Biased Data in Academia: A Virtue Ethics Analysis of Medical Physiology Literature

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Georgia Mackenzie

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: _____  _____

Approved: _____*signed electronically*_____ Date _____5/5/2020_____
Benjamin J. Laugelli, Assistant Professor, Department of Engineering and Society

Introduction

Academic textbooks have long since been the foundation of physiological knowledge for medical and biomedical engineering students alike. Author John E. Hall has written many iterations of *Textbook of medical physiology*, which is the backbone for many courses at the University of Virginia, such as Physiology II in the department of biomedical engineering. Despite this textbook being a fundamental source of knowledge on human anatomy and physiology, it fails to provide students with unbiased data and statistics. In recent years, many scholars have recognized the presence of gender-bias and sexism in medical academic curricula and have examined the effects of this information on the implicit biases of students. What this method fails to question though, is the moral valency of authors' actions in producing and distributing academic works containing gendered data. If data of this nature continues to be distributed in textbooks, students' implicit biases fostered at the undergraduate and graduate level will continue to negatively impact patient's health and wellbeing (Mackey & Diercks, 2018).

I will investigate examples of gendered data in the 13th edition of the *Textbook of medical physiology* through the ethical framework of virtue ethics to explain that author John E. Hall is morally responsible for the distribution of biased information. I will do this by examining the cardinal virtue of justice and its relation to equity, and the responsibility of academic faculty to uphold this virtue (Shiner, 1994). Through the lens of virtue ethics, I will assess three forms of information within the *Textbook of medical physiology* for the presence of bias: qualitative data, quantitative data, and anatomical depictions.

Background

First published in 1956, the *Textbook of medical physiology* has long since served as a source of accurate and trusted information for undergraduate and graduate students (Hall, 2016). The textbook was initially authored solely by Arthur C. Guyton, until the 9th edition, when John E. Hall became a co-author. From the 11th edition onward, the text was authored by Hall alone. Textbooks of this nature aid in reinforcing key concepts taught in clinics and classrooms, and are often given as supplementary reading material to lectures. For example, the course Physiology II, or BME 2102 at UVA uses this textbook, along with the 2nd edition of *Medical Physiology* by Boron and Boulpaep to aid in providing further detail to the lessons taught in class. With this in mind, biomedical engineers as well as students pursuing medicine are two major groups of the textbook's reader population.

Literature Review

Several scholarly sources have investigated the impact of gender-biased data on the gender attitudes and perceptions of both medical and biomedical engineering students. Gendered data is a result of both sexes not being equally represented in the results of academic research, such as clinical trials. The following analyses focus on the impact of gender-biased data on implicit biases, but not on how these convictions exhibit a lapse in the use of virtue ethics in creating honest and reliable academic textbooks.

In her book *Invisible women: Data bias in a world designed for men*, author Caroline Criado Perez explores the implications of gendered data on societal norms, and how the use of biased data in design can often have life-threatening consequences for women (Criado Perez, 2019). While biased information affects physiological data, Perez also explains that the design of everyday artifacts, such as seatbelts are done so under the assumption that the average male body

is the norm, leading to designs that perfectly fit the dimensions of said norm, but leave other populations to compromise. Perez argues that using the male body as the default template for the human body is an artifact from ancient Greece, where Aristotle concluded that the female body is a "mutilated male body." The author confirms these biases through discussing FDA-approved clinical trials in which the inclusion of male and female subjects was not equal. An example of the impacts of such biases can be seen in Perez's explanation of Dr Tami Martino's work on circadian rhythm and heart attacks. The director of cardiovascular investigations at the Ontario Veterinary College found that patients had a greater chance of survival if they were to experience a heart attack in the day time. Another research group counteracted this claim though when they found that a greater neutrophil response due to daytime heart attacks actually led to a worse chance of survival. It was later noted that the study conducted by Dr Martino used only male mice, whereas the secondary study used male *and* female mice.

Perez also states that the lack of sex-specific data leads to the lack of sex-specific information in medical textbooks, which is one explanation for the lapse of gender-specific data in Hall's *Textbook of medical physiology*. While there may be a lack of sex-specific data, existence of *Invisible women* alone proves awareness of the subject. This source is vital to the argument of gender bias in medical textbooks, because it provides proof of the lapse in inclusion of female subjects in research relating to physiological disruptions, such as myocardial infarction, implantable medical devices, and medications.

Parker et. al explore the effect of anatomical images in textbooks on the implicit gender-bias in medical students (Parker et al., 2018). In the double-blind study, participants were randomly assigned either a biased or non-biased set of medical drawings. The treatment set consisted of females and males performing tasks that fit within their "gender roles," whereas the

control set contained images of internal organs and other anatomical components that did not depict a gender. Afterwards, the two groups were given online, timed tests in which they were asked to assign a term to the categories “Female or Reproductive Health” or “Male or Sports Health.” This practice was iterated several times, intermixing gender and medical terms within the categories. Implicit responses were defined as decisions that were recorded in 300 to 3000 milliseconds. The results of this study showed that viewing gender-biased imagery in medical textbooks had a statistically significant effect on implicit bias towards stereotypical gender roles. More specifically, viewing gender-biased imagery *increased* the subjects’ implicit bias in favor of gender norms. The study explains that as medical textbooks play a vital role in the education of medical students, implicit biases ingrained in physicians since medical school could impact patient health and care outcome.

The first source authored by Caroline Criado Perez confirms that there is, in fact, a distinct gap in health data between males and females, which can lead to the distribution of skewed data to physicians as well as the public. Parker et. al highlight one manifestation of biased-data, and how its use can lead to the continual reinforcement of implicit biases in the users. While it is necessary to describe the large-scale ramifications of using biased data, I will deploy the framework of virtue ethics to question the morality of medical textbook author John E. Hall in using biased data.

Conceptual Framework

Hall’s medical physiology textbook will first be addressed by examining examples of biased data within its pages, followed by discussion about what makes the data biased, and why. An ethical framework known as virtue ethics will be used to address the morality of the text

included. Virtue ethics, as described by Aristotle, focuses on the actions of the person in question (van de Poel & Royakkers, 2011). In this case, the "actions" being examined are those of Hall in writing the 13th edition of their medical physiology textbook. This ethical framework implores humans to lead a good life via the development and cultivation of moral virtues. Virtues are simply human qualities. This idea of "the good life," also known as *eudaimonia*, is a term used to describe the state of being a good person, and the happiness that follows. According to virtue ethics, virtues are not bestowed upon us at birth, but can instead be developed through deeds and actions. Each virtue can be defined as having an equilibrium point, where one is practicing the virtue in its ideal form. For example, the virtue of courage is balanced between cowardice and recklessness (van de Poel & Royakkers, 2011). The four key virtues, described by Plato, Aristotle, and Cicero are temperance, prudence, courage, and justice (Carr, 1988).

The cardinal virtue of justice balances in equilibrium between the concept of having too little, and having too much of one's share (Curzer, 1995). Justice can also be described as the middle ground between selflessness and selfishness: the equity that ensures that all people are on a level playing field. Aristotle describes equity as "justice which lies beyond the written law," and as a particular type of excellence (Shiner, 1994). The virtue of equity is a necessary subset of justice, and is used to resolve disparities between written law and societal standards. Biased data in general does not align with the virtues of justice or equity, as the data does not represent a population equally. Because of this, it can be concluded that individuals who support or are involved in the collection of biased data lack a complete understanding of the justice and equity in the academic sphere.

Through the lens of virtue ethics, I will question whether the information included in Hall's textbook can be deemed as just, according to the cardinal virtues laid out by Aristotle. I

will do this by comparing examples from the medical physiology text to multiple sources, to determine whether the data provided is unbiased. Through this, I will use virtue ethics to determine whether Hall can be held morally responsible for the inclusion of biased information.

Analysis

In medicine, virtue ethics is seen as the good practice that results from the morally inclined actions of a doctor (Kotzee et al., 2017). Similarly, in academia, authors are expected to be equipped with certain virtues in order provide students with meaningful experiences (Back et al., 2018). The author of *The Textbook of medical physiology*, 13th edition, exists in the intersect of these two worlds—medical academia. A vital role of these authors is to provide unbiased information to prospective doctors and biomedical engineers to help build their foundation in medicine. Women's health has often been the title for which obstetrics and gynecology is categorized under, instead of an independent category of health. Because of this, there is a historical deficit in research on women's health, and the effect of sex on physiological mechanisms. If there is not an equal amount of clinical data on pathophysiology, such as cardiac disorders, how can we expect data to be considered just? As explained by Parker et. al, though, the context of medical textbooks can have a significant effect on the implicit bias of readers. The attitudes of individuals can be categorized as either explicit (conscious), or implicit (unconscious) (Parker et al., 2018). Implicit responses are more likely to reveal discriminatory behavior, which lead to malpractice and unequal care for patients. Within this analysis, I will highlight three examples of biased/unjust data included in Hall's textbook, which are a direct result of the author's lack of the cardinal virtue of justice. These three examples will fall into one

of three categories that are often used to convey information in textbooks: quantitative data, qualitative data, and visual data (in the form of anatomical depictions).

Justice in Quantitative Data

Within the textbook, Hall misuses quantitative data to establish a preferential and biased norm. Data that is recorded numerically, or quantitative data, is used to address specific problems and conclude certain behaviors about a large population. In this way, it is imperative that collected data reflects an explicitly stated population of individuals, so as not to misguide a reader. The *Textbook of medical physiology* includes examples of the male body being considered the "norm." This implicit bias implies that the female body is then a deviation from this norm, which automatically creates an unequal perspective between male and female health data (Criado Perez, 2019). In 1974, the International Commission on Radiological Protection authored a book on the average biological measurements of a human, which they termed the "Reference Man" (1975). This standard of humanity is described as 20-30 years of age, weighing 70 kilograms, being Caucasian, and Western European or North American in his mannerisms. In the text, it is also mentioned that this concept should be extended to include such discrepancies (and not norms) as age and sex. Despite some sections containing female and male data, the only section of the book to contain specifically female data is in section IX, The Urogenital System. As seen in Figure 1, the impression of this reference guide on the human norm can still be found in medical textbooks

Table 73-1 Energy Expenditure During Different Types of Activity for a 70-Kilogram Man

Form of Activity	Calories per Hour
Sleeping	65
Awake lying still	77
Sitting at rest	100
Standing relaxed	105
Dressing and undressing	118
Typing rapidly	140
Walking slowly (2.6 miles per hour)	200
Carpentry, metalworking, industrial painting	240
Sawing wood	480
Swimming	500
Running (5.3 miles per hour)	570
Walking up stairs rapidly	1100

Extracted from data compiled by Professor M.S. Rose.

Figure 1. Data from Hall's Medical Physiology textbook on the calorie use of a 70-kilogram man.

today. Within Hall's chapter on energetics and metabolic rate, the average expenditure of calories was described in terms of a 70-kilogram man. This figure is the only form of information provided on caloric use for daily activities performed. I argue that the author could just have easily explained caloric use in terms of calories/pound/hour, yet instead, the 70-kilogram man is deployed. This does not align with the cardinal virtue of justice, or equity, as it enforces implicit biases of the 70-kilogram man being the basis of human norm, whereas all others are a deviation from norm. In these actions, the author did not consider their population of readers and instead reinforces biased ideas of who readers can expect their average patient to be (or who the readers themselves are).

One may argue that these biased views come from the concept of ignorance, or lack of knowledge. Also described as an unknown of the unknown, ignorance in a population is unintentional, yet extremely harmful in cultivating unbiased perceptions of the world (van de Poel & Royakkers, 2011). As professors and scholarly authors are entrusted to convey pertinent and meaningful data to their students, it also accurate to hold them responsible for cultivating unbiased viewpoints on scientific fact. This aligns with the FDA's key principles of scientific integrity, which includes "protecting the integrity of scientific data and ensuring its accurate presentation, including the underlying assumptions and uncertainties" ("FDA's Key Principles of Scientific Integrity," 2012). Governing bodies such as the FDA clearly see the importance of addressing underlying assumptions in data. It is therefore the moral responsibility of leaders in academic research (whether at the federal level or undergraduate level) to emulate the tenants of virtue ethics through the pursuit of unbiased data collection and distribution.

Justice in Qualitative Data

In conjunction with quantitative data, Hall uses patient symptoms to reinforce bias views of the patient experience. While accurate health data can be quantitative (as described in the previous section), it is equally important to consider observable, non-numerical data. In the world of medicine, this form of qualitative data is recorded in order to understand trends in illnesses across a population. One example of qualitative data is a patient's symptoms, which can be especially pertinent when validated as precursors for traumatic biological events. For example, it is well known that chest pain is a tell-tale sign of a heart attack, or coronary heart disease (CHD) (Criado Perez, 2019). It is also well known that cardiovascular disease (CVD) is the number one cause of death in both men and women, with CHD being the most common form of CVD (Woodward, 2019). On the symptoms of CHD, Hall states:

> a person who has a sudden, moderate heart attack might experience nothing more than cardiac pain and a few seconds of fainting. Shortly thereafter, with the aid of the sympathetic reflex compensations, the cardiac output may return to a level adequate to sustain the person if he or she remains quiet, although the pain might persist. (Hall, 2016)

This quote from Hall's chapter on cardiac failure explains the response of the sympathetic nervous system on the heart and surrounding vasculature in the wake of a heart attack. What is overlooked though, is that the symptom of chest pain, or cardiac pain, is common in men, but not women. In fact, women experience a range of symptoms that correlate with the onset of a cardiac event that are less likely for men to experience. Women are far more likely to experience fatigue, shortness of breath, and indigestion as warning signs of CHD (Dijkstra et al., 2008).

If sources of female cardiac symptoms can be found from 2008 (and before), it seems illogical that this edition of the Hall's textbook from 2016 defines characteristically male CHD symptoms as the norm. In one study, only about 30% of women with CHD reported chest

discomfort prior to their heart attack (DeVon & Ryan, 2005). This is yet another example of the representation of an unbiased subject through a biased lens, with the world's most fatal disease for both sexes described in terms of male symptoms. Through the lens of virtue ethics, it is Hall's moral obligation to provide readers with transparent and unbiased data. Including biased data about CHD not only enforces an implicit bias (or confirms an explicit bias) within readers. It also puts prospective patients at risk. By excluding key information about women's CHD symptoms, Hall perpetuates the distribution of unequal knowledge and data. In doing so, the author is failing to act justly, or think selflessly of the entire patient population, and instead focuses on the male population.

Justice in Graphics and Visuals

This third piece of evidence explains that Hall's bias towards the male norm is perpetuated through the inclusion of mostly male drawings. These drawings analyze the morality of author John E. Hall in his use of biased data encompasses the textbook as a whole, as opposed to a specific, singular quotation. Within the *Textbook of medical physiology*, Hall uses both anatomical drawings and graphical representations of data to help students visualize important concepts. It is clear that the means used to communicate a message can be just as vital as the message itself. Doctors and authors alike strive to present data in an honest way that avoids bias, as presenting data in a biased manner will lead to a biased reaction (van de Poel & Royakkers, 2011). Biased reactions do not only occur when information on a certain group is excluded, but more importantly, when there is no awareness of such exclusion. Because of this, readers will often not realize that the information they are being presented is biased, and will continue to trust sources as unbiased. Within the textbook, Hall includes anatomical depictions in order to contextualize physiological information. As the textbook primarily focuses on physiology, it

only includes 32 anatomical references (3 of which are related specifically to sex-based anatomy). The physiological mechanisms that are subject to these anatomical depictions are universal to the male and female sexes. Some examples include images of EKG functions, dermatome mapping, and respiratory passages. Because of this, one would expect the ratio of female to male anatomical depictions to be close to 1:1. This hypothesis resonates with the virtues of justice and equity, as an equal number of visualizations of the male and female body would correspond to an equal amount of time spent by the reader considering these sexes. What is surprising then, is that of the 29 images of gender-neutral physiology, 20 were depicted with a male body, while 9 were depicted with a female body. It is of note that every single anatomical image was also Caucasian, and that no other ethnicities were included any drawings. As validated by Parker et. al, imagery in medical textbooks affects the implicit biases of readers. I argue that including over double the amount of male imagery as female imagery will continually reinforce the "male norm" throughout the entire textbook, and opposes the standards of fairness and equity laid out by the cardinal virtue of justice. Because of this, the author lacks the capacity of virtue ethics necessary to properly convey unbiased information to a trusting student population.

Conclusion

Through a virtue ethics lens, I have argued the immorality of author John E. Hall in his use of biased information in the 13th edition of the *Textbook of medical physiology*. Through biased quantitative, qualitative, and pictorial data, Hall reinforces unjust and unfortunately traditional gender norms, which continue to affect the way that individuals interact with the world. Examples from the textbook along with academic literature on female physiology prove

that the virtue of justice cannot be cultivated in tandem with the use of biased data. This concept is vital for both students and professors to understand, as it is impossible to avoid the sway of implicit biases when also trusting biased information as the absolute truth.

While this concept is imperative for prospective doctors to appreciate, it is also a necessary topic for engineers. Author Caroline Perez explains that is necessary to begin designing our world around reality, as opposed to the male norm, to support female productivity as an equal asset to male productivity. While it is difficult to reflect on one's implicit biases, one can begin by using virtue ethics to determine what virtues they wish to emulate in their actions. Through virtue ethics, medical students and engineers alike can strive to act justly in the face of biased data, and begin to explore new methods of equitable data collection.

Word Count: 3483

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