

# Launching the UK's first National Undergraduate Neuroanatomy Competition: an innovative approach to support student professional development

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## SUMMARY

Hospital specialties are becoming increasingly competitive and medical students are encouraged to prepare for job applications by engaging in research, attending conferences, and competing for academic prizes. At the University of Southampton the first national competition in neuroanatomy was established in 2013 for medical students wishing to pursue neuroscience related careers. Questionnaire responses from competitors at the first National Undergraduate Neuroanatomy Competition (NUNC) were collated and analysed alongside their examination performance. The average competitor rating for the importance of academic prizes was 4.0 out of 5 although 60% of attendees had never entered a competition before. Students in their clinical years of study performed significantly better than those in their pre-clinical years ( $p=0.0379$ ). Furthermore, the average overall score of those studying at a London University was significantly higher than everyone else (61.0% vs. 44.6%,  $p=0.0019$ ). There was a weak correlation between a student's level of confidence in their neuroanatomy knowledge with their examination performance ( $r=0.42$ ,  $p=0.022$ ). From this study we have identified a desire amongst medical students

for a neuroanatomy competition. Analysis of student performance identified several trends in examination ability which have the potential to influence undergraduate neuroanatomy education in the future.

**Key words:** Neuroanatomy – Awards and Prizes – Education – Medical undergraduate – Career mobility – Educational measurement

## INTRODUCTION

There is a widely held opinion amongst medical students that neuroanatomy is a challenging subject (Kramer and Soley, 2002). However, at the opposite end of the spectrum there are medical students with an affinity for neuroanatomy and a desire to pursue careers in neurology or neurosurgery. Unfortunately, clinical neuroscience careers, and indeed all speciality careers, are becoming increasingly competitive due to reduction in the numbers of training posts and the Calman restructure of Senior House Officer rotations. The 2012 competition ratios for neurology and neurosurgery were 1 to 6 and 1 to 16 respectively (Modernising Medical Careers, 2012).

The fierceness of competition is the most frequent reason why doctors do not apply for specialist careers (Lambert and Goldacre, 2005), and

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those medical students still wishing to pursue specialist careers are forced to start planning and preparing for speciality job applications at an earlier stage (Bann and Darzi, 2005). Applicants for specialist training feel they must strengthen their Curriculum Vitae (CV) in order to be successful (Evans et al., 2002), which they can do by attending conferences, publishing research (Evans et al., 2002; Nikkar-Esfahani et al., 2012), completing electives, intercalating and winning prizes (Taylor, 2005; Jeffries, 2007). The 2008 Tooke Report into Modernising Medical Careers further supports the use of undergraduate academic achievements for specialist training applications (Tooke, 2008).

There are numerous essay prizes for medical students. However, to the best of our knowledge, only the Duke Elder prize for ophthalmology is based solely on knowledge and exam performance. Scoring highly in the Duke Elder prize is strongly associated with acceptance into ophthalmology speciality training (Joshi et al., 2011), and supports the value of such prizes as discriminators for strong candidates.

At the University of Southampton, a team of medical students decided to design an intervention to address this problem by combining an extra-curricular event with a national prize. This led to the development of the first National Undergraduate Neuroanatomy Competition (NUNC). The event also presents the opportunity for interested students, particularly those in clinical years, to remain engaged with neuroanatomy when they have little other exposure.

Many students regard neuroanatomy with a sense of foreboding and it contributes to "neurophobia" amongst medical professionals (Schon et al., 2002). Neurophobia hinders the care of neurological diseases (Risdale et al., 2007) and dissuades people from applying to neurological specialties (Hill et al., 2011). More than half of heads of surgery sampled in the UK feel that students' anatomy knowledge is poor (Gogalniceanu et al., 2009), and there is a high level of knowledge drop-off in neuroanatomy between pre-clinical teaching and graduation (Mateen and D'Eon, 2008). The NUNC could provide the opportunity to identify trends in neuroanatomy examination performance which can be used for future educational interventions.

We aimed for this event to provide medical students throughout the UK with the opportunity to support their professional development and demonstrate their commitment to neuroscience. In the longer term we hoped that by increasing awareness and accessibility of neuroanatomy events it may even be possible to remove the stigma associated with learning neuroanatomy. This paper will explore the attitudes of students towards the first national undergraduate neuroanatomy competition, and will also identify any trends in how students perform in neuroanatomy examinations.

## MATERIALS AND METHODS

### *Level of national interest*

An invitation email and attached PDF advertising poster were sent to each UK medical school with a request that they be forwarded to their students. All medical students currently studying at a UK university were eligible to compete. The demographic information submitted by students during online registration through the event website was collated using a dedicated email service.

### *Assessment standard setting*

The spotter specimens were prepared by two medical students in collaboration with the anatomy department's Head and Neck/neuroanatomy teaching team. Single best answer Multiple Choice Questions (MCQ), each with 5 possible correct answers, were written by the student organising committee alongside two consultant neurosurgeons and the Faculty neuroanatomy teaching team, before being approved by the Royal College of Surgeons of Edinburgh. The questions for both the spotter and MCQ were peer-reviewed prior to inclusion in the final examination, with any ambiguous or implausible answers being removed.

Prior to the competition all of the questions were rated by 5 members of the organising committee, including one member of the anatomy department Faculty. Questions were rated for difficulty (easy, moderate, difficult and very difficult), neuroanatomical sub-topic (cerebrum, diencephalon, cerebellum, vascular, brainstem/cranial nerves, spinal cord and other) and whether the content was intra- or extra-curricular (based on the Southampton syllabus). The examination scripts for both components of the competition (MCQ and spotter) were double-marked using a pre-determined mark scheme under the supervision of a Faculty of Medicine advisor.

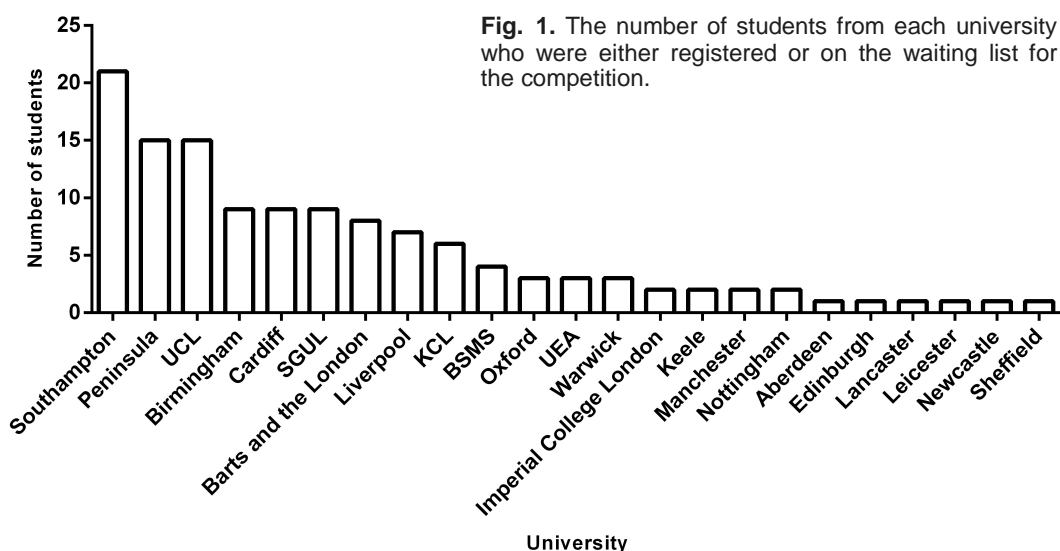
### *Questionnaire feedback forms*

At the beginning of the competition each attendee (n=32) was issued a paper questionnaire containing 16 5-point Likert scale questions (5=highest rating, 1=lowest rating). Candidates were asked to return these at the end of the competition. Questionnaires contained a disclaimer informing them that all feedback may be used anonymously for research purposes. The questionnaire feedback forms, as well as the examination results and demographics, were collated on Microsoft Excel and statistically analysed using GraphPad Prism version 6.

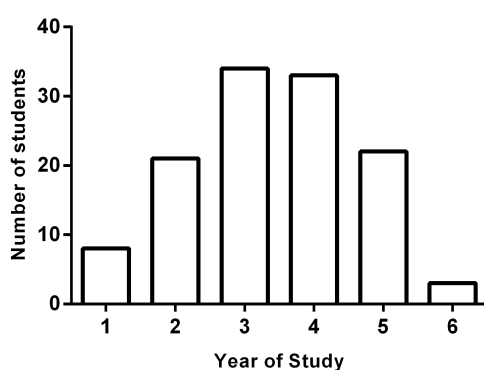
## RESULTS

### *National interest and competition participants*

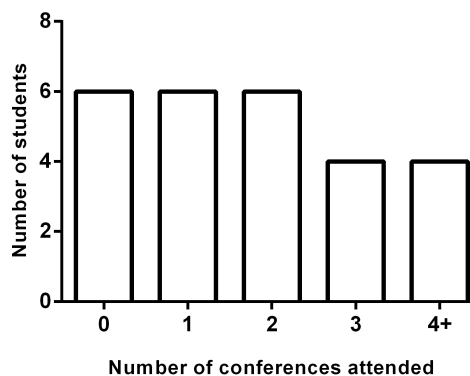
One hundred and thirty medical students from throughout the UK registered online for the National Undergraduate Neuroanatomy Competition. The



**Fig. 1.** The number of students from each university who were either registered or on the waiting list for the competition.



**Fig. 2.** The number of students who were either registered or on the waiting list for the competition divided by year of study.



**Fig. 3.** The number of previous student orientated conferences attended by the competitors.

University of Southampton was the most frequent single institution for students to register from ( $n=21$ ), although the London universities combined were the most frequent overall ( $n=40$ ) (Fig. 1). The third ( $n=34$ ) and fourth ( $n=33$ ) years of study were the most common for students to register from, although we did not record the total length of each student's degree program (Fig. 2).

Of the 130 registered students, we invited 50 to attend on a first-come-first-serve basis, which was a limit we self-imposed to keep this pilot event manageable. Of the 50 invited only 32 (64%) attended on the day due to bad weather disrupting many students' travel plans. Thirty students (94%) returned completed feedback forms at the end of the event.

#### **Preparedness for specialist training applications**

Twenty-four of the 30 questionnaire responders (80%) had attended at least one student-orientated conference before the competition, and 4 out of 30 (13%) had been to four or more (Fig. 3). Despite the high level of interest in extra-

curricular events, 18 out of 30 (60%) had never entered a prize competition before. Only 14 out of 30 (47%) competitors wished to follow a neurology or neurosurgery career, and the remaining 16 (53%) without future neuroscience interests were evenly divided into 8 who wanted to pursue other surgical specialties and the remaining 8 who had yet to formulate a specific career intention.

When asked how seriously they are preparing for specialist training applications (1 = not at all, 3 = indifferent, 5 = very seriously), those students in their clinical years of study ( $n=20$ ) have an average rating of 3.5 out of 5.0 compared to 2.9 out of 5.0 for those in their pre-clinical years ( $n=10$ ). The average competitor's rating of the importance of academic prizes for specialist applications was 4.0 out of 5.0.

#### **Trends in examination performance**

The performance characteristics of our competitor cohort (Table 1) show that students scored significantly higher on the MCQ paper than on the spotter (55.0% vs. 47.0%,  $p=0.0025$ ). A competitor's performance on the MCQ paper was strongly

**Table 1.** The distribution of student performance both overall, and in each component of the competition

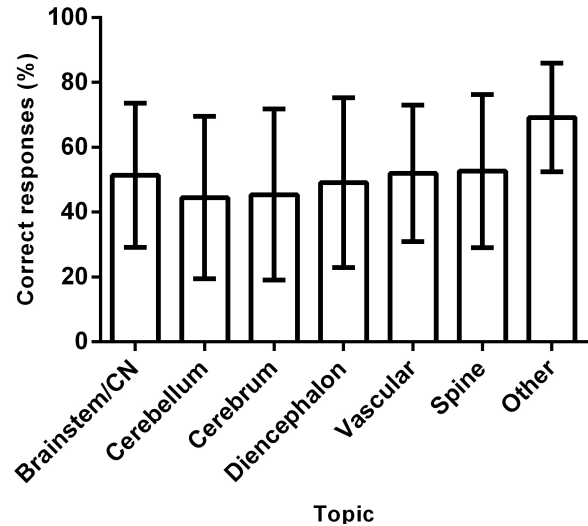
	Spotter	MCQ	Overall
<b>Average mark (%)</b>	47	55	51
<b>S.E.M</b>	3,1	2,7	2,7
<b>Range (%)</b>	3 - 83	16 - 82	18 - 82

associated with their score on the spotter with a positive Pearson's correlation co-efficient of 0.72.

Examination performance was compared against competitor demographics. This revealed that those students in their clinical years of study (n=21) performed significantly better overall than those in their pre-clinical years (n=9) ( $p=0.0379$ ) (Fig. 4a). The medical students who identified neurology or neurosurgery as a future career prospect (n=14) scored significantly higher than those medical students interested in other careers (n=16) (56.9% vs. 45.6%,  $p=0.0464$ ) (Fig. 4b). There was no significant difference (51.3% vs. 51.0%,  $p=0.9606$ ) in the overall exam score between men (n=23) and women (n=9).

Considering the high reputation of London Institutions (St George's University, London, Bart's and the London University College, London, and King's College, London) (n=13, 40.6%), we compared them to those studying in the rest of the UK (n=19, 59.4%). The average overall score of those students from a London University was significantly higher than that for everyone else (61.0% vs. 44.6%,  $p=0.0019$ ) (Fig. 4c). Furthermore, the winners of both prizes categories attended London Universities (UCL and Bart's and the London).

The percentage of correct responses for each question was averaged by neuroanatomical sub-topic. However, no significant strengths or weaknesses were found amongst our competitors either when both examination components were com-

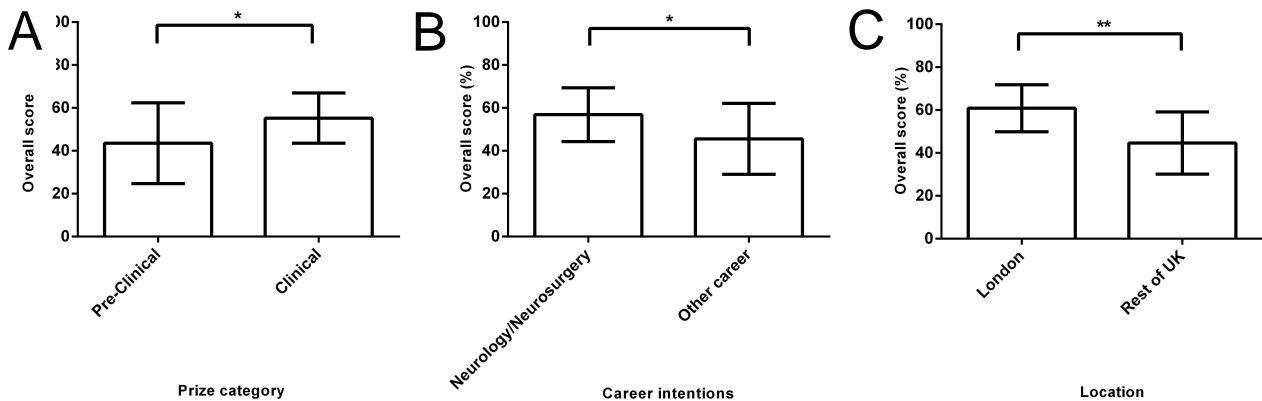
**Fig. 5.** A comparison of overall performance in each of the neuroanatomical sub-topics.

bined (Fig. 5) or separated. However, each sub-topic did not have the same proportion of question difficulties (data not shown). Results from the MCQ component were found to contain a high proportion of functional distracters because the lowest individual question correct response rate was 16%. The trend of decreasing correct responses with an increase in our difficulty rating (data not shown) supports the internal validity of our rating and standard setting approach.

There is a moderately positive Pearson correlation ( $r=0.50$ ,  $p=0.0048$ ) between how enjoyable a competitor finds learning neuroanatomy and their exam performance. In contrast there is weaker Pearson correlation ( $r=0.42$ ,  $p=0.022$ ) between the student's level of confidence in their neuroanatomy knowledge with their overall exam performance.

#### Student satisfaction with the competition

A further aim of the questionnaire was to ascertain the competitors' attitudes towards this event. The criteria we assessed (including the average

**Fig. 4.** (A) Comparison between the overall score achieved by students in the pre-clinical category and the clinical category. (B) Comparison between the overall score achieved by the students wishing to pursue neuroscience careers and those with other aspirations. (C) Comparison between the overall score achieved by students from London universities compared to the rest of the UK.

rating out of 5) were: how enjoyable they found the event (4.4/5), the appropriateness of the examination questions (4.4/5), the quality of the speakers (4.8/5) and the overall quality of the event organisation (4.8/5).

## DISCUSSION

### *The value of academic prizes*

Applications for entry into specialist training programs are becoming increasingly competitive in the UK. Potential applicants are looking to improve their employability by strengthening their portfolios through engaging in research, achieving higher degrees and proving their academic abilities (Taylor, 2005; Jefferies, 2007). The high level of interest in this pilot competition as indicated in Fig. 1 shows there are a number of ambitious and motivated medical students who are already preparing for their future career applications. Our objective was to design and run a neuroanatomy event which met the needs of medical students wishing to prepare themselves for careers in neurology or neurosurgery.

Our findings show that these students are keen to attend extra-curricular events (Fig. 3) even if comparatively few have entered competitions before. This suggests that it is due to a lack of availability of scholarly events to attend, rather than a lack of interest. Our competitors placed a high value on academic awards for future job applications to demonstrate an interest in their subject and prove their ability which further supports the need for more competitions and educational events.

Unsurprisingly many of the students in our cohort intended to follow neuroscience careers. However, the remaining half of the cohort was interested in general surgery or was undecided. It is natural for some students not to have settled on a career whilst at university, so their motives for competing without a specialist interest may include a non-specific desire to enhance their CV. There may be a perceived value to winning, or even competing for any academic prize regardless of the discipline. This value might be even greater for clinical anatomy because it underpins all surgical specialties.

### *Neuroanatomy examination performance*

Whilst competitions such as this are designed for students to prove their high level of academic ability, our competition results demonstrate a wide range of performance (Table 1). The lowest scores were particularly surprising considering students should be familiar with an Ebel's or Angoff standard set pass mark in their own curriculums of approximately 50% (Gogalniceanu et al., 2009). However, this may be another indication of students just wishing to take part rather than to mount a serious attempt to win. This is supported by the significantly higher scores achieved by those who wished to pursue neuroscience careers (Fig. 4b).

Alternatively, the range of results may be caused by a lack of precedence to guide competitors' expectations regarding question difficulty and topic selection, in which case we would expect to see the range or scores narrow in future years.

Analysis of examination results highlighted several trends in performance. Firstly, we observed significantly higher scores in the MCQ paper compared to the spotter (Table 1), for which there may be a number of explanations. The MCQ paper, unlike the spotter, requires students to select the most correct answer from a list of distractors allowing a 20% probability of guessing correctly. The questions for each examination were not based on a university curriculum, and therefore it is possible that the spotter had more extra-curricular questions with which students were unfamiliar. In addition, it has been reported that neuroanatomy is the only anatomy topic to be taught with a higher proportion of time spent on lectures than in the dissecting room (Drake et al., 2009; Gogalniceanu et al., 2009), which may impact on topographic recognition skills. Lastly, the MCQ paper tested the clinically important elements of neuroanatomy, which may also promote deeper learning and aid in students' memory recall (Dangerfield et al., 2000; Svirko and Mellanby, 2008; Emilia et al., 2012).

The variability in each university's anatomy teaching program may also impact on their exam performance. Students from a London-based university performed significantly better in this competition (Fig. 4c) which may be a reflection of differences in neuroanatomy education throughout the UK (Heylings, 2000). These differences are a mixture of teaching duration and course structure (traditional/subject-based/problem based). However, our sample size is too small to draw robust conclusions. This issue is further confounded by the students learning beyond their expected curriculum level in preparation for this competition and their future career.

The competition naturally appeals to those who already enjoy neuroanatomy, but those who enjoy it more score higher, most probably because they spend more time studying it. More enjoyable and relaxing forms of teaching may therefore be beneficial for teaching neuroanatomy, especially for those students who struggle with it. The value of enjoyment in learning neuroanatomy has been previously demonstrated in near-peer teaching (Hall et al., 2013).

Another interesting trend in student attitudes towards neuroanatomy is that confidence in their level of knowledge correlates poorly with their actual performance. It is possible that students had inaccurate expectations of the knowledge required for this exam. However, the mean average overall mark of 51% (Table 1) and the high competitor rating for appropriateness of questions suggests this is not the case. This finding is consistent with

reports from other specialties where medical students demonstrate a lack of ability to self-assess their level of knowledge (Woolliscroft et al., 1993; Tousignant and Desmarchais, 2002; Weiss et al., 2005). It may also be a reflection of neurophobia and the associated lack of confidence some students have in neurology and neurosurgery (Risdale et al., 2007). An accurate self-awareness of one's abilities is important for personal development, whereas lack of it may lead to unsafe medical practice (Berner and Graber, 2008). Increased feedback throughout medical school, particularly in the later years, may go some way to addressing this issue.

Surprisingly there were no significant differences in examination performance across any of the neuroanatomy sub-topics (Fig. 5), which suggests that no part of the central nervous system is more difficult than another. In the future we might expect some patterns to emerge, as it is likely that this sample was not large enough to identify small margins.

Despite there being a higher proportion of women enrolled in university medical degrees only 7% of applications for run-through neurosurgery training are made by women (McNally, 2008). Our findings suggest that this pattern emerges during medical school, since the NUNC was more popular with men than women. Despite this observation, no statistical difference in performance was found between men and women. Therefore it is unlikely that ability in the subject is the cause. It will be interesting to see if this trend continues in future years.

### Study limitations

When dealing with the results from a pilot study we must interpret them tentatively due to the small sample size. However, compiling a larger data set of national student performance in neuroanatomy from consecutive competitions could be very useful. Assuming NUNC results remain reliable over time, they have the potential to inform medical communities about national performance and possibly facilitate educational change in undergraduate neuroanatomy curriculums. When generalising we do need to be mindful that these results represent the ability of the most keen and able students from across the country. It might be that strengths and weaknesses of the average student in neuroanatomy are not reflected in NUNC results.

### Conclusion

In conclusion, the evaluation of this competition has demonstrated that there is a demand for a national neuroanatomy competition amongst medical students in the UK. The students who attended valued the opportunity to win a prize and thought highly of the event itself. The competition also appears to be a valuable tool to provide insight into trends in neuroanatomy performance. As the

NUNC develops and grows over the future years, we hope that it will become a staple tool for medical students to prove their abilities for post-graduate specialty applications.

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