Gender and Health Research Group

Jennifer M Merchant, Catherine Vidal, Mylène Botbol-Baum, Catherine Bourgain

Inserm

La science pour la santé
From science to health

Gender and Health Research Group

Inserm Ethics Committee

June 2014

Gender and Health Research Group

Presentation text written by Jennifer Merchant, Catherine Vidal, Mylène Botbol-Baum and Catherine Bourgain

On April 17th, 2014, the bill “For Equality Between Women and Men” (www.legifrance.gouv.fr), presented by French Minister of Women’s Rights, Najat Vallaud-Belkacem, was passed. Its areas of application are broad, covering education, work, politics, family, culture, media, sports and the fight against violence towards women. In such a context, it is important that the health sciences also take on this issue female-male equality.

Consequently, the Inserm Ethics Committee has established a Gender and Health Research Group, not just to raise the awareness of Inserm researchers on this issue, but also to reach beyond its laboratories by participating in societal debates that are open to everyone, from patients and doctors to health research stakeholders.

Our ethical reflection covers the following points:
- Raising researcher awareness of the health consequences of sex and gender discrimination;
- Taking into consideration gender aspects in medical and research practices;
- Recognizing the need to improve women’s access to leadership and decision-making roles in the research community;
- Adopting a critical approach to the naturalistic conceptions of the differences between men and women.

Introduction

The differences between the sexes in terms of public health have been well established in epidemiology surveys. However, it is clear that research aiming to understand such discrepancies from the gender perspective remains rare in France, unlike in Anglo-American and other European countries. Indeed, we must question how the disparities in social roles influence how women and men are exposed differently to health problems, how they perceive their health problems, whether or not they seek treatment, and how healthcare professionals respond differently according to the sex of their patients.

The gender aspect is also often neglected in biomedical research. Rare are the studies that question the role of social factors in the physiological and pathological differences between the

sexes. It is important to encourage researchers to consider the differences between men and women not as a simple dichotomy between male and female, but as the result of intricate links between sex and gender (Fausto-Sterling 2000, 2012, Springer 2012, Krieger 2003). Biology influences gender, and gender influences biology. Neuroendocrinology is a good illustration of this. The social relationships and psychological experiences that vary according to gender influence the production of hormones (sex hormones, cortisol, adrenaline, etc.) and their associated pathologies.

Considering gender in health involves making and testing hypotheses to link biological and social mechanisms that can explain differences between women and men. This approach is crucial to the development of research in all areas of health.

What do we mean by sex and gender?

Sex designates the biological determinants – chromosomes, genital organs, hormones, reproductive functions – which characterize and differentiate males from females, including in humans. In this sense, the differences between men and women can be described in terms of molecular, biochemical and physiological mechanisms.

Gender is a concept that designates the processes through which male and female identities are socially and culturally constructed. It is a tool for analyzing the relationships and norms that differentiate and attribute hierarchy to the social roles of women and men. The concept of gender is based on a body of validated studies in many disciplines: sociology, philosophy, anthropology, history, psychology and biology. Disciplines which all concur in demonstrating – in all of studied societies – that biological sex is not enough to make a woman or a man.

Indeed, sex and gender are not separate variables but come together in a process of "embodiment", a term describing the complex interaction between biological sex and social environment that begins at birth and even before then (Fausto-Sterling 2000, 2012). Health research should take this connection into account in order to explain the differences and similarities between women and men in physiology and pathology. The belief that biology can be distinct from the social environment continues to hold strong among doctors and researchers (Klinge 2010, Springer 2012). Hence, before being quick to conclude the existence of biological differences, it is important to consider other variables, such as ethnicity, age, size, education, occupation, socioeconomic environment and so on, in order to formulate alternative hypotheses.

The interaction between sex and gender means looking beyond the differences themselves in order to question how they develop and to give them a social and political context, which can be a source of disparity and inequality. Ethical consideration of these issues is needed in order to improve medical and research practices that will benefit the health of both women and men.

N.B: See **Appendix 1** for a discussion of the history and role of the concept of gender.

Gender in the field of public health

Since the 1980s, developments in reproductive health technologies have sparked critical reflection on sex and gender. Indeed, the dissociation between sexuality and reproduction has led to questioning the obviousness of the categories of “woman” and “man”. This reflection has expanded to include the various biomedical sciences.

Inequalities between the sexes in matters of health can no longer be resumed by the longer life expectancy of women – in France and many other countries (Baudelot, 2008). However, while women live longer, they also spend more years living in poor health (Nusselder, 2010) and present markedly different morbidity rates at various stages of life and for a large number of diseases (Cambois, 2011).

The detection, expression and treatment of myocardial infarction is a textbook example of the interaction between sex and gender. Despite being the leading cause of female mortality in the USA and Europe (WHO, 2008), it was underdiagnosed for a long time in women by a medical profession who considered it as a “man’s” disease, characteristic of stressed middle-aged managers (Klinge 2010). Doctors were more inclined to prescribe tranquilizers to women complaining of fatigue and breathlessness, thereby missing the diagnosis of heart disease. The consideration of sex and gender in myocardial infarction has stimulated research into its symptoms, diagnosis, prevention and treatment, leading to a deeper understanding of the disease in both women and men (Regitz-Zagrosek, 2011; Mosca 2012). This meant challenging the concept of the cardioprotective effect of estrogen (Stefanick, 2005). Another outcome is the obligation to enroll more women in clinical trials of new myocardial infarction treatments. The interaction between sex and gender must also be considered when analyzing risk factors for circulatory system diseases (stroke, embolism, etc.): smoking, obesity, physical

inactivity, diet reflecting the links between gender, health and environment (Mosca, 2012; Shafey, 2009).

One example of a disease which remains underdiagnosed in men is osteoporosis. Until 1990, it was considered a “women’s” disease because it was linked to menopause and HRT. The subsequent challenging of such therapy in the prevention of female osteoporosis led to reconsidering the disease and the establishment of bone density scores not only for women but for men as well (Klinge, 2010).

In psychological disorders with differing levels of prevalence between the sexes (autism, depression, etc.), the gender aspect is often overlooked. Yet recent research on autism shows that the expression of symptoms differs according to gender, which influences the child’s early interactions with their environment and the construction of their identity. Social norms contribute to the fact that boys are more likely than girls to receive a diagnosis (Cheslack-Postava, 2012). With depression, the expression of psychological suffering also varies according to gender. Beyond the symptoms traditionally taken into account (sleep disorders, withdrawal, etc.), the consideration of additional symptoms (depressive behavior, risk-taking, etc.) leads to equal prevalence between women and men (Martin 2013).

Beyond the specific field of reproduction, many examples of the influence of sex and gender on health can be found in virtually all areas of medicine: asthma, cancer, cardiovascular health, diabetes, obesity, osteoarthritis, osteoporosis, addiction, aging, and so on.
Studies in North America and Europe show the influence of feminine social codes (fragility, sensitivity, verbal expression) and masculine social codes (virility, resistance to pain, risk-taking) in the expression of symptoms, the relationship with the body, and use of healthcare. Similarly, among healthcare professionals, gender stereotypes influence the detection, treatment and prevention of diseases.

The weight of social representations proves to be a factor of major risk and inequality in the health of both men and women

Gender in biomedical research as illustrated in neuroscience and genetics

The contribution of social factors to the differences between the sexes in physiology and pathology is often neglected. Particularly in fundamental neuroscientific studies, which aim to compare the brains of men and women. The influence of personal experience and social and

cultural context must be taken into account in relation to knowledge on brain plasticity. Yet, essentialist prejudices continue to prevail. In an article published in December 2013 in the prestigious US journal *Proceedings of the National Academy of Sciences*, researchers from Philadelphia concluded from their MRI analysis of neural connections that "*male brains are structured to facilitate connectivity between perception and coordinated action, whereas female brains are designed to facilitate communication between analytical and intuitive processing modes*" (Ingalhalikar, 2013). This was in addition to the investigation leader announcing to the press that their study backs up stereotypes of masculine and feminine behaviors… The absence of critical discussion of their findings in relation to international literature (with current knowledge of the human brain not making it possible to establish causal links between brain anatomy and such vague and general behaviors) and above all the failure to consider brain plasticity in the subject's history and brain construction when interpreting the images, shows that the interference between ideology and scientific practice continues to prevail in the 21st century (Vidal 2005, 2012). While this position is certainly nothing new, brain images using MRI are now being increasingly instrumentalized to justify gender differences through biological determinism (**see Appendix 2**: What does cerebral imaging tell us about the sex of the brain?)

The same phenomenon is encountered in genetics. An article published in the *American Journal of Human Genetics* (Jacquemont, 2014) examines the gender bias observed in many neurodevelopmental disorders. The study compares the distribution of deleterious variants on the autosomal DNA of two cohorts of girls and boys with neurodevelopmental disorders and autism. Describing an excess of deleterious variants in the girls, the authors concluded a "female protective effect", with the lead author, Jacquemont, declaring to the French daily *Le Figaro* in February 2014 that girls' brains are in a way better equipped for dealing with and "compensating for" certain mutations. Yet the proportion of deleterious variants ranged from 34% to 9% in the girls and from 30% to 6% in the boys, representing a 3% difference between the sexes and in one third of the girls and boys concerned in the cohort studied. Findings that are far from providing elements compatible with the binary mechanistic view of the differences between the brains of girls and boys presented in the article's conclusion. In addition, the social factors likely to explain these differences are very quickly dismissed by the authors with no real discussion.

International initiatives in terms of gender, health and biomedical research

USA

- **Government initiatives**

In the USA of the 1980s and early 1990s, a certain number of scientists and researchers in the social sciences began to call attention to the underrepresentation of women and ethnic minorities as research subjects (Dresser, R. 1992: A.C. Mastroianni, A.C., *et al.* 1994). For example, in cardiovascular disease research or in clinical trials developing new drugs, women were largely understudied. The researchers accepted without too much question the idea that men's bodies were easier to study. The male body was considered the human "prototype", whereas the female body was perceived as "other" or "deviant" (Tavris, C., 1992; Waldby, C., 1996) and therefore only capable of introducing dysfunction into biomedical research.

Thanks to the initiatives of researchers in the social sciences, as well as in biology and medicine, this absence of taking women into account was made public. Many female scientists at the NIH – such as Florence Haseltine, Director of the Center for Population Research at the National Institute of Child Health and Human Development – began to endeavor for major change.

During the same period, in the US Congress, female Democrat representatives led by Pat Schroeder (Colorado) mobilized in response to the challenges concerning women's health. In 1990, Schroeder declared before a law commission on health system reform that excluding US women from biomedical research was putting them at major risk. This was in reference to an NIH heart attack prevention study launched in 1981 in which not a single one of its 22,000 subjects was female. Olympia Snowe, Republican Senator and Co-Chair of the Committee on Women's Issues, drew attention to another study funded by the Federal government on the links between obesity and cancer of the breast and uterus, for which the pilot study had only used men!

The various female members of Congress mobilized to encourage their peers to pass laws that would require the NIH to change its research policy. To help them with the legislative procedures, Haseltine and others called on Bass & Howes, a lobbying agency specialized in issues affecting women. This alliance created a pressure group, the Society for the Advancement of Women's Health Research (SAWHR), which prioritized the inclusion of

women in clinical research. It contributed to the drafting of the NIH Revitalization Act (NIH-RA), signed by President Clinton in 1993.

This law enabled the budget of the Office of Research on Women's Health (ORWH), created in 1990 and not attached to a federal agency, to be included in that of the NIH. In addition, the NIH-RA brought in two controversial provisions. First of all, the NIH – whose biomedical research center has the world's largest budget – was now required to include women and minorities in their research projects. In addition, each project had to be designed and conducted to enable analysis of whether the variables measured in the clinical trial specifically concerned women or minorities.

In the year the NIH-RA was enacted, the Food and Drug Administration (federal agency granting authorizations to use and commercialize new medical techniques and new drugs) announced a full review of the ethical rules on the participation of women in clinical trials funded by pharmaceutical companies. Indeed, the regulations in existence since 1977 automatically excluded women of childbearing age from Phase 1 and 2 trials, due to a fear of the effects on potential fetuses.

Following the mobilization of Congress on the subject, and thanks to the HIV Law Project that submitted a petition challenging the FDA, the agency withdrew the 1977 regulation and drafted a new framework governing clinical trials. These new directives, published in 1993, permitted the enrolment of women – even in the initial test phases of new drugs – provided that they were using a form of contraception. Pharmaceutical companies were also required to submit data on women as well as on men in relation to their clinical trials.

Since 1993, the ORWH and FDA verify that all studies conducted and funded by their agencies embark on projects related to women's health. They encourage fundamental and clinical research on the influence of sex and gender on health and diseases and define research priorities for diseases that particularly affect women.

- **Academic and university initiatives in the USA**

  These government initiatives were, of course, preceded by the second wave of feminism of the late 1970s and early 1980s. This social movement was accompanied by many studies performed by human science researchers in US universities – which saw the creation of departments of Women's Studies, Feminist Studies, and Gender Studies. Today, many research centers and networks entirely dedicated to the issues relating to women, health and

biomedical research have their roots in various major US universities. A few links are provided below:

- Gendered Innovations in Science, Health & Medicine, Engineering and Environment. http://genderedinnovations.stanford.edu/

- Gender Tutorials on Women in Science
http://www.hunter.cuny.edu/gendertutorial/

- Association for Women in Sciences (especially STEM, but not exclusively)
http://www.awis.org/

- Gender and Health Working Group of the Robert Wood Johnson (RWJ) Health and Society Scholars Program at Columbia University. Special Issue of *Social Science & Medicine*, 74 (2012): "Gender and health: Relational, intersectional, and biosocial approaches".

- Publications of US gender and science pioneer, Anne Fausto-Sterling, may be found at:
http://www.researchgate.net/profile/Anne_Fausto-Sterling/publications?ch=reg&cp=re50_x_p2

- **European and international initiatives:**

  - Réseaux Internationaux spécifiques aux Neurosciences
  International Network "Neuro-Gendering" : http://neurocultures2012.univie.ac.at
  et www3.unil.ch/wpmu/neurogenderings3

  HORIZON 2020 Europe
  - European portal:
  http://ec.europa.eu/programmes/horizon2020/
  - French portal:
  http://www.enseignementsup-recherche.gouv.fr/cid71866/horizon-2020-le-nouveau-programme-de-l-union-europeenne-pour-la-recherche-et-l-innovation.html

  - IGM (*International Society of Gender in Medicine*)
  http://www.isogem.com/

  - Berlin Institute of Gender in Medicine
  http://gender.charite.de/en/

- Center for Gender and Diversity, Holland
http://www.genderbasic.nl/

- Nordic Network: Gender, Body and Health, Upssala University
http://www.genna.gender.uu.se/themes/bodyembodiment/nordic-network-gender-body-and-health/

- Gender Balance in Research, Norway
http://eng.kifinfo.no/

- Ministry of Public Health, Norway
http://www.phmed.umu.se/enheter/allmanmedicin

The situation in France in terms of gender, health and biomedical research

The national inventory of research on gender and/or women, managed by the CNRS
In 2011, the Women's Taskforce of the National Center for Scientific Research (CNRS) began to compile an inventory of all research involving gender and/or women at national level. More than 1,000 entries have been published to date in the first online directory devoted to this issue. (http://www.cnrs.fr/mpdf/spip).

The directory contains only 12 researchers and teams that fall within the remit of Inserm:
- 3 from the Center for Research in Medicine, Science, Health, Mental Health, and Society (CERMES 3), in Villejuif
- 4 from the Center for Research in Epidemiology and Population Health (CESP), Team 7: Gender, Sexual and Reproductive Health, in Kremlin-Bicêtre
- 4 from the Institute of Interdisciplinary Research on Social Issues Social Sciences, Politics, Health (IRIS), in Paris
- 1 from INSERM-U952, Pathophysiology of Central Nervous System Diseases (PMSNC) (Molecular Genetics, Neurophysiology and Behaviors team), which became U1130 Neuroscience Paris Seine on 01/01/2014

The Gender Studies Interdisciplinary Thematic Network established for a three-year period (2010-2012) by the CNRS
A Gender and Health Round Table was held on February 10, 2011

Emilie du Châtelet Institute (GID Ile-de-France) in partnership with the Inserm and Paris Diderot University, the Center for Research on Psychoanalysis, Medicine and Society (CRPMS)

An International Gender and Health Colloquium was held in June 2015 (www.mnhn.fr/iec)

The place of women in the health research professions

In the USA

For several decades, the historical, critical and sociological study of the place and role of women has constituted an academic discipline. Various names are linked to its origins, one of whom is Matilda Joslyn Gage. At the end of the 19th century, she observed what became known as the “Matilda Effect”, in which the achievements of female scientists are systematically denied and then attributed to male colleagues. The Matilda Effect was observed in the UK for Rosalind Franklin and in France for Marthe Gautier, to name but two examples.

Note that it was only in 2013 that the prestigious journal *Nature* finally devoted an entire issue to the question of women and men in science, whether as researchers or research subjects.

Despite progress towards equality of recent decades, women still face significant obstacles to career advancement. US universities and colleges (universities that do not issue doctorates) continue to employ greater numbers of male scientists who are also much more highly paid.

Concerning the NIH, women have equal involvement in intramural research projects, thanks to the initiatives previously discussed. However, the famous "glass ceiling" is very much present, once past Clinical Fellow level (see table below).

Table 1: Percentages of women and men in the NIH research professions (NIH 2005)

NIH Intramural Programs

	Total	**Women**	**% of total**	**Men**	**% of total**
Sr Investigators	941	187	19.9	754	80.1
Tenure-track	283	75	26.5	208	73.5
Staff clinicians	193	82	42.5	111	57.5
(Staff clinicians do not exist in France apart from *Assistants de Recherche Clinique*/Clinical Research Assistants whose status is more that of an *Ingénieur d'Étude/*Study Engineer)					
Staff scientists	787	253	32.1	524	67.9
Research fellows	930	347	37.3	583	62.7
Clinical fellows	325	132	40.5	193	59.5
(No equivalent in France)					
Postdoctoral fellows	2487	1065	42.8	1422	57.2
Graduate students	370	191	51.6	179	48.4

One persistent problem, despite the efforts deployed, is due to the fact that an abnormally high proportion of qualified women abandon their scientific careers very early on or see them slowed down by their decision to start a family. The constraints of family life weigh more heavily on women than on men. In some analyses, the underrepresentation of female scientists is also attributed to the absence of successful female scientific role models.

Another enduring factor that is more difficult to eradicate is gender bias, whether implicit or explicit. The stereotypes have just as much an influence on female scientists and even,

according to neurobiologist Jennifer Raymond, people who actively promote the place of women in the sciences.

So what can be done? One idea is to impose quotas. In some contexts, this would be a good way of ultimately ensuring female scientific role models for young women interested in research. Another suggestion is to conduct a major awareness campaign. The scientists themselves – from Nobel prizewinners to postdoctoral researchers – all have a role to play. Some Laureates have already helped raise general-public and scientific-community awareness through foundations, such as that of Rita Levi-Montalcini, which supports aspiring young female scientists in Africa or that of Christiane Nüsslein-Volhard, which supports young female scientists with children.

At the institutional level, various European research bodies have created funding programs specifically for female researchers, enabling them to establish their own laboratories.

In France

At the Inserm

In 2012, over 60% of Inserm statutory personnel were women. A proportion that no longer holds true once the various civil servant categories are analyzed individually: while 53% of all researchers are women, this figure falls to 39% of Research Directors and 23% of Exceptional Grade Research Directors. The same pattern is found in the various categories of engineers. And only 20% of Inserm research training programs are led by women. The year 2012 was not exceptional, the proportions were essentially the same in 2002.

Table 1: Percentage of women in the Inserm Researcher and Engineer categories – Figures from the 2002 and 2012 Inserm HR statistics

The Inserm HR statistics since 2002 are available at: http://www.rh.inserm.fr/INSERM/IntraRH/RHAccueil.nsf/BilanSocial.html?OpenPage

Category	2002	2012
Research Officer	53%	53%
Research Director	39%	39%
Exceptional Grade Research Director	37%	23%
Total researchers	49%	47%
Research Engineer	55%	54%
Study Engineer	71%	67%
Assistant Engineer	78%	77%
Total Engineers	69%	67%
Entire Institute	63%	60%

While the meritocratic mode of recruitment and career advancement of our professions is considered a guarantee of the highest levels of career equality, it must be noted that in practice it does not prevent an institute such as the Inserm from avoiding the presence of the glass ceiling – a phenomenon long since observed in the private sector in which women do not progress beyond a certain level (Marry 2005, 2008). The few studies conducted in the context of the French research institutes focused on aspects concerning the women themselves (lower ambitions, family workload, etc.) as well as historical and institutional factors, particularly the nature of the recruitment and selection processes specific to these organizations (Löwy 2004). They illustrate the role played by accumulated discrimination: small differences at the outset (rapid career progression considered a sign of scientific excellence, importance of cooptation, etc.) turn into major discrepancies after several years of one's career.

These days it is evident that only proactive measures can help change this situation. Producing annual gender statistics – albeit necessary in order to quantify the phenomenon – is not enough. The Inserm needs to tackle this issue more vigorously. Various measures can be envisaged: initiation of studies on the situation at the Inserm; establishment of systems to correct gender discrimination at all levels of selection (job applications, projects, etc.) based

on accurate and quantifiable criteria – possibly in the form of quotas; development of training in gender issues, including during careers, as part of research training, and so on.

Perspectives and proposals

The gender dimension in health practices and research represents an innovation in medicine and biomedical research in their ethical and social aspects, making it possible to have a more specific view, all for the benefit of public health and research findings. It forces one to go beyond essentialist reductionism on biological sex by incorporating the social roles assigned by gender norms and, as such, opens up novel questions of justice, healthcare access, and reinforces the need for antidiscrimination policies.

Proposals for implementing the intellectual and methodological conditions conducive to the inclusion of gender in Inserm research practices.

1. In collaboration with our social science laboratories, surveys on research performed at the Inserm with an interest in gender.
2. Educational workshops on the concept of gender and the links between gender and health, with the aim of:
   - Raising researcher awareness of the fact that biology must not mask the role played by social constructs in health behaviors.
   - Challenging the clinical methods of management, healthcare, screening, follow-up... through the lens of gender.
   - Developing novel methodological approaches to research with the gender tool in understanding the normal and the pathological.

   Among others, the research domains addressed will be those of reproductive health, endocrinology, cardiology and neuroscience etc. and public health implications.
3. Recommendations to the Ethics Committees (CPPs) and Regional Ethical Think Tanks (ERREs) to introduce the issue of gender in the examination of clinical research protocols in accordance with recent European regulations

Bibliographical references

Baudelot C (2010). "Les inégalités sociales de santé parmi les autres inégalités économiques et sociales". Actes du colloque *Réduire les inégalités sociales de santé*, Ministère de la santé, Paris.

Cambois E, C Laborde, I Romieu, J-M. Robine. (2011). "Occupational inequalities in health expectancies in France in the early 2000s: Unequal chances of reaching and living retirement in good healt", *Demographic Research,* 25: 407-36.

Cheslack-Postava K and Jordan-Young R (2012). "Autism spectrum disorders: Toward a gendered embodiment model," *Social Science & Medicine*, 74, 1667-1674.

Dresser, R. (January-February 1992). "Wanted: Single White Male for Medical Research", *Hastings Center Report*

Fausto-Sterling A. (2000). *Sexing the Body. Gender Politics and the Construction of Sexuality,* Basic Books.

Fausto-Sterling, A. (2012). *Corps en tout genre,* La Découverte.

Ingalhalikar M, Smith A, Parker D, Satterthwaite TD, Elliott MA, Ruparel K, Hakonarson H, Gur RE, Gur RC, Verma R (2014). "Sex differences in the structural connectome of the human brain," *Proc Natl Acad Sci* U S A, 111(2):823-8.

Jacquemont et al., A (2014). "Higher Mutational Burden in Females Supports a 'Female Protective Model' in Neurodevelopmental Disorders, *The American Journal of Human Genetics*, 94, 1–11.

Klinge Ineke and Wiesemann Claudia (2010). "Sex and gender in biomedicine", Universitätsverlag Göttingen ed. , pp 1-129 (http://univerlag.uni-goettingen.de).

Krieger Nancy (2003). "Genders, sexes, and health: What are the connections—and why does it matter? *International Journal of Epidemiology*, 32, 652-657.

Löwy Ilana (2004) "Pourquoi si lentement ? Les obstacles à l'égalité des sexes dans la recherche scientifique." Dans Genevieve Hatet-Najar (ed.), *Les femmes dans l'histoire du CNRS*, Paris: CNRS, pp.27-38.

Marry C. (2008). "Le plafond de verre dans le monde académique : l'exemple de la biologie". *CNDP Idées économiques et sociales*, 153:36-47.

Marry C et Irène Jonas. (2005). "Chercheuses entre deux passions. L'exemple des biologistes", *Travail, genre et sociétés*, n°14 : 69-88.

Martin Lisa A, Harold W. Neighbors, Derek M. Griffith (2013). "The Experience of Symptoms of Depression in Men vs Women, Analysis of the National Comorbidity Survey Replication", *JAMA Psychiatry,* published online August 28, 2013.

Mastroianni, A.C. Faden, R. et Federman, D . (eds), (1994). *Women and Health Research: Ethical and Legal Issues of Including Women in Clinical Studies*, Washington, DC, National Academy Press.

Mosca, L., Barrett-Connor, E., & Wenger, N. (2012). "Sex/Gender Differences in Cardiovascular Disease Prevention: What a Difference a Decade Makes", *Circulation*, 124, 2145-2154.

NIH (2005). http://grants.nih.gov/archive/grants/policy/sex_gender/q_a.htm#q16. Pour un panorama plus complet, voir le dernier rapport du National Science Foundation : http://www.nsf.gov/statistics/wmpd/2013/start.cfm?CFID=15591681&CFTOKEN=49292408&jsessionid=f0301d9c60460aa0c98d31559232a3658a54.

National Institutes of Health, "What's the Difference? Sex and Gender Differences on Health and Disease A to Z" (http://orwh.od.nih.gov/resources/sexgenderhealth/index.asp).

Nusselder WJ, Looman CW,Van Oyen H, Robine JM, Jagger C. (2010). "Gender differences in health of EU10 and EU15 populations: the double burden of EU10 men", *Eur J Ageing*, 7(4):219-227.

Regitz-Zagrosek, V. (2011). "Sex and Gender Differences in Cardiovascular Disease," dans Prigione, S., & Regitz-Zagrosek, V. (Eds.), *Sex and Gender Aspects in Clinical Management*, pp. 17-45. London: Springer Verlag.

Schafey, O., Eriksen, M., Ross, H., Mackay, J. (2009). *The Tobacco Atlas*. Atlanta: American Cancer Society.

Springer Kristen W, Jeanne Mager Stellman, Rebecca M. Jordan-Young (2012a). "Beyond a catalogue of differences: A theoretical frame and good practice guidelines for researching sex/gender in human health", *Social Science & Medicine,* 74, 1817-1824.

Springer Kristen W, Olena Hankivsky, Lisa M. Bates (2012b)." Gender and health: Relational, intersectional, and biosocial approaches", *Social Science & Medicine,* 74,1661-1666.

Stefanick, M. (2005). "Estrogens and Progestins: Background and History, Trends in Use, and Guidelines and Regimens Approved by the U.S. Food and Drug Administration", *American Journal of Medicine*, 118 (12*),* 64-73.

Tavris, C. (1992). *The Mismeasure of Woman*, New York: Simon and Schuster.

Vidal C. et D. Benoit-Browaeys (2005). *Cerveau, sexe et pouvoir*, Belin.

Vidal C. (2012) "The sexed brain: between science and ideology", *Neuroethics*, 5, 295-303.

Waldby, C. (1996). *AIDS and the Body Politic: Biomedicine and Sexual Difference*, London, Routledge.

Appendix 1: From *sex* to *gender* – what impact on health research?

The ethical and methodological challenges of redefining the *gender* concept for research

The term *gender relations* is generally used in science. It is more refined than that of *sex* alone. These days, the institutions use the latter exclusively because the concept of *gender* levels out differences with its notional vagueness which depoliticizes the hierarchy between the sexes as social categories derived from the biological. It is therefore important to define how *gender* differs from social sex, and how that definition impacts the ethical challenges of research which can no longer consider itself from a universal masculine perspective (*Sexe et Genre*, Hélène Rouch, 2002).

In fact, science traditionally considers itself in terms of *gender* neutrality and tries to avoid being disrupted in its description of reality by social aspects with their historical – and as such mutable – dimension. Yet when its subject is the human being, scientific knowledge cannot disengage itself from the social and ethical consequences of research. Scientific realism cannot limit itself to descriptions of reality but must accommodate the nominalism that constructs concepts from mutations in the social field.

Biological determinism challenged by assisted reproductive technologies

The question of *gender* first arose in the field of assisted reproduction, which challenged the obviousness of heterosexual reproduction as a fact of nature. By creating possibilities outside of nature and by taking the embryo out of the uterus and into the petri dish.

With the reproductive biotechnologies, science has become a social anthropology player. With assisted reproduction, sexuality has become – through reproductive medicine – not just a subject of science, but also a third party in the dual relationship of the heterosexual couple, which can circumvent nature and enter a realm of possibilities, including surrogate mothers, lesbian couples, embryonic reduction or genetic alteration. These new techniques have enabled what US feminists refer to as *embodiment*, namely the consideration of the body as an operational datum in the abstraction of scientific regulations (Rosemarie Tong, Anne Donchin, for feminist bioethics)[1].

1. *Embodying bioethics*, edited by Anne Donchin, Oxford, 1999.

Following rapid legal regulation and thanks to the concept of *gender*, these new possibilities for reproduction and filiation entered the institutional and normative register of the social sciences, laying down non-discrimination between the sexes. It is therefore this conjunction between scientific possibilities and social choices which has given the concept of *gender* its full relevance. It has triggered a radical change in our perceptions of filiation as being necessarily biological and natural, once the embryo could leave its "natural" setting and nonetheless survive in order to be transformed or "improved".

As such, the convenient separation and hierarchy of the sexes, which is perceived as necessary, is no longer operational when it comes to understanding the ethical and political issues presented by the concept of *gender* in social sciences. This terminology cannot be restricted to the social sciences and requires reflection as to the consequences of these ethical, semantic and anthropological evolutions brought about by biomedical research, itself as a place able to shape – and not just describe – reality.[2]

Biological plasticity and *gender*

In addition, the plasticity of the *gender* concept over the previous fifteen years goes beyond original roots in terms of grammatical conventions. By placing sex on the side of biological certainty and *gender* on the side of social constructivism, we only reiterate that it is not the same thing, that the two categories are not superimposable. Is this sufficient to encompass societal challenges posed by the sciences to the anthropological categories of *gender* through their increased possibilities, notably in terms of reproduction and filiation?

What position must scientists adopt in the face of religious and legal authority resistance to the concept of *gender*, which implies bioethical decisions in a democratic and pluralistic society that resists the idea of sanctified human nature?

These far from abstract questions influence the possibility or prohibition of certain types of research nowadays and therefore demand that researchers position themselves in relation to the ethical challenges elicited by these frontier shifts between social and scientific norms.
Genre in French does not have the same history or meaning as *gender* in English. However, its aim in both languages is to reject biological determinism (Scott 1988).

2. H. Atlan, M. Baum, *Des embryons et des hommes*, PUF, 2008.

The biopolitical challenges of this concept are increasing and require clarification as to the legitimacy to afford them in scientific discourse. Nevertheless, we no longer can forgo reflection on the interactions between biological sex, social sex, and *gender*, precisely on the basis of empirical questions of ethics and society that raise potential reconsideration of the sole duality of the sexes in the sciences themselves.

Why should scientists have to consider the concept of *gender* rather than just biological sex, which does not describe the complexity of reality? What are we referring to? Can we conflate biological sex and the human science issue of *gender*?

While our perspective will be more ethical than epistemological, we will show that the two dimensions are mutually dependent, because subjective experience is inseparable from the experience of liberty and subjective rights. Law and ethics must reinvent the “objective” or the neutral based on heterogeneous viewpoints, without one definition being exclusive from the others, because the *gender* perspective is ethically inclusive of the plurality of sexual lifestyles that exist, beyond social norms, and, by that, calls into question the objectivity of biological norms which would only recognize the existence of two sexes, from a reproductive perspective. This is both a biological and a social function, which has long been determinant of the social and hierarchical destiny of women as reproducers. Biology can contribute to the emancipation of social representations and vice versa. This is what makes it possible to elaborate the concept of *gender*.

Far from just a problem of terminology, this semantic tension reveals the problematic status of women in relation to the concept of humanity in normative discourse, whether legal or scientific. Indeed, it reveals confusion between grammatical *gender* and natural history, which leads to confusion between the linguistic and the biological. This incoherence raises ethical questions as to the relevance of science, and even medicine, to tell the truth on issues beyond their sphere of competence.

On the basis of experienced or empirical situations, the term *gender* challenges a universal dualism of reproduction as heterosexual. This perception has structured our representations, psychological intuitions and ways of thinking. It reveals the confusion between the generic man and the masculine man as well as the societal and health impacts of this confusion.
This critique of the universals is nothing new, inherited from the Enlightenment by “speaking subjects” who refuse to be determined in their *a priori* desires by a so-called natural categorization, which would mechanically determine their social choices and desires as subjects.

It evokes the question with which Condillac challenged Linnaeus:
"Il n'existe dans la nature que des individus" [There are only individuals in nature], (Grand dictionnaire universel du XIXème, article on the universals). *"Ainsi, bien que le genre soit d'invention humaine, sa composition n'en est pas moins fondée sur une somme de caractères fournis exclusivement par la nature elle-même." [Although genus is a human invention, its composition is nevertheless founded on a sum of characteristics supplied exclusively by nature itself].* (Linnaeus, Larousse 1878: 1168)

It is not about choosing between what is natural and what is constructed but about realizing their continued interaction and the slow mutations that it elicits in our representations and beliefs.

It would, however, seem that, despite the evolution of the biogenetic sciences, the preconception remains the same as regards the female as both biological and social sex, even though it needs to be reconsidered if we are to take seriously the subjective dimension of the ethical norms and the potential resultant changes in Western mores, and that we associate it with freedom of research as with freedom of the individual.

It presupposes causality external to the natural and biological language and, as such, universal and fraternal. It is precisely this idealistic presupposition that the concept of *gender* is challenging. It is challenging the fact that the division of the sexes divides the species in a necessarily hierarchical manner. Hierarchy is not of nature, but on the contrary an interpretation contingent on biological differentiation.

The challenge of this re-naturalization – namely to qualify as natural the social and cultural products of the sciences – is to consolidate the representation of the difference and of the sexual roles by founding them in nature and in law.

This conservative position is necessarily in tension with our knowledge of the plasticity of the living, which is described by the biological sciences themselves, and therefore demands the capacity for reflective and critical researcher discourse, in order to accompany scientific and societal development processes more consistently.

However, here it is not about a consensual definition of *gender* – which would mask the biopolitical challenges of the definition – but about shedding light on the ethical issues raised

by the historicization of the concept, in relation to fixist biological perspectives which would confound convention and naturalization.

Feminism as an interdisciplinary field has signaled social effects in the biological sciences, the medicalization of *gender*, the *re-naturalization* of the body, whereas science challenges the anthropologies on the fixism of their own categories. The field of sciences is globally interpellated by the concept of *gender*; these questions cannot be the subject of the sole fields of sociology or philosophy. That is why this opinion appears to us to have to elicit reflection and a stance that is not *a priori* normative but gives the means of raising researcher awareness of the complexity of the social issues linked to the concept of *gender*.
It is important to reiterate that if we separate the issue and critical usage of *gender* and its ethical effects, the question arises as to why the determination of sex leads to classifications. In other words: why is sex supposed to cause *gender*? What are the effects and relevance of these classifications? Are they consistent with the scientific data? And above all, is that the question?

Giving ourselves the conceptual means of addressing these questions would avoid certain confusion in understanding the extension of the *gender* concept to research ethics and avoid naturalist reasoning and its ideological bias for categories of individuals that do not feel recognized by the existing normative model, founded on the sole duality of conventional biological determinism.

In her book, *Undoing Gender*, Judith Butler states: “For many, I think, the structuring reality of sexual difference is not one that one can wish away or argue against, or even make claims about in any reasonable way. It is more like a necessary background to the possibility of thinking, of language, of being a body in the world (...) [it is] a particularly dense moment of irresolution within language” (pp.176-177)

The hypothesis of the term *gender* is that the sexual difference is not just factual or given but that it is a question for our time, that of knowing how to include otherness and uncertainty which weaken our acquired representations in the face of questions which must remain open in order to continue to be considered.

Extending the concept of *gender*

We should also ask the question of the relevance of the rapid expansion of the concept of *gender* to all fields of activity and its non-limitation to sexuality, procreation or the social effects on filiation. Interpellated by the ethical and bioethical issues raised by the concept of *gender*, we need to delineate the scope within which researchers may encounter the concept.

For that we will need to decipher in an interdisciplinary manner the challenges of the prevailing ideological debate which opposes the term *gender* as being a threat to biological determinism, and reiterate that *gender* is not a theory which claims to be an alternative to the biological description of sex, terms that are often used indiscriminately by biologists, without taking into account the debate needed with the social sciences to clarify the boundaries of the scope.

Tension between the fixist definition of sex and the social challenges of gender identity classification: division or hierarchy?

One hypothesis considers that even these days biological sex continues to remain a trait intended to be the receptable of classifications (Archer and Lloyd 1985). The concept of *gender* will remain because it is practical for classifying people, as some biologists tell us. These two needs are simply affirmed in order to maintain the differentiation of the social roles.

This hypothesis is upheld by the “cognitivists” who call on postulates on the prerequisites of human cognition. Its learned version is that of Levi-Strauss who bases his interpretation of kinship on the pre-social (i.e. psychological) need of humans to divide everything in two.
How can we avoid confusing the differences that form the basis of grammatical language with the social structures that are responsible for justifying the hierarchy of *gender*? Giving consideration to *gender* in the social sciences and ethics precisely involves criticizing these presuppositions and the implications for the social hierarchy that they validate in the social roles of men and women.

How can we not believe that the response is given *a priori* and, what is more, naturally? Sex is a crucial marker of the social division that the *gender* concept is rethinking, in order to rethink the relationship between the dominant and the dominated, but also in the social relationships inherent to the practice of medicine and research.

The question of the naturalism of the division of the sexes has repercussions for the legitimacy of certain research areas, such as embryo research, because it excludes a gradualist perspective of the respect of the human being, but above all for the decision-makers who will orient the social issues of this research for individuals whose subjectivity may be altered by choices of sexual orientation, delegitimized or pathologized by science, as it was in the past with homosexuality or the concept of “race”.

Is it acceptable, and to what extent, that the church, religious leaders and even the normative bodies of scientific organizations interfere with these individual questions that inductively shape the values of a society and limit the legitimacy of some types of research, against the opinion of the men and women concerned, infantilizing them in relation to their life choices or refusal of parenthood. These issues are crucial to the bioethical debates and suggest a culture of pluralism. They have paved the way, against the opinion of the most conservative, for unprecedented desires of filiation, made possible by the sciences and the techniques radically questioning the idea of an *a priori* model of a human nature to be preserved, and revived the idea that we are not men and women but that we become them. This point of view suggests the possibility of a mutation of the social constructions that cannot be overlooked by scientists, and especially not by the biomedical science field, which is the social laboratory for these possibilities. This is to avoid pathologizing behaviors that would be considered deviant in relation to the myth of a universal norm that would be good for everyone and at all times, outside of any social, economic or political contextualization.

The biological markers themselves are not ready-to-use markers and do not escape a certain contextualization. Reducing the complexity of the markers of sexual differentiation is a social act that translates in different languages into conflicts of interest with science, the church, feminist discourse, and the way in which subjects perceive themselves and demand to be recognized in the social order. Certain biologists impose as marker the presence or absence of a penis (Money 1972), others the biological capacity to procreate.

But these divergences within scientific discourse itself challenge the hard cores of our understanding of the world as divided into clear and immutable categories of masculine and feminine as being natural and innate and must be considered as social categories that can be modified by circumstances or individual choices in history.

We must then, when faced with the debate provoked by the new technoscientific possibilities in a pluralist democratic society, ask the following question: When we correlate *gender* and

sex, do we compare social with natural? Or do we compare social with social? Or a given representation of what is the biology of reproduction?

As such, the social debate on *gender* and its place in relation to sex to a large extent intersects the debate on the priority between two constituent elements of *gender* which are given together but which must be separated analytically: division and hierarchy.[3]

Gender and naturalness

The concepts of sex and *gender* are therefore not neutral and refer to epistemological models which are more or less consistent depending on the disciplines that use those concepts. Nevertheless, when we refer to *gender*, it is about raising the issue of or rethinking gender relations in a non-hierarchical model, in the French sociology context for which in the 1960s sex was a variable like any other, such as age or occupation. But the masculine was still being used as the default variable in sociology until the end of the 1990s. Joan Scott specifically aimed to reject the idea of biological determinism (Scott 1988), stating that the concept of *gender* is paradoxically an ideologization of the difference of the sexes, which its use initially aimed to criticize. We will discuss it later in relation to *gendered medicine*.
Biological sex therefore remains all too often accepted as indisputable because – coming before *gender* – it is evident and natural. The economic and ideological foundations of European societies remain largely based on dual sexual categorization. This is in spite of assisted reproductive technologies that displace the obviousness of reproductive function as natural and immutable. The differences between individuals consequently appear more difficult to attribute to two distinct sexual categories.

"Genetic sex"

The multi-stage evolution of the complex sexual differentiation process interrogates sexual determinism in the differentiation towards the testicle and not the differentiation towards the ovary, perceived as "modifying the natural process" (*testis-determining factor*). It must be remembered that it was only in the 1950s that the relationship between the presence of the Y chromosome and the male phenotype was established (Jacobs 1959), but the scientific

3. See Anne Fausto-Sterling, *Sex/Gender, Biology in a Social World*. Routledge, 2013.

publications considered the male-female dual categorization as unshakeable, as was shown by Christine Delphy.

Studies on sex went from the cellular to the molecular level, focusing on a cell surface molecule, and then to the genetic level, focusing on the genes present on the Y chromosome, and giving the latter a dominant role. But analysis of the various karyotypes showed that a non-negligible number of individuals do not possess the standard chromosomal formula.

The second candidate was the Hy antigen, which also proved not to be the expected testis-determining factor. Research then became increasingly complex in order to find the cause of this small difference that would prove the insurmountable barrier between the sexes. As if biology could support or prove a doxa. The idea of an event triggering sexual differentiation became difficult to prove. These variants were incidentally perceived as pathologies undermining the *a priori* hypothesis.

This is how sterility came to be presented as a disease. But is it not the conceptual framework that needs to be reconsidered, rather than pathologizing individuals outside normal limits? Such is the question that the *gender* perspective is asking precisely by criticizing the obviousness of the prevailing epistemological models to determine the sexual difference genetically.

It is also important here to reiterate that the question of the biological determinism of social behaviors was raised by the sociobiology movement (Wilson 1975), which cannot be considered a universally acceptable position.

This school of thought also bases the identification of the natural on an “invariant” in the form of the simultaneous existence of three universals, confirming that sociocultural differences exist from the origin of humans, by re-appropriating and giving a scientific veneer to the myth of the patriarchy, and even the matriarchy, based on biometrics.

How to “undiagnose *gender*”[4]

The growing place of the concept of *gender* in scientific dialog leads to the consistent formulation of research ethics regulations in terms of *gender*, the French translation of which is *genre*.

4. The title of Chapter 4 of *Undoing Gender* by Judith Butler, referring to the diagnosis of gender dysphoria.

This term suffers, as emphasized previously in this document, from a conceptual gray area that risks, if it is not clearly explained, sanitizing the issues addressed in the scientific context under the label *gender relations*. It remains to determine the extent of the consideration of gender relations in the field of biomedical research that interests us here.

We cannot define *gender* without explaining the context of its emergence, against the obviousness of the binary discussion between two terms of biological sex.

Indeed it is important to reiterate, like Butler, that the term *gender* was not created by radical US feminists but by the sexologist John Money, having written a thesis on hermaphroditism from a behaviorist perspective. His thesis, contrary to *gender* studies discourse, aimed to understand “normal” behavior and analyze, based on pathologies, nothing less than “human nature” (Castel 2003:64). The intention of Money was not to understand intersexuality but what he called errors of nature, based on sexual normalcy, which implies the existence of normal and pathological sexuality. It was paradoxically Money who created the concept of *gender*, and the feminists, through the development of *gender studies*, opposed this normative medicalization of the subject’s sexual identity. He thought it possible to bring about a cure by hormonally rebuilding the sexual identity of the hermaphrodite subject.

While these theories met with strong reactions by partisans of the biological primate, paradoxically in psychiatry the antecedence of *gender* over sex remained the paradigm for “treating” intersex neonates. There was therefore the refusal of sexual ambiguity, as being unnatural, to which science responded with hormonal normalization, in order for the concept of *imprinting* borrowed from Konrad Lorenz to take place as early as possible. His treatment of the hermaphrodism of David Reimer challenged the theory because, as Butler showed, this theory radicalized sexual normativity through medicine, in the name of science, with the objective of normalizing the body as naturally belonging to either the biological male or female sex. Social expectation is predefined in medical terms. The concept of *gender* at its origin therefore, far from challenging the normative binarity of sex, made it possible to rewrite sexual nature "thanks" to surgical tools. *Gender* was therefore at the outset a tool for normalizing bodies through prevailing social prejudices. It aimed to hormonally manufacture a male or female sex and therefore normalize bodies for a predetermined social function, because ambiguous sexual behavior was perceived as a biological and psychiatric pathology, without taking into account the coexistence of other categories as pathological[5], the complexity of

5. Which is rejected by the countries that recognize a third sex, such as Germany, or which reject sexual identity as a social parameter to mention on an ID card.

social roles or their hierarchy. This gave his nebulous ideas a scientific veneer reinforced by the fact that it is based on statistical data and substantial samples.

The embryologist Jost confirmed these intrauterine sexuation processes, asserting that the fetus was female by default, whereas the male was the result of more complex fetal development. He went on to discuss the insufficiency of the Adam principle in transsexuals[6], giving scientific support to mythological presuppositions (Money 1976).
It was precisely *against this scientistic current* that *gender* studies were constructed in the feminist movement. Because, very rapidly, this concept of *gender*, shaped by psychiatrists and US sexologists in the context of clinical child psychiatry, was to pass into everyday language but radically change meaning based on the critical discourse of psychoanalysis, which does not reduce the gendered subject to their biology.

The epistemological and social function of the concept of *gender*

The emergence of the distinction between sex and *gender* at the end of the 1960s certainly lent consistency to the work of English-speaking feminists. This distinction links to the concept of sex the biological characteristics used to differentiate men from women, and to that of *gender* the activities, psychological attributes, and social roles and statuses culturally assigned to each sex category and constituting a belief system, the pivot of which is the principle of biological determinism.

The critical virtue of this distinction is to challenge the manifest nature of the explanatory power of the *biological sex* category as inferring psychological and social differences. It makes it possible to rethink the relevance of the dichotomous – and above all hierarchized – system by revealing the power relations binding women to men; even in scientific research meant to be epistemologically protected from such controversies, by stepping behind the veneer of scientific neutrality.

In addition, there is a simultaneously scientific and political dimension of this *sex/gender* distinction of which it is important to be aware in the biological research domain. Such distinction, albeit useful, nevertheless risks reinforcing the idea that the biological would be invariant because it is “natural”, setting aside the fact that the biological is itself the subject of social and psychological elaboration. A certain fondness in the legislative texts for the term

6. See John Money and Richard Green, *Transsexuals and Sex Reassignment*, John Hopkins Press, 1969. But above all Margaret Mead’s analysis of “The Roles of the Sexes”.

gender has all too often led to it substituting that of sex and thereby depriving it of any effective meaning and changing nothing of the biomedical explanatory system. Its virtue is therefore to reiterate that *gender* is a construction that challenges the biological.
It is about liberating the view of the researcher from a determinism that would imply a social construction of binarity of the sexes from the biological reality of the sexed body. How not to conceal either the biological or the psychosocial, so as not to dilute the issue of sex hierarchy in research? This question is a reason for the development of the *gendered* approach in research ethics.

How can their coexistence in biological research be reconsidered? The most difficult question is knowing how biomedical research could epistemologically take into consideration the growing polysemy of the *gender* concept and on what criteria it will have to determine its limits with other normative institutions?

Indeed, how can we maintain a difference between the biologically determined sexes, without hierarchy or discrimination? The recognition of this difference is part of the new civil rights of some European democracies, because sexual identity is now a matter of subjective law.

It is about ensuring that the term *gender* does not replace the categorization of sex but does not eliminate it either through the concept of *gender medicine which aimed to correct the exclusion of women from research protocols*[7], the relevance of sex-differentiated health markers. In other words, the concept of *gender* must make it possible at the very least to replace hierarchized discrimination with differentiating categorization, and not to espouse either school of thought in the polysemic concept of *gender*.

It appears evident that the sole use of the term *gender* in scientific discourse causes problems in terms of reference points and epistemological signification. It challenges above all the obviousness of the hierarchy, which is useful but insufficient if not supported by means of considering – in public health and in medicine – the categories of man, woman, feminine, masculine, as cognitive categories, non-equivalent but equal in law, as the universalism of the access to healthcare for agents whose capacities are limited by their belonging to or their recognition in a particular gendered group.

Gender and health: the recognition of *gendered medicine*?

7. www.GenderMedJournal.com

The field of *gendered medicine* is recent, having been in existence for some twenty years. It aims to offer healthcare targeted according to biological sex, and also from a *gender* perspective[8]. It aims, ideally, to incorporate recognized health and disease criteria in clinical research. This highly prominent innovative field encompasses scientific literature of multiple disciplines, from reproduction and neuroscience to psychiatry, adopting a differentialist view of biological determinism from a *gender* perspective.

It must first of all be emphasized that *gender and health* research receives little university funding and is generally limited to the social sciences. The recent document produced by Norway indicates the need to change this point of view[9].

And yet it appears extremely important to recognize the impact of *gender representations* on clinical research as a whole, and especially on the research themes funded or excluded from research funding, and therefore to reveal discrimination in terms of *gender* topics:

- Assisted reproductive technology. Research on stem cells has generally ignored the extremely important research conducted by various feminist schools of thought in bioethics and biolaw on these issues. It is therefore not about innovating but about translating and adapting to the medical research context the issues derived from the social sciences and which do not always share the same word play or toolboxes. This produces therefore, despite itself, semantic filters that can have discriminatory effects.
- This is precisely the role of the *gender* concept to be attentive to this discrimination and respond to it from the viewpoints of healthcare distributive justice or access to research participation.

Gendered medicine is a relatively new term, highly developed in Germany, the USA and Northern Europe, but much less so in France and the Latin countries, for ideological reasons and a masculinist research bias on what represents a scientifically valid subject of knowledge.

A change has recently taken place, as a result of multicenter research and its globalization. This globalization raises new issues related to *gender* in context, with it being difficult for the concept of *gender* to permeate traditional patriarchal societies founded on the hierarchy of the sexes and predetermined social roles. This challenge proved to be substantial during the Cairo conference[10].

8. Inneke Klinge et Claudia Wiseman, *Sex and Gender in Biomedicine*, University of Gottingen, Akron Press, 2012.
9. Research Council in Norway, *Gender Balance and Gender Perspectives in Research and Innovations*, 2013.
10. Cairo conference, 1984.

Institutionally, the European Commission promotes the *gender* perspective in its programs, which poses problems to researchers often content to note the number of female researchers in their team or – to meet requirements – ensure that their work constitutes minimal risk to women, their fetuses or any other vulnerable category, that they undertake not pursue research on embryos, and thereby feel exonerated from the issue of *gender* and health research.

Yet, research policies establish *gender* equality as a criterion of scientific excellence in the 2020 project[11], for the same reasons.

In addition, personalized medicine which appears in Horizon 2020 will not be able to elude it, because the issue of *gender* discrimination, beyond its biological basis, is clearly presented as a construction of the self. This construction of the self forms part of the human rights of our liberal societies, as shown in Europe by the anthropological upheavals perceived surrounding legislation on assisted reproduction and its effects on filiation, as well as parenthood whose definitions have been disrupted by the multiple possibilities opened up by biotechnological advances. These techniques are often applied without consideration of the anthropological, social and symbolic impact of their biotechnical advances, another very sensitive domain involving the representation of *gender*.

The institutionalization of the *gender* perspective and its deviations

The involvement of *gender studies* with the biomedical sciences started with the women's health movement and the feminist critique of the sciences in the 1980s.

One cult reference is the book *Alice Through the Microscope*[12], which reveals the stereotypes conveyed through patriarchal science and medicine which operate according to implicit *gender* stereotypes. Female biologists such as Lynda Birke and Anne Fausto-Sterling[13] developed, from their experiments, a critical approach to biomedicine by introducing questions of equality, which challenge the naive epistemology of a neutral science because it would be objective and true.

11. Londa Schiebinger, *Has Feminism Changed Science ?*, 1999 : « Historical examples show how gender can become a silent organizer of scientific theories and practices, setting priorities and determining outcomes ».
12. Eds Lynda Birke, Wendy Faulkner, Sandy Best, Deirdre Janson-Smith, Kathy Overfield, *Alice Through the Microscope - The Power of Science Over Women's Lives*, Virago (1980).
13. Anne Fausto-Sterling, *Sex/Gender, Biology in a Social World*, op cit.

The critical *gender* perspective allows biological determinism to be rethought as separate from a historical destiny of female social roles. Although it remains for the moment a biological and universal fact that only women can give life, this should not affect the social choices regarding who cares for the child, an argument upheld by Londa Schiebinger in *Has Feminism Changed Science?* (op. cit). We must accept the fact that the *gender* perspective cannot overlook the history of feminism and its multiple schools of thought.

These thoughts led to considering changes in research methodology – above all in the northern European countries, with France lagging behind in this area.

As for OPHRYS (Women's Health Research), at the NIH, it fought for changes in the standard practices according to which women used to be excluded as research subjects due to their vulnerability but are now included without discrimination based on the principle of equal access to healthcare.

The same argument applies to research on children, or any socially vulnerable group, which had the collateral effect of not offering women the benefits of research targeting their pathologies or perceptions of illness. These regulations have affected the use of sexist metaphors in scientific language, condemning its pseudoneutrality or objectivity.

Research into the use of metaphors and analogies in scientific discourse has shown that even when we are unaware of it, *gender* plays a non-negligible role in researcher perceptions and intentions, and that it must be made more explicit to avoid bias.
This was behind the creation of the journal *Gender Medicine*[14], which gathers reports from all academic disciplines that address the issue of gender.

Mention must also be made of the *International Society of Gender in Medicine (IGM)* and the *Berlin Institute of Gender in Medicine*, which are also devoted to these issues.

Taking *gender* into account in medical research and practices therefore constitutes an innovation in the field of biomedical research and in its ethical and social aspects. It enables a more specific approach to personalized medicine, by re-centering concerns around the gendered subject and their biographical self-perception.

14. *Gender Medicine* ceased publication in 2005.

Gendered medicine therefore plays a role of critical distance in the face of the normative and populationist approaches to public healthcare.

The question of *gender* equality also invites questions of distributive justice in access to healthcare beyond the difference of *gender* in terms of *class* and *race*, of which the researchers must be made aware.

The *gender* perspective aims to reinforce antidiscrimination policies and differentiate between biological sex as biological fact, which cuts across cultural differences, and the choices of *gender* values as social construct of roles or relationships, and of the values associated with this choice of belonging.

The degrading metaphors representing a woman's stages of life – menstruation, pregnancy and menopause – are legion and have not helped to promoting femininity or women's performances or physiological capacities.

The impact of *gender* roles at individual level

A study on *gender* and coronary heart disease in the 1990s had shown, at a time when sex differences beyond reproduction were being acknowledged, that coronary heart disease is one of the leading pathologies where sex and *gender* aspects in research have had a certain impact.

This conceptual distinction has no reality in the life of female patients, for whom there is a continuous interaction between sex and *gender*; it therefore concerns a level of education that enables self-awareness as not being linked to mere biological determinism, but as also being an agent of one's health.

In addition, *gender* roles are not fixed. They can change throughout an individual's existence, and as such evade the standard measurement tools of Evidence-Based Medicine and its methodological presuppositions.

The role of European institutions in disseminating the *gender* concept

It was only in the year 2000 that these issues were given visibility in mainstream research. This was the year in which the European Commission for example launched the Gender Impact Assessment Studies, based on the principle of equality between the sexes, which responded most approximatively to the results of the reflection on the impact of gender.
The studies were conducted by seven research teams which examined women's participation in research, analyzing how research might affect women and men in terms of their differences, whether perceived or real.

The term *gender* being understood by the European Commission in biomedical research as taking into consideration both sex differences and the effects of *gender*. This study had a certain impact because it became a major dimension of qualitative research.

On pages 4-5 of the *FP6 Work Program*[15] *for Life Sciences, Genomics and Biotechnology for Health* it is stated:

"Sex and gender aspects in research have a particular relevance to this theme as risk factors, biological mechanisms, causes, clinical manifestation, consequences and treatment of diseases and disorders often differ between men and women. Therefore all activities within the thematic priority must take the possibility of such differences into account in their research protocol, methodologies and analysis of results".

This program analyzed how organizations such as Inserm or the Karolinska Institute had or had not themselves developed these aspects in the regulation and evaluation of their own qualitative research.

Gender medicine was considered back then as an innovative view of biomedical research, but which risked crystallizing a definition of *gender* rather than considering that the approach had a critical virtue towards the mainstream universalist methodologies.

Paradoxically, we maybe need to dissemble and re-assemble the link between *gender* and sex in medicine as one that is plastic and not a rigid epistemological separation producing new stereotypes. Indeed, the aim of the *gender* concept is to give critical capacities to the scientific approach by rendering it sensitive to the issues of the values that it produces, showing that a

15 Program FP6, European Commission.

scientific concept of *gender* which would replace the term sex would only confirm the scientistic approach concerning the naturalism of biological sex.

Above all it is about raising researcher awareness of the issue of *gender*, while giving them the tools to observe that it has a real and potentially quantifiable effect on the health of women and men, to evaluate risk factors taking differences into account, without giving them a hierarchy, and not to make *gender* an alternative norm to biological determinism. Our capacity for learning throughout existence cannot be content with fixist dualism. *Gender* therefore presents itself as a critical tool enabling the sciences to enter into dialog with the ethical and epistemological issues raised by the application of biomedical techniques in the social domain.

Mylène Baum

Appendix 2: Sex and gender in neuroscientific research. What does cerebral imaging tell us about the sex of the brain?

In the 19th century, skull shape and brain size were used to justify the hierarchy between the sexes. Men, supposedly more intelligent, were thought to be naturally endowed with larger brains than women. Some physicians, notably Paul Broca, fed into these hypotheses through comparative measurements of brains that had been carefully selected. Despite other contemporary studies clearly showing that brain size was not the cause of intelligence, the ideology of the conservative bourgeoisie prevailed over scientific rigor (Gould 1997).

These days, the neurosciences are on the front line in satisfying our need to explain human behaviors, with MRI techniques representing a major advance in brain exploration. Considerable progress has been made in the knowledge of sensory, motor and cognitive functions. Their applications in human clinical medicine have been immense. But the fields of investigation covered by brain imaging do not end there. Some researchers use MRI to study moral judgment, empathy, aggressiveness, sexual preference, etc. (Illes 2005, Vidal 2010), in which one approach is to compare the brains of men and women. When differences between male and female subjects show up on the MRI, it is not rare for researchers to interpret them as explaining differences between the sexes in aptitude and social roles. As such, in an article published in December 2013 in the prestigious US journal *Proceedings of the National Academy of Sciences*, researchers from Philadelphia concluded from their MRI analysis of neural connections that *"male brains are structured to facilitate connectivity between perception and coordinated action, whereas female brains are designed to facilitate communication between analytical and intuitive processing modes"* (Ingalhalikar 2013). This was in addition to the study leader announcing to the press that their study backs up stereotypes of masculine and feminine behaviors… The absence of critical discussion of their findings in relation to the international literature (with current knowledge of the human brain not making it possible to establish causal links between brain anatomy and such vague and general behaviors) and above all the failure to consider brain plasticity in the subject's history and brain construction when interpreting the images, shows that the interference between ideology and scientific practice continues to prevail in the 21st century (Fillod 2014; Vidal 2005, 2012).

While this position is certainly nothing new, brain images are now with MRI being increasingly instrumentalized to justify gender differences through biological determinism. Yet knowledge of the brain's capacities for plasticity continues to increase. Nothing is ever set in stone or

programmed at birth (May 2011; Vidal 2009). Brain plasticity is a key concept in understanding how our identities as men and women are constructed (Fausto-Sterling 2000).

Brain development and plasticity

At birth, the brain of an infant contains one hundred billion neurons, which cease to multiply at that point. But the brain is far from being fully formed because the synapses (the connections between the neurons) are only just starting to take shape: only 10% of them are present at birth. This means that the majority of the synapses start to be made once the baby begins to interact with the outside world (Fausto-Sterling 2000, 2012).

In the eminently complex processes of brain development, interaction with the outside world plays a major role in building the neural networks (Kahn 2007, Rose 2006). The visual system is a striking illustration of this. The vision of a child is gradually constructed from birth to 5 years of age. Lack of eye stimulation by light in young people with cataracts can lead to blindness (Angeles-Han 2012). The early experience of light is an essential prerequisite for establishing good connectivity of the neurons that transmit visual information from the retina to the cerebral cortex. Likewise, all kinds of environmental stimuli guide the establishment of neural circuits used to fulfill key functions, whether sensory, motor of cognitive. In this dynamic, brain matter structuring and neural network formation are the intimate reflection of personal experience. It is at this point we understand that we cannot separate the innate from the acquired: while the innate provides the capacity for neuron wiring, the acquired enables its effective realization.

The cerebral imaging of learning

Thanks to brain MRI, we can now “see” the brain change according to learning and experience (May 2011; Vidal 2009). In musicians for example, we have been able to demonstrate changes to the cerebral cortex related to the intensive practice of their instrument since childhood (Gaser 2003). In experiments performed using professional pianists having begun playing the piano at 6 years of age, MRI revealed thickening of the cerebral cortex in the regions specialized in hand motricity and hearing. A phenomenon due to the production of additional connections between the neurons. One fundamental aspect of this study is that the brain modifications are proportional to the time spent practicing piano in early childhood. This finding shows the major impact of learning on brain construction in children whose capacities for brain plasticity are particularly marked.

Brain plasticity is also at work during adulthood. An MRI study in taxi drivers showed that the brain regions controlling the representation of space are more developed, and in proportion to the number of years spent driving taxis (Maguire 2000). Another eloquent example of brain plasticity was observed in subjects learning to juggle with three balls (Draganski 2006). After three months of practice, MRI showed thickening of the regions specialized in vision and the coordination of hand and arm movements. And if the training stops, the previously thickened regions shrink. As such, brain plasticity is not only reflected by the increased mobilization of the cortical regions to fulfill a new function, but also by the ability to reverse the process when the function is no longer needed.

Brain development and gender identity

The capacities of brain plasticity shed new light on the processes that help shape our gender identities (Fausto-Sterling 2000; Vidal 2005, 2012a). At birth, the baby is not aware of its sex, but will gradually become so as its brain capacities develop. It is only from two and a half years of age that the child becomes able to identifying itself as belonging to one of the two sexes (Le Maner-Idrissi, 1997). Yet since birth, the child develops in a gendered environment, with its bedroom, toys and clothing differing according to sex. Many psychology experiments have shown that adults, often unconsciously, do not have the same ways of behaving with babies (Pomerleau 1990, De Mendonca, 2011). It is interaction with the familial, social and cultural environment that orients tastes and aptitudes and helps shape personality traits in accordance with societal models of femininity or masculinity (Fausto-Sterling 2012, Vidal 2005, 2012c). However, not all children adopt this system of gender norms, and not all of the time. Moreover, the game is far from being over during childhood. At all ages of life, brain plasticity makes it possible to change habits, acquire new talents and choose different life directions (May 2011).That is why our brains are all different, irrespective of sex. There are seven billion people on earth, all with different brains and personalities.

Do girls have a natural gift for languages?

Linguistic aptitude is often presented as being more developed in women than in men, considered to be facilitated by a predisposition of their brain. MRI experiments performed in 1995 had shown that in some language tests the women used both cerebral hemispheres and the men one. These observations, based on a sample of a few dozen people, were not confirmed in later studies. An overview of the MRI experiments published between 1995 and 2009, which together included 2,000 subjects, does not show any statistically significant differences between the sexes in the distribution of language regions (Kaiser, 2009). This is

explained by the fact that the language regions vary considerably in their location from one individual to another, with this outweighing any potential variability between the sexes. It can be noted that when a large number of individuals is analyzed, the differences that might have been observed with a small number of subjects go largely undetected. However, it is the studies that show differences that are cited the most often! A meta-analysis of MRI experiments on cognitive function shows that out of 16,000 articles published from 1992 to 2008, only 2.6% reported differences between the sexes (Kaiser, 2009)! And there is nothing to say that the latter are not due to differences in experience, which brings us back to the thorny issue of bias in scientific publications. It is more media-friendly to publish an article entitled: “Difference between the sexes in memory capacities” than to publish, following an experiment revealing no differences: “MRI study of memory capacity”.

Are boys better at math?

In January 2005, Laurence Summers, the then President of Harvard University, caused a scandal in academic, feminist and scientific circles when he declared that the small number of women in scientific disciplines was due to their innate inability to succeed in those fields! It drew the attention of the mainstream press, which published the conflicting opinions (see Time Magazine, March 2005). Indeed, some researchers stepped in to defend Summers against the feminists. One of them, Steven Pinker, Harvard professor and author of successful works on evolutionary psychology, maintained that the differences in cerebral aptitude between the sexes explained women’s poorer performances in math (Pinker, 2005). Contesting it would therefore pertain to obscurantism, poor knowledge of science and partisan ideological positions, such as those attributed to feminists...

The scientific reality shows that the so-called inferiority of girls in mathematical reasoning has no neurobiological basis (Spelke, 2005; Vidal 2012b). Many studies have analyzed in children the development of the cognitive systems which make it possible to master elementary operations in math (Spelke, 2005). The sense for numbers and the perception of geometric relationships appear from 6 months of age. Towards 2 years of age, children distinguish the singular from the plural and learn to count. They use geometric environmental markers to orient themselves in space and find their way. Then, between 4 and 5 years of age, the children begin to combine the various representation systems by using language to handle numbers and geometric data. These observations all agree in showing that the aptitudes for mathematical reasoning develop in the same way in both sexes.

An MRI study published in 2011 followed the effects of one year of teaching on performance in arithmetic and brain activity in young elementary school pupils (Rosenberg-Lee 2011). One mixed group of 2nd-grade children between 7 and 8 years of age were compared with another mixed group, this time of 3rd-grade children between 8 and 9 years of age. Once the child was settled in the MRI machine, the experiment used a screen to show additions and subtractions in Arabic numerals. The child had to say whether the calculation was true or false while their brain activity was analyzed. The experiment showed that in comparison with the 2nd-grade pupils, the 3rd-grade pupils performed better in arithmetic and had increased brain activity in the regions specialized in handling and visualizing numbers. In addition, the connections of these regions with those implicated in memory and attention were more developed. These results were the same for both girls and boys. This experiment illustrates the impact of academic learning on brain construction and the establishment of neural networks that underlie the cognitive functions in math. Early childhood is far from being decisive in terms of intellectual development and aptitude in math. Neither sex can claim to be better at math than the other.

In adults, study of the brains of female and male mathematicians led to the same conclusions (Aydin, 2007). MRI showed thickening of the cerebral cortex in the parietal and frontal regions which come into play in the handling of numbers and visual and spatial representation. In addition, such thickening increases along with professional experience in mathematics, in both sexes. It is experience that counts!

Do men have superior moral judgment?

The capacity of the sexes for moral judgment was compared in a study using MRI (Harenski, 2009). The brains of 14 male and female subjects were analyzed while they viewed photos representing scenes of various degrees of moral violation: crime, physical violence, verbal violence, disputes. The MRI images showed brain differences between the sexes in assessing the degree of morality of the various situations. The regions implicated in emotional processes were activated more in women whereas those implicated in cognition were activated more in men. From this the researchers concluded that MRI confirms the sex divide in terms of moral judgment, with women driven by care and empathy, and men by rational evaluation of the rules of justice. Men are therefore said to be endowed with a more reliable moral sense than women, with evidence to back it up!

This example of sexist deviation in interpreting an MRI experiment raises the issue of scientific authority in the face of an unenlightened public (Illes, 2006; Racine 2010). How can we evaluate the validity of the arguments put forward when we are not specialists? In order to

avoid abusive interpretations, it is necessary to consider the methods and procedures used for MRI:

- The conditions of the experiment intended to test moral judgment (or any other personality traits) have nothing to do with real life. All the subject in the MRI machine does is look at photos. They must remain strictly immobile for a certain length of time, without speaking or blinking, so as not to disrupt the data acquisition.
- The majority of MRI experiments are performed on small numbers of subjects, generally between 10 and 40, which limits the statistical significance of the results and their extrapolation.
- Finally, it is important to bear in mind that MRI only gives a snapshot of the state of a person's brain at any given time. It is now accepted that the brain is a "plastic" organ whose structure and function change with learning and experience throughout life. When an MRI scan shows differences between the sexes, it does not mean that these differences have been engraved in the brain since birth, or that they will persist. Brain imaging does not provide information on an individual's personal history, motivations or future. Claiming that MRI allows us to read thoughts is a fantasy.

Conclusion

The revelation of brain plasticity represents an unprecedented step forward, challenging of the fixist theories of brain function. The concept of brain plasticity provides a fundamental neurobiological insight into the processes of social and cultural construction of our gender identities. It also reinforces and enriches human science research on gender (Fausto-Sterling, 2012; Vidal 2005, 2012c).

Yet despite all this evidence, the idea of genetic determinism of the cognitive and behavioral differences between the sexes still holds strong (Jordan-Young, 2010, Fillod 2012). A vision in line with the evolutionary psychology school of thought which claims that the mental functioning of *Homo sapiens* is the result of genetic selection since prehistoric times. Evolution is thought to have forged the brains of women and men differently for improved adaptation to the environment and to societal life. This theory, inspired by sociobiology, finds increasing resonance in the English-speaking countries (Pinker 2005). It claims to provide an explanatory framework for the differences of social positions between the sexes and also for personality traits such as sexual orientation, aggressiveness, empathy, maternal instinct, drug use, mental disorders, etc.

The bio-determinist ideology that founds evolutionary psychology has as a corollary a reductionist conception of the human person that reduces the psyche to the brain, the brain to

molecules and the molecules to genes. With the current upsurge in the neurosciences, the brain has become the metaphor of reference for describing the human being in their individuality, subjectivity, actions and private and social lives (Illes, 2005, 2006, Ortega 2007; Choudhury, 2009; Racine, 2010). Contemporary “neurosexism” with its pseudoscientific airs is encountering great success in conservative circles with its justification of gender prejudice and inequality (Fine, 2010). Critical analysis is needed, especially as the political scope of such discourse can have far-reaching consequences. Because beyond that the idea continues to prevail that the social order is the reflection of a biological order. In this context, it is crucial that biologists join forces with the human sciences to forge and disseminate high-quality scientific knowledge and thus help build a culture of equality between women and men.

Catherine Vidal

Bibliography

- ANGELES-HAN, Sun and Sue YEH (2012). "Prevention and management of cataracts in children with juvenile idiopathic arthritis-associated uveitis", *Curr Rheumatol Rep*. 141: 42-9.
- AYDIN, Kubilay (2007). "Increased gray matter density in the parietal cortex of mathematicians." *Am J Neuroradiol, 28 : 1859–64.*
- CHOUDHURY, Suparna, Saskia NAGEL et Jan SLABY (2009). « Critical neuroscience: Linking neuroscience and society through critical practice », *Biosocieties, 4 : 61-77.*
- DE MENDONÇA, Julia, Louise COSSETTE, Francis STRAYER et France GRAVEL (2011). "Mother-child ans father-child interactional synchrony in dyadic and triadic interactions" *Sex Roles, 64 : 132-142*.
- DRAGANSKI, Bogdan, Christian GASER ,Volker BUSCH, Gerhard SCHUIERER, Ulrich BOGDAHN et Arne MAY (2004). "Changes in grey matter induced by training" *Nature, 427 : 311-312.*
- FAUSTO-STERLING, Anne (2000). *Sexing the Body. Gender Politics and the Construction of Sexuality,* NewYork, Basic Books.
- FAUSTO-STERLING, Anne, Cynthia GARCIA and Meghan LAMARRE (2012). “Sexing the baby: Part 1. What do we really know about sex differentiation in the first three years of life?,” *Social Science & Medecine*, 74 : 1684-92.
- FILLOD, Odile 2012 « Observatoire critique de la vulgarisation », http://allodoxia.blog.lemonde.fr/
- FILLOD, Odile (2014). *Le connectome et la circulation circulaire des stéréotypes de genre* http://allodoxia.blog.lemonde.fr/
- FINE, Cordelia (2010). *Delusions of gender* , Icon Books Ltd.
- GASER, Christian et Gottfried SCHLAUG (2003). "Brain structures differ between musicians and non-musicians" *J. Neuroscience, 23 : 9240-9245.*
- GOULD, Stephen.Jay (1997). *La mal-mesure de l'homme*, Odile Jacob, nouvelle édition.
- HARENSKI, Carla et Kent KIEHL (2008). « Gender differences in neural mechanisms underlying moral sensitivity », *SCAN, 3 : 313–321.*
- ILLES Judy et Eric RACINE (2005). "Imaging or imagining? A neuroethics challenge informed by genetics", *American Journal of Bioethics, 5: 1-14.*
- ILLES, Judy, Raymond DE VRIES, Mildred CHO et Pam SCHRAEDLEY-DESMOND (2006). "ELSI priorities for brain imaging", *American Journal of Bioethics, 6 : 24-31.*
- JORDAN-YOUNG, Rebecca (2010). *Brain Storm: The Flaws in the Science of Sex Differences*, Cambridge, Harvard University Press.
- KAHN, Axel (2007). *L'homme, ce roseau pensant*, Paris, Odile Jacob.

- KAISER Anelis *et al*. (2009). "On sex/gender related similarities and differences in fMRI language research", *Brain Research Reviews, 61: 49-59.*
- LE MANER-IDRISSI, Gaid (1997). *L'identité sexuée*, Paris, Dunod.
- MAGUIRE, Eleonor, A., David GADIAN et Christopher FRITH (2000). "Navigation-related structural change in the hippocampi of taxi drivers", *Proc Natl Acad Sci U S A, 97 : 4398- 4403.*
-MAY, Anne (2011). “Experience-dependent structural plasticity in the adult human brain,” *Trends in Cognitive Sciences*, 15: 475-82.
- ORTEGA, Francisco et Fernando VIDAL (2007). « Mapping the cerebral subject in contemporary culture », *RECIIS, 1 : 255-259.*
- PINKER, Steven (2005). « Il y a des différences entre les sexes »*, Courrier international*, 747, 24 février.
- POMERLEAU, Andree, Daniel BOLDUC, Gerard MALCUIT et Louise COSSETTE (1990). "Pink or blue : environmental gender stereotypes in the first two years of life, *Sex Roles, 22: 359-367.*
- RACINE, Eric, Sarah WALDMAN, Jarett ROSENBERG et Judy ILLES (2010). « Contemporary neuroscience in the media », *Social Science & Medicine*, 71 : 725-733.
- ROSE, Steven (2006). *Lifelines : Biology, freedom, determinism*, New York: Vintage Books.
- ROSENBERG-LEE, Miriam, Maria BARTH et Vinod MENON (2011). "What difference does a year of schooling make? Maturation of brain response and connectivity between 2nd and 3rd grades during arithmetic problem solving", *NeuroImage 57: 796–808.*
- SPELKE, Elisabeth (2005). *"*Sex differences in intrinsic aptitudes for mathematics and science ? a critical review", *American Psychologist*, 60 : 950-958.
- VIDAL, Catherine et Dorothée BENOIT-BROWAEYS (2005). *Cerveau, Sexe et Pouvoir*, Paris, Belin.
- VIDAL, Catherine (2009*). Le cerveau évolue-t-il au cours de la vie ?",* Paris, Le Pommier.
- VIDAL, Catherine (2010). « Vers une neuro-justice? *»,* *Paris, Revue Ravages*, 4 : 17-21.
- VIDAL, Catherine (2012a). *Hommes, femmes : avons-nous le même cerveau ?* , Paris, Le Pommier.
- VIDAL, Catherine (2012b*). Les filles ont-elles un cerveau fait pour les maths* ? *,* Paris, Le Pommier.
- VIDAL, Catherine (2012C). "The Sexed Brain: Between Science and Ideology", *Neuroethics, 5: 295-303.*