

Neurophobia: A side effect of neuroanatomy education?

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Running title: Is neurophobia a side effect of education?

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ABSTRACT

Background: Neuroanatomy in the medical curriculum tends to be challenging for both lecturers and students. Students and lecturers perceive the relevance and importance of neuroanatomy differently. If not taught sufficiently, students develop a dislike or fear (termed neurophobia) for the subject. This fear prevents them from being receptive to the teaching and consequently applying the neuroanatomy knowledge in the clinical environment.

Aims: Information on the approach and perception of undergraduate neuroanatomy lecturers in South Africa regarding neuroanatomy in the medical curriculum is scarce and inconclusive. A study was undertaken to explore the attitudes and perceptions of neuroanatomy lecturers towards the relevance of neuroanatomy, as well as the teaching techniques and approach thereof, in the medical curriculum. In order to determine whether the lecturers' teaching approach and attitudes could be a contributing factor to neurophobia.

Methods: In a cross-sectional qualitative study, neuroanatomy lecturers from the nine South African medical schools were invited to complete an anonymous online questionnaire. Results were thematically analysed and grouped.

Results: Lecturing staff from seven of the medical schools participated in this study and included fourteen respondents. The respondents classified themselves mainly as either proficient (78.6%) or experts (15.8%) in their neuroanatomy teaching experience. All the respondents acknowledged that neuroanatomy is important in their students' medical training.

Conclusion: A lecturer's perceptions and attitude towards the subject or content, greatly affect the facilitation approaches and techniques used. This might have far-reaching consequences for students as it might impact on their attitude towards the content.

Key words: neuroanatomy education; undergraduate education; lecturers' perceptions; medical education, neurophobia

INTRODUCTION

Human anatomy is regarded as the cornerstone of any undergraduate medical degree [1]. As such, anatomy lecturers perceive human anatomy as extremely important in the teaching of medicine, irrespective of whether these lecturers are professional anatomists or clinicians [2-4]. Students, however, do not always share this viewpoint. Students and lecturers perceive the relevance and importance of anatomy - and in this case, neuroanatomy - within the medical curriculum, differently [5]. Evidence suggests that medical students do not necessarily initially comprehend the relevance and importance of neuroanatomy in their studies and medical careers and further lack the ability to integrate their neuroanatomy knowledge in the clinical environment [6, 7]. Students perceive neuroanatomy as extremely difficult to understand [8], to such an extent that some of them develop an intense dislike for the subject which eventually translates into a dreaded fear towards neurosciences - described as neurophobia [8, 9]. This fear impacts on the subconscious mind of the student, altering the hidden curriculum. The hidden curriculum has a great influence in medical education [10, 11] and includes the nonverbal messages that a student unconsciously accumulates from occurrences or experiences during his/her studies at an institution [11 – 13]. The lecturer plays an irrefutable role in shaping these messages, perceptions and fears and will therefore be the focus of this phase of the study.

In any method of education, the role of the lecturer is indisputable [13] and includes the didactical and pedagogical approach to the facilitation of learning, the ignition of curiosity, inspiration, as well as the engagement and support of the students to allow them to learn [14, 15] and to grow in their professional roles [16]. Therefore, all lecturers should have the following six basic core teaching competencies: content knowledge, student centeredness, professionalism, self-reflection and improvement, systems- based learning (in the form of

dedication), as well as communication skills [16 – 18]. These competencies should enable the lecturer to facilitate student interaction with the content.

The contextualization and explanations of the material, combined with student engagement, create the greatest impact on learning [14, 19] and alter the perceptions of the students towards a module or course [20, 21]. In essence, the teaching approach and method in which the lecturers facilitate a learning encounter, exchange information, the language used, intellectual honesty and the respect towards students and fellow staff members, all shape the hidden curriculum [13] and the students' perception of the topic or content under discussion. Therefore, the subconscious messages transmitted by the lecturer and received by the students can be regarded as a “side- effect of education” [13 p5] and can have either a positive or negative impact on the students' perception [11]. This places a huge responsibility on the shoulders of the lecturer.

Besides the lecturer's core teaching competencies [18], the lecturer's ontological assumptions, personal teaching philosophy, beliefs, values and viewpoints on teaching and learning must also be considered and consist of a combination of personal intentions and beliefs, prior experiences, as well situational circumstances [22, 23]. Five distinct perspectives of teaching and the reasons thereof have been identified in higher education and describe the way in which lecturers have different beliefs about their teaching, different didactical approaches, the justification thereof and various goals to accomplish it [17, 22, 24, 25]. Personal factors that influence these perspectives include the lecturer's emotions, personal experiences as a student, professional identity, and the perception of control over the content being taught and the teaching methods used. However, these perspectives can be influenced by the teaching environment, work engagement and -satisfaction of the lecturer [25], as well as the organizational culture of the institution's academic leadership and

management [23]. This is especially important in modules where students traditionally struggle to 'connect' with the content.

The consequences of an uninspiring and demotivated teaching approach to the facilitation of neuroanatomy conveys a message of the irrelevance or unimportance of the specialty within the medical curriculum. A negative connotation is created when inconsistencies occur between the formal structured curriculum and hidden curriculum, which in turn might contribute to the development of disinterest or fear (neurophobia) of the content [26].

Neurophobia is not a new phenomenon. Jozefowicz coined the term in 1994 when he identified and described this fear in undergraduate medical students [8, 9, 27]. Neurophobia is a global phenomenon reported in resource-rich countries such as the United States of America (USA) [28], Saudi Arabia [29], United Kingdom (UK) [30], Portugal [8] as well as in countries that tend to have limited resources such as India [31]. Factors contributing to, or fuelling this irrational fear towards neuroscience include poor and/or insufficient teaching methods [29, 32], limited time allocated within the medical curriculum for neuroscience [30] leading to cognitive overload, the complexity of neuroanatomy as a subject [6, 29, 32] and the lack of the students' theory-practice integration, which causes an inability to apply their basic science knowledge to the clinical environment [6, 33]. Although the lecturer does not have control over all of these factors, his/her perceptions and willingness to address some of the modifiable factors might greatly contribute to alleviating this fear amongst students.

By exploring the factors contributing to neurophobia, some elements of the hidden curriculum become evident and the influence and impact of the perspectives of the neuroanatomy lecturer, more crucial. A cross-sectional, quantitative study was therefore undertaken to explore the

attitudes and perceptions of neuroanatomy lecturers towards the relevance of neuroanatomy, and the teaching thereof, in the medical curriculum. The results reported in this study are part of a larger multi-phase, multi-method exploratory study into neuroanatomy within the South African medical curriculum where student and key-opinion leaders in the field of neurophobia are also surveyed.

METHODS

This study used a cross-sectional approach consisting of a quantitative data collection method with qualitative enhancement. A self-developed peer-validated questionnaire was sent to all the neuroanatomy teaching staff employed by the nine South African universities that offer medical degrees. The study was purposefully restricted to the South African context as the researcher wanted to compare local universities prior to looking at international trends and perspectives. Data was collected between May and November 2019.

The questionnaires were developed by the researchers and validated by independent academic consultants and statisticians. Some of the statements used in the questionnaire were adapted from previous studies by Patel and co-workers [2] and Moxham and co-workers [5].

RESPONDENTS

Only undergraduate neuroanatomy lecturing staff were invited to participate in this study. They were contacted via email and requested to complete an online/digital questionnaire anonymously. The confidentiality of the respondents was upheld by means of the Qualtrics™ online survey platform used for the questionnaire. This software was set to not capture any identifying information of the respondents such as email addresses.

The respondents were from the Departments of Anatomy at the following nine participating South African medical universities: University of Cape Town (UCT), University of Pretoria (UP), University of Witwatersrand (WITS), Sefako Makgatho Health Sciences University (SMU), University of the Free State (UFS), University of KwaZulu-Natal (UKZN), University of Stellenbosch (SUN), Walter Sisulu University (WSU) and the University of Limpopo (UL). Figure 1 illustrates a geographical overview of the respective institutions' location.

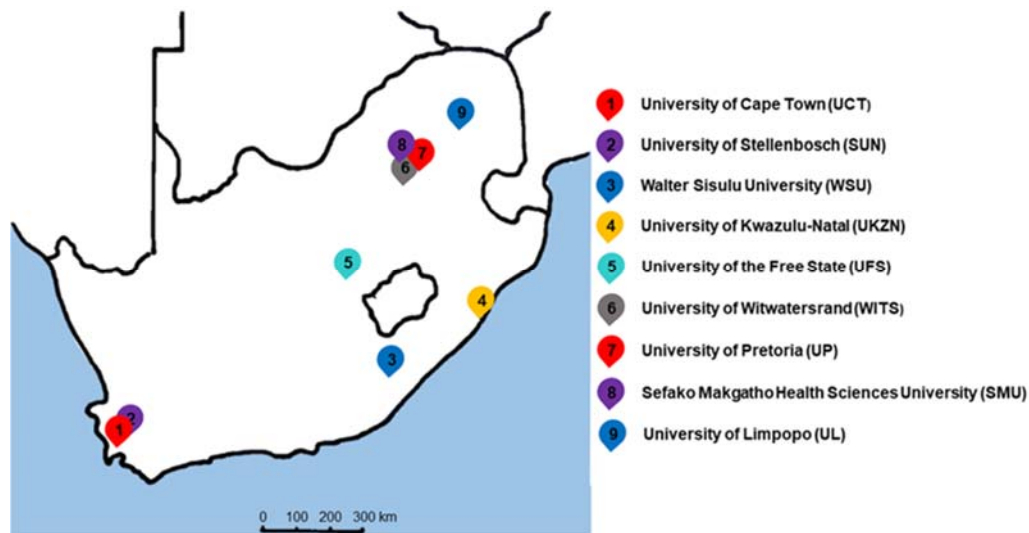


Figure 1: Map of South Africa indicating the location of the medical schools.

ETHICAL CONSIDERATIONS

Ethical approval for this study was obtained from the Research Ethics Committee of the University of Pretoria (Reference number: 587/2018). All other relevant approvals for the project were granted by the Anatomy Department and the Health Sciences Faculty, in which this project was conducted. Various legal documentation was further consulted. The documents contain clear guidelines regarding research involving human participants and included the Nuremberg Code [35], the Belmont Report [36] and the revised Declaration of

Helsinki [38]. The researcher diligently adhered to the prescribed ethical principles of beneficence, respect for persons and justice [36].

The initial email, containing the request for participation, an information leaflet, the details of the study and the rights of the respondent was sent to all the neuroanatomy lecturing staff at the various medical universities. Although this is a very small community and most of the lecturers are known to one another, the researcher focused on maintaining the anonymity of the respondents. All information received was automatically collated and depersonalized in the Qualtrics™ online survey software platform.

QUESTIONNAIRE DESCRIPTION

The design of the quantitative questionnaire included a four-point Likert scale-, matrix-, four-level item scale and a limited number of open-ended questions. A four-point Likert scale (forced Likert scale or ordinal scale) was intentionally chosen to prompt a response from the indifferent respondents by selecting their agreement/disagreement with the statements [38]. By removing the neutral options, this scale does not essentially distort the truth, but it remains a possibility and allow the respondent to give thought to their response before moving on to the next question [38]. This four-point scale eased the reporting of the results which reflected that the respondents either agreed or disagreed with the statements as their opinions are essential [38, 39]. The four-point Likert scale is widely used in market research and personal relations [38]. The questionnaire provided concise information regarding the current teaching, facilitation, and assessment practices for neuroanatomy at the South African medical schools. The questionnaire collected biographical information on the qualifications and teaching experiences of the lecturing staff, as well as their perceptions on the relevance of neuroanatomy within the medical curriculum. The open-ended questions added richness and

depth to the quantitative questions.

STATISTICAL ANALYSIS

Statistical analysis was done with the support of a biostatistician (who validated the questionnaire prior to distribution), using IBM SPSS (Statistics for Windows, Version 22.0). Analysis mainly contained descriptive statistics, which included frequencies, means and standard deviations. Although a Cronbach alpha test might have provided insight to the reliability of the questionnaire [40], the biostatistician did not deem it necessary at the time to assess the reliability of the Likert scale questions. Going forward, the reliability/internal consistency of questionnaires will be tested with the Cronbach alpha test.

RESULTS

The response rate of this study was 60.8%, with fourteen of the lecturing staff completing the online questionnaires. This is regarded as a high response rate since the 2019 average for online surveys is 29% and for email surveys, 30% [41]. The respondents included all the lecturers involved in teaching neuroanatomy to medical students at seven of the nine medical schools in South Africa. Two universities opted to not participate. Their information is summarized in Table 1.

The respondents selected their level of teaching experience from a provided drop- down list provided. The list of teaching experiences was adapted from the Dreyfus model of adult skills acquisition [42], and included beginner-, trainee-, proficient- or expert levels. The definitions provided, described a beginner as a lecturer at the beginning of his/her career, with no teaching experience. A trainee lecturer works with the guidance of an expert, while a proficient neuroanatomy lecturer is one with teaching experience. The expert lecturer is a content expert and highly skilled in the teaching of neuroanatomy.

Most of the neuroanatomy lecturing staff at the South African medical schools are women (71.4%) and professional anatomists (92.9%). Only one of the respondents was a clinician (7.1%). Most of the teaching staff had obtained additional training in medical education (57.1%) which included short courses, diplomas, and masters' degrees. The respondents classified themselves mainly as proficient (78.6%) and experts (15.8%).

Table 1: Information and characteristics of the respondents

	Respondents (n=14)
Age range	31 – 65 years
Mean age (SD)	50.1 years (SD 13.6)
Self-identified gender	Females = 10 Males = 4
Highest qualification	Doctorate degree = 6 Master's degree = 6 Honours degree = 1 Medical degree = 1
Additional qualification in education	Master's degree = 2 Diploma = 4 Short courses = 2
Neuroanatomy teaching experience	Beginner = 1 Trainee = 0 Proficient = 11 Expert = 2

RELEVANCE OF NEUROANATOMY

The respondents were requested to select whether they agreed / disagreed with statements regarding the relevance of neuroanatomy in the medical curriculum. The statements were

adapted from previous studies by Patel and co-workers [2] and Moxham and co-workers [5].

The results are summarized in Table 2.

Table 2: The relevance of neuroanatomy in the medical curriculum as perceived by the lecturing staff.

Statement	Number of participants who agreed with the statement		Number of participants who disagreed with the statement	
	n	%	n	%
Neuroanatomy is an important component in my student's medical training.	14	100	0	0
Neuroanatomy is necessary for safe medical practice.	14	100	0	0
Neuroanatomy is of some use in the clinical setting, but its importance may be exaggerated. *	2	14.2	11	78.6
Neuroanatomy is only beneficial in certain medical specialities.	3	21.4	11	78.6
Neuroanatomy is so old-fashioned that it has no importance in contemporary medicine.	0	0	14	100
Neuroanatomy is time wasted in the medical curriculum.	0	0	14	100
Neuroanatomy needs to modernise if it is going to be really useful in medicine.	4	28.6	10	71.4
A very good doctor must have a good understanding of neuroanatomy.	13	92.9	1	7.1
It is impossible to conceive a good medical training without a major neuroanatomy component.	13	92.9	1	7.1
It is not possible to make a reasonable medical diagnosis without a sound knowledge of neuroanatomy.	9	64.3	5	35.7
Medicine would not exist without neuroanatomy.	12	85.7	2	14.2
Only a limited neuroanatomical knowledge is required for safe medical practice.	4	28.6	10	71.4
Rather than studying neuroanatomy, medical students should concentrate on clinical sciences.	0	0	14	100
Without knowledge of neuroanatomy, the doctor is of limited effectiveness.	12	85.7	2	14.2

* One respondent did not answer this question

All the respondents agreed that neuroanatomy is important in the medical students' training and is necessary for safe medical practice. Most of the respondents (78.6%) disagreed with the statement that the importance of neuroanatomy is exaggerated in the medical curriculum. Two respondents (14.2%) agreed with the statement and one respondent did not answer this question. All the respondents further disagreed that neuroanatomy is time wasted or old-fashioned in the medical curriculum. Ten lecturers (71.4%) indicated that it is not necessary for neuroanatomy to be modernized in the medical curriculum, however, four respondents (28.6%) agreed that changes need to be made to the current neuroanatomy medical curriculum.

DISCUSSION

When teaching, most lecturers are not always aware of the influence of the hidden curriculum on the content they teach [11] or what the students are learning in the process [43]. Although the lecturers perceive the senior students as adult learners, more appropriate student-driven (andragogical) teaching and learning approaches are not necessarily used in their undergraduate teaching and facilitation sessions [44]. The reason for this might be that some of the medical students, especially in the first and second year of study, are not yet self-directed learners and their locus of motivation is still externally located [45]. These students further lack the neuroanatomy knowledge to scaffold onto their previously acquired knowledge of the nervous system.

Teaching methods or approaches should not be confused with teaching perspectives [46]. The lecturer's perspectives include his/her intentions and beliefs that justify the teaching methods [46]. Therefore, if the lecturer believes that neuroanatomy is not important and/or relevant in the medical curriculum, it might become apparent to the students through the hidden

curriculum and the teaching methods used. The same implies if the lecturer is overwhelmingly didactic in his/her approach and expects the students to master the same amount of content as his / her own level of knowledge [47], leading to cognitive overload. Other anatomy colleagues' scepticism and negative perceptions on the importance of neuroanatomy in the medical curriculum can also affect the neuroanatomy lecturer's attitude [4].

The results obtained from the characteristics of the respondents indicate that most of the lecturing staff is familiar and comfortable with neuroanatomy teaching in the undergraduate medical curriculum and comply with one of the core teaching competencies, namely content knowledge.

Enthusiasm, dedication, and knowledge in neuroanatomy are regarded as successful attributes of neuroanatomy lecturers, regardless of whether they are professional anatomists or clinicians [4]. Basic neuroscience should be taught by enthusiastic lecturers who are knowledgeable in neuroanatomy [48]. Although the respondents were not asked to indicate their levels of enthusiasm in the questionnaire, their teaching experience in neuroanatomy can attribute to their knowledge levels. The dedication of these respondents is reflected in comments which were provided for some of the open-ended questions including: "*Students and staff members prefer the practical lectures instead of the didactic lectures*" as well as "*Love to teach it, just have very limited time*". Another comment referred to the use of open-education resources such as brain dissection videos available online to supplement the limited resources available at a specific medical school.

All the respondents in this study acknowledged that the neuroanatomy which they teach and facilitate is important, and NOT time wasted in their students' medical training and is a necessity for safe medical practice. The teaching of neuroanatomy needs to remain current

and exciting for both students and lecturing staff and should include formal training in education for the future generation of lecturers [4]. However, the responses were divided on whether modern changes are needed for neuroanatomy within the medical curriculum, or not. Nearly 30% of the lecturers believe that changes are needed in the teaching of neuroanatomy to remain relevant in the medical curriculum, in comparison to 70% who feel that no changes are necessary.

Innovative change in a curriculum contains opposing forces of which personality- and logistical factors are part of [49]. Lecturers might perceive change as inconvenient and uncomfortable [49]; they might lack self-reflection [16], or they are not familiar with new trends in education [50] and therefore did not indicate that changes are necessary within the neuroanatomy curriculum. Logistical factors such as time, resources, and resistance from colleagues at their institution, might also prevent lecturing staff from indicating that changes need to be made - there is no point in changing the curriculum if there is no additional time and funding available, or even support from the relevant stakeholders to implement innovative changes. Reflecting on available resource one respondent particularly stated “*Our brains are not well embalmed, which results in the students not successfully dissecting it*” “This, in turn, will affect the teaching of neuroanatomy as it is most effective when the lecturing staff is encouraged and supported by faculty [4].

Most (90%) of the neuroanatomy lecturing staff have positive attitudes towards the teaching and facilitation of neuroanatomy in the South African medical curriculum. These respondents have indicated that they receive positive feedback from students and love teaching neuroanatomy to the medical students. Others have mentioned that they have a well-integrated teaching approach which includes basic sciences and clinical departments. However, neuroanatomy lecturers should be careful not to teach irrelevant, but interesting content within

the medical curriculum, as it increases the cognitive load and leads to curriculum-overloaded students who might become despondent, neurophobic and mainly rely on rote learning [48, 51]. Neuroanatomy as a subject is known to be heavily loaded with facts and information [51].

FUTURE DIRECTIONS AND RECOMMENDATIONS

The results reported in this study are part of a larger exploratory study into neuroanatomy within the South African medical curriculum, including student perceptions. By using this study as a framework, similar studies in South Africa and worldwide can scaffold on this type of research, as uniformity within our national and international medical curricula is vital for our medical students. Furthermore, neuroanatomy lecturers need to recognize and practice the four competencies of good teaching.

CONCLUSIONS

A lecturer's attitude towards teaching and the content taught (in this case neuroanatomy) affects the teaching approaches used. This study focused on the perceptions and attitudes of the South African neuroanatomy lecturing staff towards their teaching of neuroanatomy in the medical curriculum. These lecturers recognized the relevance and need of neuroanatomy in their medical students' training and further acknowledged the need for modern changes to the curriculum for neuroanatomy to remain relevant for the 21st century medical student. As neuroanatomy lecturers, our attitudes, perspectives, and perceptions influence our actions, teaching competencies and teaching approaches which might influence our students' perceptions, attitudes, and fears towards neuroanatomy in the medical curriculum. Further creating a lack of integration of basic neuroanatomy and the clinical application thereof, which will result in a medical doctor with insufficient knowledge of the human body that might put his/her patients' lives at risk. If the lecturer has a negative attitude, it could be instilled in the

medical student which may contribute to the development of neurophobia. Therefore, our perceptions affect our teaching competencies, our teaching competencies affect our teaching styles, and our teaching styles indirectly affect our students' attitudes towards the module. It is therefore safe to conclude that neurophobia is a side-effect of improper neuroanatomy education.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Research Ethics Committee of the University of Pretoria (Reference number: 587/2018). The respondents and participants in this study gave consent to participate and to publish the outcomes of this study.

COMPETING INTERESTS

The authors declare no conflict of interest. This work has not been presented at a conference or meeting.

AUTHORS' CONTRIBUTIONS

Gerda Venter is the main author of this study. Johanna C. Lubbe and Marius C. Bosman acted as the supervisors and co-authors of this study and contributed to the manuscript and its editing.

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