC. PSYCHOL. 996 (1998).

[61] Rong Su et al., *Men and Things, Women and People: A Meta-analysis of Sex Differences in Interests*, 135 PSYCHOL. BULL. 859, 880 (2009).

[62] For a more detailed account, see BROWNE, BIOLOGY AT WORK, *supra* note 5, at 117-129; Browne, *Sex and Temperament*, *supra* note 4, at 985-1016.

mates leave more of their genes behind than those who are less successful.[63] Moreover, men have likely garnered fitness advantages through skills valuable in hunting and warfare, including the dynamic spatial perception demanded by projectile weapons[64] and spatial skills that allow a hunter to navigate directly home from a hunt rather than retracing what may have been a lengthy and circuitous route in search of prey.[65]

Whether or not the evolutionary account sketched out above is the ultimate cause of sex differences, there is powerful evidence that the differences do in fact have biological causes. Evidence supporting a link between many sex differences in both morphology and behavior and the actions of sex hormones is by now extremely strong, suggesting that identical environments for the two sexes (that is, eliminating "sexist socialization" and discrimination) will not result in identical behavior.

A. *Hormones: A Proximate Cause of Many Sex Differences*

One advantage that evolutionary psychologists who study sex differences have over those who study other phenomena is that not only is an adaptive account plausible (and consistent with abundant evidence from other species), much is also known about the proximate mechanisms by which these differences develop. Although the story is complex, and social factors can be important, a major portion of that story comes from sex hormones.

Sexual differentiation of the brain is caused by the same sex hormones that cause sexual differentiation of the body: male sex hormones, or androgens, primarily testosterone; and female sex hormones, primarily the estrogen estradiol. The female form, being the "default" form,[66] will develop in the absence of androgens. In fetuses, the primary source of androgens is the testes of males, although smaller amounts are produced by the adrenal glands of both sexes.

Sex hormones can affect the brain in two different ways. During a critical period of fetal brain development, androgens exert an "organizing" effect, causing the brain to become masculinized. Later in life, especially at and after puberty, circulating hormones influence behavior more directly, the "activational" effect.

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[63] BUSS, 2011, supra note 8.

[64] GEARY, 2010, *supra*, at 289-290.

[65] Irwin Silverman et al., *Evolved Mechanisms Underlying Wayfinding: Further Studies on the Hunter-Gatherer Theory of Spatial Sex Differences,* 21 EVOL. & HUM. BEHAV. 201 (2000).

[66] LINDA MEALEY, SEX DIFFERENCES: DEVELOPMENTAL AND EVOLUTIONARY STRATEGIES 14 (2000).

1. Organizing Effects

Some of the earliest evidence for organizing effects of androgens came from girls with congenital adrenal hyperplasia (CAH), a condition in which the adrenal gland produces excessive levels of androgens during fetal brain development. Girls with CAH have a more "masculine" behavioral pattern than normal girls, tending to be tomboys who are more likely to play with boys and with male-typical toys and who are less interested in infants and marriage than unaffected girls.[67] They perform better than unaffected girls on targeting tasks,[68] and they have higher levels of spatial ability.[69] CAH girls also have more male-like occupational preferences.[70]

Data supporting a hormonal explanation also come from differences in hormonal levels in normal populations. For example, maternal testosterone levels during pregnancy are associated with a daughter's male-typical behavior in both childhood [71] and adulthood.[72] Spatial ability in seven-year-old girls is correlated positively with prenatal testosterone levels in second trimester amniotic fluid,[73] as is sex-differentiated play in six- to ten-year

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[67] Catherine L. Leveroni & Sheri A. Berenbaum, *Early Androgen Effects on Interest in Infants: Evidence from Children with Congenital Adrenal Hyperplasia*, 14 DEV. NEUROPSYCHOL. 321 (1998); Vickie Pasterski et al., *Prenatal Hormones and Childhood Sex Segregation: Playmate and Play Style Preferences in Girls with Congenital Adrenal Hyperplasia*, 59 HORMONES & BEHAV. 549 (2011).

[68] Melissa Hines et al., *Spatial Abilities Following Prenatal Androgen Abnormality: Targeting and Mental Rotations Performance in Individuals with Congenital Adrenal Hyperplasia*, 28 PSYCHONEUROENDOCRINOL. 1010 (2003).

[69] David A. Puts et al., *Spatial Ability and Prenatal Androgens: Meta-analyses of Congenital Adrenal Hyperplasia and Digit Ratio (2D:4D) Studies*, 37 ARCH. SEX. BEHAV. 100 (2008).

[70] Sheri A. Berenbaum, *Effects of Early Androgens on Sex-Typed Activities and Interests in Adolescents with Congenital Adrenal Hyperplasia*, 35 HORMONES & BEHAV. 102 (1999).

Although the CAH data have been challenged on the ground that the behavioral masculinization of CAH girls might be caused not by androgens but rather by differential parental treatment of the girls because of their masculinized genitals (Wood & Eagly, 2002), evidence is unkind to that argument. In fact, parents of CAH girls would prefer their daughters to show less masculine-typed behavior than they do (in contrast to parents of non-affected girls, who would prefer them to show more). Anna Servin et al., *Prenatal Androgens and Gender-Typed Behavior: A Study of Girls with Mild and Severe Forms of Congenital Adrenal Hyperplasia*, 39 DEV. PSYCHOL. 440 (2003). Moreover, girls with CAH receive more encouragement for female-typical play than their unaffected sisters do. Vickie L. Pasterski et al., *Prenatal Hormones and Postnatal Socialization by Parents as Determinants of Male-Typical Toy Play in Girls with Congenital Adrenal Hyperplasia*, 76 CHILD DEV. 264 (2005).

[71] Melissa Hines et al., *Testosterone During Pregnancy and Gender Role Behavior of Preschool Children: A Longitudinal, Population Study*, 73 CHILD DEV. 1678 (2002).

[72] J. Richard Udry et al., *Androgen Effects on Women's Gendered Behaviour*, 27 J. BIOSOCIAL SCI. 359 (1995).

[73] Gina M. Grimshaw et al., *Mental Rotation at 7 Years: Relations with Prenatal Testosterone Levels and Spatial Play Experiences*, 29 BRAIN & COGNITION 85 (1995).

olds.[74]

2. Activational Effects

Circulating hormones have more immediately observable effects than the organizational effects described above. A number of researchers have reported an association between circulating testosterone and dominance behaviors, although the direction of causation is not always clear.[75] A much larger body of data supports a relationship between hormones and cognitive performance. For example, the optimal level of testosterone for high spatial ability appears to be in the low-normal male range, so that among men, those in the low-normal range have the highest ability, while among women, those with the highest testosterone levels tend to have the highest performance (because their levels are closest to the low-normal male range).[76] Low-testosterone women, for example, take longer to navigate the Virtual Water Maze, a test of spatial performance, than do high-testosterone women.[77]

Changes in an individual's hormone levels are associated with changes in cognitive performance. For example, female performance on cognitive tasks varies depending upon the phase of the menstrual cycle, with spatial performance being highest in those phases when estrogen levels are low (and therefore the testosterone/estrogen ratio is at its highest), and verbal performance being the highest in the high-estrogen portions of the cycle.[78] Treatment with exogenous hormones also produces effects consistent with the hormonal explanation. Spatial performance in female-to-male transsexuals increases after treatment with male hormones,[79] and verbal memory performance in male-to-female transsexuals increases after treatment with female hormones. Cross-sex hormone treatments are also

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[74] Bonnie Auyeung et al., *Fetal Testosterone Predicts Sexually Differentiated Childhood Behavior in Girls and in Boys*, 20 PSYCHOL. SCI. 144 (2009).

[75] Richard E. Tremblay et al., *Testosterone, Physical Aggression, Dominance, and Physical Development in Early Adolescence*, 22 INT'L J. BEHAV. DEV. 753 (1998).

[76] Catherine Gouchie & Doreen Kimura, *The Relationship Between Testosterone Levels and Cognitive Ability Patterns*, 16 PSYCHONEUROENDOCRINOL. 323 (1991).

[77] Jennifer Burkitt et al., *Evidence for the Influence of Testosterone in the Performance of Spatial Navigation in a Virtual Water Maze in Women but Not in Men*, 51 HORMONES & BEHAV. 649 (2007).

[78] Elizabeth Hampson, *Variations in Sex-Related Cognitive Abilities Across the Menstrual Cycle*, 14 BRAIN & COGNITION 26 (1990); Cheryl M. McCormick & Sarah M. Teillon, *Menstrual Cycle Variation in Spatial Ability: Relation to Salivary Cortisol Levels*, 39 HORMONES & BEHAV. 29 (2001).

[79] *See* Clare Miles et al., *Estrogen and Memory in a Transsexual Population*, 34 HORMONES & BEHAV. 199 (1998).

associated with an increase in aggression-proneness and sexual arousability in females and a decrease in males.[80] Even a single administration of testosterone to women can enhance mental-rotation performance,[81] while administration of testosterone to normal men results in a reduction in spatial performance,[82] consistent with the finding that men in the low-normal range perform best.

Although testosterone gets the lion's share of attention, estrogen also has substantial effects. In elderly men suffering from dementia, for example, aggression levels are negatively correlated with estrogen levels (and positively correlated with testosterone levels),[83] and estrogen therapy has been effective in decreasing their physical aggression.[84] Moreover, women's risk-taking activities vary over the course of the menstrual cycle, with risk-taking decreasing during the ovulatory phase of the cycle, when the woman is fertile and has particularly high levels of estrogen.[85] Estrogen also seems to have a depressing effect on spatial ability,[86] which may at least partially explain both the increased sex difference in spatial ability observed after puberty and the tendency of extremely feminine women to have relatively low spatial ability.[87]

B. *Biology or Society?*

Appreciation of man's place in nature makes the purely social view of sex differences very difficult to accept, as it requires something akin to "special creation" for humans to have slipped the bonds of connection to the animal kingdom. Indeed, studies on nonhuman animals paint a picture consistent with the human data. Female mammals in a variety of species are

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[80] Stephanie H.M. Van Goozen et al., *Gender Differences in Behaviour: Activating Effects of Cross-Gender Hormones*, 20 PSYCHONEUROENDOCRINOL. 343 (1995).

[81] *See* André Aleman et al., *A Single Administration of Testosterone Improves Visuospatial Ability in Young Women*, 29 PSYCHONEUROENDOCRINOL. 612 (2004).

[82] *See* Daryl B. O'Connor et al., *Activational Effects of Testosterone on Cognitive Function in Men*, 39 NEUROPSYCHOLOGIA 1385 (2001).

[83] Claudia Orengo et al., *Do Testosterone Levels Relate to Aggression in Elderly Men with Dementia?*, 14 J. NEUROPSYCH. & CLIN. NEUROSCI. 161 (2002).

[84] Helen H. Kyomen et al., *Estrogen Therapy and Aggressive Behavior in Elderly Patients with Moderate-to-Severe Dementia: Results from a Short-Term, Randomized, Double-Blind Trial*, 7 AM. J. GERIATRIC PSYCH. 339 (1999).

[85] Arndt Bröder & Natalia Hohmann, *Variations in Risk Taking Behavior over the Menstrual Cycle: An Improved Replication*, 24 EVOL. & HUM. BEHAV. 391 (2003).

[86] Markus Hausmann et al., *Sex Hormones Affect Spatial Abilities During the Menstrual Cycle*, 114 BEHAV. NEUROSCIENCE 1245 (2000).

[87] HELMUT NYBORG, HORMONES, SEX, AND SOCIETY: THE SCIENCE OF PHYSICOLOGY 110 (1994).

masculinized by exposure to testosterone in utero, and males who are castrated, either chemically or surgically, prior to the critical period for psychosexual differentiation develop stereotypic female behaviors.[88] Female monkeys show cognitive changes across the menstrual cycle similar to those found in women,[89] and young monkeys exhibit the same sex-typed toy preferences that young children do.[90]

There are additional reasons to be suspicious of a purely sociological account. Many sex differences appear early in life, some as early as infancy, before a child has had an opportunity to absorb any social expectations of sex-appropriate behavior.[91] Moreover, across the globe, consistent sex differences are found,[92] and around the world, people hold the same stereotypes of men and women.[93]

III. EFFECT OF SEX DIFFERENCES ON OCCUPATIONAL OUTCOMES

It should not be surprising that all of the above-described sex differences can produce sex differences in occupational outcomes. According to the "Theory of Work Adjustment,"[94] two dimensions of correspondence between the individual and the job are required for a successful match, *satisfactoriness* and *satisfaction*. The former involves correspondence of the individual's abilities and the demands of the occupation, while the latter entails correspondence of the occupational rewards (e.g., compensation,

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[88] William C. Young et al., *Hormones and Sexual Behavior*, 143 SCIENCE 212 (1964); Robert F. Goy et al., *Behavior Masculinization Is Independent of Genital Masculinization in Prenatally Androgenized Female Rhesus Macaques*, 22 HORMONES & BEHAV. 552 (1988).

[89] Agnès Lacreuse et al., *Fluctuations in Spatial Recognition Memory Across the Menstrual Cycle in Female Rhesus Monkey*, 26 PSYCHONEUROENDOCRINOL. 623 (2001).

[90] Janice M. Hassett et al., *Sex Differences in Rhesus Monkey Toy Preferences Parallel Those of Children*, 54 HORMONES & BEHAV. 359 (2008).

[91] *See, e.g.*, Gerianne M. Alexander et al., *Sex Differences in Infants' Visual Interest in Toys*. 38 ARCH. SEX. BEHAV. 427 (2009); Anne Campbell et al., *Infants' Visual Preference for Sex-Congruent Babies, Children, Toys and Activities: A Longitudinal Study*, 28 BRIT. J. DEV. PSYCHOL. 479 (2000); David S. Moore & Scott P. Johnson, *Mental Rotation of Dynamic, Three-Dimensional Stimuli by 3-Month-Old Infants*, 16 INFANCY 435 (2011); David S. Moore & Scott P. Johnson, *Mental Rotation in Human Infants*, 19 PSYCHOL. SCI. 1063 (2008); Paul C. Quinn & Lynn S. Liben, *A Sex Difference in Mental Rotation in Young Infants*, 19 PSYCHOL. SCI. 1067 (2008); Lisa A. Serbin et al., *Gender Stereotyping in Infancy: Visual Preferences for and Knowledge of Gender-Stereotyped Toys in the Second Year*, 25 INT'L J. BEHAV. DEV. 7 (2001); Anna Servin et al., *Sex Differences in 1-, 3-, and 5-Year-Olds' Toy Choice in a Structured Play-Session*, 40 SCAND. J. PSYCHOL. 43 (1999).

[92] GEARY, 2010, *supra.*

[93] JOHN E. WILLIAMS & DEBORAH L. BEST, MEASURING SEX STEREOTYPES: A MULTINATION STUDY (1990).

[94] RENÉ V. DAWIS & LLOYD H. LOFQUIST, A PSYCHOLOGICAL THEORY OF WORK ADJUSTMENT (1984).

working conditions, type of work) and the individual's values and interests. The "theory" thus reflects the common-sense proposition that people gravitate toward, and do best at, jobs for which they have the skills and ability and that provide them the kinds of satisfactions they desire from a job.

A. *The "Glass Ceiling"*

It cannot be doubted that women are "under-represented" at the highest level of occupations if proportional representation is the standard,[95] and no one could plausibly deny that sex discrimination against women exists, although in today's workplace, there is also no denying that there is much discrimination in favor of women as organizations seek more "diverse" workforces. Yet, even in the absence of nefarious causes, there is no reason to assume there would be sexual parity among CEOs. Indeed, because of the previously described sex differences, such an assumption would be highly implausible.

The traits of high-level corporate executives are not randomly distributed with respect to sex, as successful executives of both sexes tend to possess a constellation of traits more characteristic of males than fem\ales. They tend to be competitive, assertive, ambitious, strongly career-oriented risk-takers.[96] Because achievement opportunities are often coupled with uncertainty and the potential for loss, they may appear threatening to the risk-averse.[97] Risk preferences are well known to influence occupational choices,[98] so it should not be surprising that sex differences in risk aversion would have workplace implications.

Achievement of the highest corporate positions requires more than just the right personality. It frequently requires decades of devotion to one's career, long hours, frequent travel, and a willingness to subordinate other things in one's life–often including families. Women are less willing than men to make these investments, both because of family issues and because

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[95] The Catalyst Census for 2011 found that women constituted 14.1% of Fortune 500 executives and 7.5% of executive top earners. *2011 Catalyst Census: Fortune 500 Women Executive Officers and Top Earners, available at* http://www.catalyst.org/file/534/2011_fortune_500_census_weote.pdf (last visited 9/23/2012).

[96] ANN M. MORRISON ET AL., BREAKING THE GLASS CEILING: CAN WOMEN REACH THE TOP OF AMERICA'S LARGEST CORPORATIONS? (Updated Ed. 1992); Kenneth R. MacCrimmon & Donald A. Wehrung, *Characteristics of Risk Taking Executives*, 36 MGMT. SCI. 422 (1990).

[97] MARGARET HENNIG & ANNE JARDIM, THE MANAGERIAL WOMAN 23 (1977) (observing that "men see risk as loss or gain; winning or losing; danger or opportunity," while "women see risk as entirely negative. It is loss, danger, injury, ruin, hurt.").

[98] Charles N. Halaby, *Where Job Values Come From: Family and Schooling Background, Cognitive Ability, and Gender*, 68 AM. SOC. REV. 251 (2003).

the "payoff"–being "top dog"–is not valued by women as much as it is by men.[99] Women are also less willing to uproot themselves from networks of friends and relatives to move off to a new city, a career move that is a prerequisite to advancement in many organizations.[100]

Marriage and children have different impacts on men and women. When women marry, and especially after they have children, they tend to reduce their work involvement, whereas men tend to increase theirs.[101] Many women remain out of the work force for an extended time after childbirth,[102] and if they do return to work, many cut back on their work commitment to spend more time with their children. To an observer with an evolutionary perspective, it is unsurprising to find that mammalian mothers find it emotionally difficult to separate from their young, but it is also unsurprising that a reduction in work commitment and experience is associated with diminished workplace rewards.

B. *The "Gender Gap" in Compensation*

Many of the same factors that cause women to be under-represented in the executive suite also affect their compensation. In 2010, the female-to-male annual earnings ratio was .77,[103] and the weekly earnings ratio was .81.[104] Most of the pay gap occurs across occupations rather than within them,[105] suggesting that garden-variety pay discrimination–paying women less for performing the same jobs–cannot account for much of the gap.

A great many factors, often having only relatively modest effect by themselves, account for most of the gender gap. Many of these are relatively straightforward, and, like contributors to the glass ceiling, appear to reflect psychological sex differences (or physical differences, in the case of some

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[99] *See* Renée Adams & Patricia Funk, *Beyond the Glass Ceiling: Does Gender Matter?*, 58 Mgmt. Sci. 219 (2012) (finding that male corporate directors "care more about achievement and power than female directors, and less about universalism and benevolence"). *See generally* FELICE N. SCHWARTZ, BREAKING WITH TRADITION: WOMEN AND WORK, THE NEW FACTS OF LIFE (1992).

[100] David C. Baldridge et al., *Saying "No" to Being Uprooted: The Impact of Family and Gender on Willingness to Relocate*, 79 J. OCCUP. & ORG. PSYCHOL. 131 (2006).

[101] Thomas W. Harrell, *The Association of Marriage and MBA Earnings*, 72 PSYCHOL. REP. 955 (1993).

[102] SCHWARTZ, 1992, *supra* note 99.

[103] U.S. Census Bureau, *Income, Poverty, and Health Insurance Coverage in the United States: 2011* (2012) at 7, *available at* http://www.census.gov/prod/2012pubs/p60-243.pdf (last visited 9/23/2012).

[104] U.S. Department of Labor, Bureau of Labor Statistics, *Women in the Labor Force: A Databook* 2 (2011), *available at* http://www.bls.gov/cps/wlf-databook2011.htm.

[105] Erica L. Groshen, *The Structure of the Female/Male Wage Differential: Is it Who You Are, What You Do, or Where You Work?*, 26 J. HUM. RES. 457 (1991).

blue-collar occupations). In general, men tend to invest more of themselves in the workplace in order to attain both status and resources; women tend to invest more of themselves in their families and less in the workplace. Much of the wage gap, like the glass ceiling, is thus related either directly or indirectly to marriage and families.[106] Single women without children often earn about the same (or more) than single men, while married mothers earn substantially less than married men (or single women).[107]

Men earn more in part because they tend to work more hours,[108] and they tend to occupy riskier jobs.[109] Indeed, the most dangerous occupations are overwhelmingly dominated by males: fisherman, logger, airplane pilot, iron and steel worker, roofer, and so forth.[110] Each year, approximately 92 percent of workplace deaths are men. Not surprisingly, all else being equal, the compensation of risky jobs is greater than that of non-risky jobs.[111] Moreover, men have a substantially higher preference for "tournament" situations in which there are winners and losers,[112] such as the "partnership tournament" prevalent in large law firms, under which many associates compete for a limited number of partnerships.[113] Also, men are more likely to be employed under wage schemes having a greater component of pay that

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[106] *See generally* Michelle J. Budig & Melissa J. Hodges, *Differences in Disadvantage: Variation in the Motherhood Penalty across Women's Earnings Distribution*, 75 AM. SOC. REV. 705 (2010).

[107] DIANE FURCHTGOTT-ROTH & CHRISTINE STOLBA, WOMEN'S FIGURES: AN ILLUSTRATED GUIDE TO THE ECONOMIC PROGRESS OF WOMEN IN AMERICA (1999); Francine D. Blau & Lawrence M. Kahn, *The Gender Earnings Gap: Learning from International Comparisons*, 82 AM. ECON. REV. 533 (1992).

[108] In 2010, for example, full-time male employees worked approximately 14 percent more hours than full-time female employees (40.5 hours and 35.5 hours, respectively). *Women in the Labor Force*, *supra* note 104, at Table 21, p. 73. At the high end of hours, the disparity is even greater. *See* Joan C. Williams & Heather Boushey, *The Three Faces of Work-Family Conflict: The Poor, the Professionals, and the Missing Middle* at 7 (2010), *available at* http://www.americanprogress.org/wp-content/uploads/issues/2010/01/pdf/threefaces.pdf (last visited 9/23/2012) (reporting that professional-managerial men are 2.7 times as likely as equivalent women to work 50 or more hours per week).

[109] Barbara S. Kilbourne & Paula England, *Occupational Skill, Gender, and Earnings, in* WOMEN AND WORK: A HANDBOOK 68 (Paula J. Dubeck & Kathryn Borman, eds., 1996) (noting that the higher the proportion of female employees in an occupation, the less likely it is that the occupation involves hazardous working conditions).

[110] U. S. Department of Labor, *Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data* (2011), *available at* http://www.bls.gov/iif/oshwc/cfoi/cfch0010.pdf; http://www.bls.gov/iif/oshcfoiarchive.htm#rates (data for prior years) (last visited 9/23/2012).

[111] *See generally* Randall K. Filer, *Male-Female Wage Differences: The Importance of Compensating Differentials*, 38 INDUS. & LAB. REL. REV. 426 (1985); W. KIP VISCUSI, RISK BY CHOICE: REGULATING HEALTH AND SAFETY IN THE WORKPLACE (1983).

[112] Muriel Niederle & Lise Vesterlund, *Gender Differences in Competition*, 24 NEGOT. J. 447 (2008).

[113] *See* MARC GALANTER & THOMAS PALAY, TOURNAMENT OF LAWYERS: THE TRANSFORMATION OF THE BIG LAW FIRM (1991).

is contingent on performance, such as sales commissions and performance bonuses, meaning that they bear more of the risk of short-run variations in performance.[114] A study of over 500 MBA students found that high levels of circulating testosterone among women were associated with low risk aversion and with a higher probability of selecting a risky career in finance.[115]

Men are also more likely than women to enter quantitatively demanding fields, and there is a substantial correlation between the quantitative demands of a field and its mean starting salary for college graduates.[116] A recent study found that approximately 95 percent of the sex difference in starting salaries of new college graduates is accounted for by college major.[117] Within fields, starting salaries for males and females tend to be very close.[118] It should be emphasized that the foregoing does not rest solely on men's higher ability. Instead, highly able men tend to pursue employment in fields that actually require high ability, while highly able women tend to distribute themselves more widely among fields,[119] a finding that is consistent with the view that men are motivated by status concerns than women in selecting occupations.

The "gender gap" in compensation is largely an illusion. It mostly disappears when variables that legitimately affect compensation–many of which are related to the sex differences previously described. As will be seen below, many of these same factors influence the occupations that individuals choose.

C. *Occupational Segregation: Women in "Persistently Male" Occupations*

Despite changing social mores reflecting widespread agreement that individuals should be free to pursue the occupations of their choice, a substantial amount of occupational segregation persists. Over 90 percent of receptionists, registered nurses, and pre-school and kindergarten teachers are

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[114] Keith W. Chauvin & Ronald A. Ash, *Gender Earnings Differentials in Total Pay, Base Pay, and Contingent Pay*, 47 INDUS. & LAB. REL. REV. 634 (1994).

[115] Paola Sapienza et al., *Gender Differences in Financial Risk Aversion and Career Choices Are Affected by Testosterone*, 106 PROC. NAT'L ACAD. SCI. 15268 (2009).

[116] Morton Paglin & Anthony M. Rufolo, *Heterogeneous Human Capital, Occupational Choice, and Male-Female Earnings Differences*, 8 J. LAB. ECON. 123 (1990). Paglin and Rufolo found that quantitative ability alone accounted for 82 percent of the variance in earnings among various fields of new college graduates.

[117] Judith A. McDonald & Robert J. Thornton, *Do New Male and Female College Graduates Receive Unequal Pay?*, 42 J. HUM. RES. 32 (2007).

[118] Barry Gerhart, *Gender Differences in Current and Starting Salaries: The Role of Performance, College Major and Job Title*. 43 INDUS. & LAB. REL. REV. 418 (1990).

[119] Donald I. Templer & Marie E. Tomeo, *Mean Graduate Record Examination (GRE) Score and Gender Distribution as Function of Academic Discipline*, 32 PERS. & INDIV. DIFFS. 175 (2002).

female, for example, and over 90 percent of electrical and mechanical engineers, firefighters, mechanics, and pest exterminators are male.[120] Some scientific fields, such as mathematics, physics, and engineering, continue to be disproportionately male. In many respects, however, women have made breathtaking advances in the past several decades. Professions such as law and medicine are reaching parity among new entrants,[121] and over 60% of new pharmacists and over three-quarters of new veterinarians are women.[122] This pattern–"progress" in some occupations but not in others–is what must be explained by any comprehensive account of occupational segregation.

Concern about under-representation of women has focused primarily on scientific, technical, and blue-collar occupations. The occupations of concern are often referred to as "traditionally male" or "nontraditional," although these labels are misleading. Virtually all occupations not specifically reserved for women were "traditionally" filled mostly by men, so history alone cannot be the distinguishing factor. What does distinguish them is the *current* representation of women. The U.S. Department of Labor, for example, considers an occupation nontraditional if women comprise 25 percent or less of total employment.[123] Thus, it would be more precise to label these fields "persistently male." The central question is what it is about these occupations that has caused them to remain predominantly male at a time when so many other occupations–even prestigious ones–have become fully integrated or even predominantly female.

1. Women in Science and Technology

Although the scarcity of women in some scientific fields has been attributed to a hostility so great that it is "shocking . . . that there are any

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[120] U.S. Department of Labor Bureau of Labor Statistics, *Highlights of Women's Earnings in 2009* (2010), *available at* http://www.bls.gov/cps/cpswom2009.pdf (last visited 9/23/2012).

[121] American Bar Association, *First Year and Total J.D. Enrollment by Gender 1947 - 2011* (2012), *available at* http://www.americanbar.org/content/dam/aba/administrative/legal_education_and_admissions_to_the_bar/statistics/jd_enrollment_1yr_total_gender.authcheckdam.pdf (last visited 9/23/2012); Association of American Medical Colleges, *U.S. Medical School Applicants and Students 1982-83 to 2011-12* (2012), *available at* https://www.aamc.org/download/153708/data/charts1982to2012.pdf (last visited 9/23/2012).

[122] American Association of Colleges of Pharmacy, *Academic Pharmacy's Vital Statistics* (2012), *available at* http://www.aacp.org/about/Pages/Vitalstats.aspx; Katie Burns, *At Veterinary Colleges, Male Students Are in the Minority*, *available at* https://www.avma.org/News/JAVMANews/Pages/100215g.aspx (last visited 9/23/2012).

[123] U.S. Department of Labor, Women's Bureau, *Quick Facts on Nontraditional Occupations for Women*, *available at* http://www.dol.gov/wb/factsheets/nontra2008.htm (last visited 9/23/2012).

women in science at all,"[124] the reality is quite different. Women's representation in scientific fields is not uniformly low, and at the doctoral level there is wide variation in female representation. In 2010, women earned 23 percent of the doctorates in engineering, 53 percent in biological sciences, and 73 percent in psychology.[125] In fact, there is substantial differentiation by sex even within fields. For example, women were scarce among Ph.D. recipients in mining/mineral, metallurgical, and mechanical engineering (0, 8, and 12 percent, respectively), but more heavily represented in bioengineering, environmental health, and textiles science and engineering (39, 46, and 56 percent, respectively). In biology, women earned 44 percent of the Ph.D.s awarded in biochemistry but 81 percent of those in nutritional sciences. In psychology, women earned 43 percent of the degrees in physiological psychology and psychobiology but 78 percent of those in developmental and child psychology and 84 percent in school psychology. In the social sciences, women were "under-represented" in political science (41 percent) but "over-represented" in anthropology and sociology (59 percent and 62 percent, respectively).[126] In the humanities, women earned only 28 percent of philosophy Ph.D.s but 80 percent of the Ph.D.s in French language and literature.

It would be an odd hostility toward women that would produce this variegated pattern of female representation, with each subfield being differentially hostile to women. A more plausible explanation – an explanation that does not rest on the view that women are puppets dancing on the strings of puppeteers – is differential interest and ability. That is, sex differences in occupational choice reflect average differences in temperament and tastes. The disciplines and sub-disciplines in which there are relatively few women tend to be those having the lowest social dimension–engineering, physics, mathematics–while those attracting relatively large numbers of women–such as anthropology, sociology, biology, developmental and child psychology, environmental health, and bioengineering–have a higher social dimension. David Lubinski and his colleagues have characterized this distinction as being between the "organic" and the "inorganic."[127] The fields

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[124] Marguerite Holloway, *A Lab of Her Own*, 269 SCI. AM. 94, 95 (1993) (quoting philosopher Sandra Harding, and also describing science as a "well fortified bastion of sexism").

[125] Thomas D. Snyder & Sally A. Dillow, *Digest of Education Statistics 2011* (2012), National Center for Education Statistics, p. 433, Table 292, *available at* http://nces.ed.gov/pubs2012/2012001.pdf (last accessed 9/23/2012).

[126] National Science Foundation, *Science and Engineering Doctorate Awards: 2006* (2009), *available at* http://nsf.gov/statistics/nsf09311/pdf/nsf09311.pdf (last visited 9/23/2012).

[127] David Lubinski et al., *Gender Differences in Engineering and the Physical Sciences among the Gifted: An Inorganic-Organic Distinction*, *in* INTERNATIONAL HANDBOOK OF GIFTEDNESS AND TALENT 627 (Kurt A. Heller et al., eds, 2d ed. 2000).

avoided by women tend also to be among the most mathematically demanding. Given the relative positions of males and females on the "people-things" dimension and the disproportion of men at the very highest levels of mathematical ability, it would be surprising to find sexual parity in each of these widely differing fields.

Part of the sex difference in mathematics and science participation undoubtedly reflects the increasing sexual disparity in mathematical talent at the extreme high end of ability. Although the "gifted" are often discussed as if they were a homogeneous group, they are highly diverse in ability. The range of the top one percent of scores on a typical IQ test (≈135-200+) is as broad as that of the middle 96 percent of scores (≈66-134); that is, it accounts for a full one-third of the entire score distribution.[128] The combination of a higher male mean and greater variability causes males to especially outnumber females in the top quarter of the top one percent of mathematical ability, a group from which a major portion of scientists in quantitative fields is derived.[129] Although it has been argued that "there is little evidence that those scoring at the very top of the range in standardized tests are likely to have more successful careers in the sciences,"[130] in fact there is powerful evidence that they are.[131] For example, in a large sample of the mathematically gifted, the differences in outcome between those in the top quarter of one percent and those in the bottom quarter of one percent were substantial. Those in the top quarter of one percent were over eighteen times as likely to have obtained a STEM doctorate and over seven times as likely to have received tenure at a Top 50 university as those in the bottom quarter.

Even among those with very high ability, the sexes differ in their commitment to math and science both because of differences in interests and in patterns of ability. People who score high on the Social theme tend not to thrive in the cloistered environment of laboratory science, while those entering math-intensive fields tend to have a "low need for people contact."[132] High-math males tend to gravitate strongly to math and inorganic

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[128] Camilla P. Benbow & David Lubinski, *Psychological Profiles of the Mathematically Talented: Some Sex Differences and Evidence Supporting Their Biological Basis*, *in* THE ORIGINS AND DEVELOPMENT OF HIGH ABILITY, at 44 (Ciba Foundation Symposium) (1993).

[129] Kimberley F. Robertson et al., *Beyond the Threshold Hypothesis: Even Among the Gifted and Top Math/Science Graduate Students, Cognitive Abilities, Vocational Interests, and Lifestyle Preferences Matter for Career Choice, Performance, and Persistence*, 19 CURRENT DIRECTIONS IN PSYCHOL. SCI. 346 (2010).

[130] Carol B. Muller et al., *Gender Differences and Performance in Science*, 307 SCIENCE 1043 (2005).

[131] Jonathan Wai et al., *Creativity and Occupational Accomplishments Among Intellectually Precocious Youth: An Age 13 to Age 33 Longitudinal Study*, 97 J. EDUC. PSYCHOL. 484 (2005).

[132] David Lubinski et al., *Reconceptualizing Gender Differences in Achievement among the Gifted*, *in* INTERNATIONAL HANDBOOK OF RESEARCH AND DEVELOPMENT OF GIFTEDNESS AND TALENT 693, 701 (Kurt A. Heller et al. eds., 1993).

sciences, and high-math females tend to spread out among math and inorganic sciences, medical and organic sciences, and humanities and arts, because their interests are "more evenly divided among investigative, social, and artistic pursuits."[133] Moreover, another reason that high-math women often find themselves in disciplines other than math and science is that they have more options than high-math men. High-math men tend to have a relatively "tilted" pattern of abilities, with substantially higher mathematical ability relative to verbal ability, while high-math women tend also to be high in verbal ability, leading them into fields requiring high verbal ability.[134] Moreover, differences in spatial ability make an independent contribution, as high math and verbal ability but (relatively) low spatial ability predict a career in the humanities and social sciences, whereas high math and high spatial ability but (relatively) low verbal ability predict a career in a STEM field.[135]

2. Women in Blue-Collar Occupations

Despite substantial integration of women in many white-collar occupations, including the most prestigious ones, women's low representation in blue-collar occupations has been relatively stable.[136] The percentage of women remains very low in many such occupations, including firefighter (4.8% female), construction laborer (3.1%), aircraft pilot and flight engineer (2.6%), auto mechanic (1.6%), carpenter (1.5%), electrician (1%), and mason (0.4%).[137] The conventional explanation is that society and employers have created expectations about what is "appropriate" work for women, so that women tend not to seek these jobs and that when they do, they face both discrimination and sexual harassment. These are not altogether false explanations, but they are grossly incomplete.

Women's low participation rate in most blue-collar jobs results in substantial part from the sex differences previously described. Some of the largest sex differences revealed by the Strong Interest Inventory are on the "Realistic" General Occupational Theme, which measures interest in

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[133] *Id*. at 702.

[134] David Lubinski et al., *Top 1 in 10,000: A 10-Year Follow-Up of the Profoundly Gifted*, 86 J. APPLIED PSYCHOL. 718 (2001); Gregory Park et al., *Contrasting Intellectual Patterns Predict Creativity in the Arts and Sciences: Tracking Intellectually Precocious Youth Over 25 Years*, 18 PSYCHOL. SCI. 948 (2007).

[135] Rose Mary Webb et al., *Spatial Ability: A Neglected Dimension in Talent Searches for Intellectually Precocious Youth*. 99 J. EDUC. PSYCHOL. 397 (2007).

[136] Brigid O'Farrell, *Women in Blue Collar and Related Occupations at the End of the Millennium*, Q. REV. ECON. & FIN. 699 (1999).

[137] U.S. Department of Labor, 2009, *supra*

building, repairing, and working outdoors. Most blue-collar occupations are heavily oriented toward the Realistic dimension; indeed, the three-letter Holland code for virtually all blue-collar jobs begins with R.[138] Many blue-collar occupations also require a high degree of mechanical ability, a dimension for which very large sex differences exist.

Physical strength continues to be demanded by many blue-collar occupations, and women have only one-half to two-thirds the upper-body strength of men.[139] In many studies, the effect sizes are greater than 2.0, which means that there is very little overlap between the strength distributions of the two sexes, even less overlap than there is between the sexes in height.[140] Although many jobs have changed in ways that diminish the importance of women's relative lack of strength,[141] others have not. Occupations such as heavy-equipment mechanic, for example, require substantial upper-body strength, not to mention a high degree of mechanical ability. The combination of these two requirements should lead one to expect few women in that job, and that is just what one sees, with only about one percent of such positions filled by women.[142]

CONCLUSION

Despite major changes in the workplace, many favoring women, some worry about residual areas where men seem to have an advantage. There is seems to be a double standard behind the worry. When women are seen as doing well, it seems sufficient simply to assert that women are more suited to the modern workplace than men, and it is their natural talents that are responsible for their advances.[143] When men are seen as doing well, however, it seems to be viewed as borderline blasphemy to suggest that they may be more suited to certain jobs and their natural talents may be responsible; instead, the blame must rest on subtle or even invisible barriers. To do otherwise is to "blame the victim."

Most people probably appreciate that different individuals have different strengths and interests and that different strengths and interests may take them in different directions in the workplace. Most people probably have

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[138] Examples include arc welder (RIS); electrician (RIE); fire fighter (RES); and automobile mechanic (RCI). HOLLAND, *supra*.

[139] S. T. Pheasant, *Sex Differences in Strength: Some Observations on Their Variability*, 14 APP. ERGON. 205 (1983).

[140] *See* KINGSLEY R. BROWNE, CO-ED COMBAT: THE NEW EVIDENCE THAT WOMEN SHOULD NOT FIGHT THE NATION'S WARS 19-27 (2007).

[141] Bruce A. Weinberg, *Computer Use and the Demand for Female Workers*, 53 INDUS. & LAB. REL. REV. 290 (2000).

[142] U.S. Department of Labor, 2009 supra

[143] *See generally* FISHER, *supra* note 4.

distinct images of corporate executives, used-car salesmen, nurses, physicists, musicians, special-forces soldiers, kindergarten teachers, and trial lawyers. We would expect such people to be quite different from one another and would doubt that a single person would be drawn to, or excel at, all of these positions. Instead, we would expect people to be attracted to, and successful in, jobs for which they have the skills and ability and that provide them with the satisfactions that they desire from a job. Because many of talents and tastes that have workplace ramifications are ones that also vary by sex, it would be odd if there were to be parity between the sexes in all jobs.

To be sure, no set of workplace outcomes is foreordained or permanent. Changes in the workplace will continue, and these changes are likely to have somewhat different impacts on the two sexes. As both Neils Bohr and Yogi Berra are reputed to have observed, however, predictions are difficult, especially about the future, so I'll leave it to others to tell us what the workplace of the 2030's will look like.