

## CHRISTMAS 2008: FORMATIVE YEARS

## Right-left discrimination among medical students: questionnaire and psychometric study

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## ABSTRACT

**Objective** To determine medical students' self awareness and ability to discriminate right from left; to identify characteristics associated with this ability; and to identify any techniques used to aid discrimination.

**Design** Questionnaire and psychometric study.

**Setting** Undergraduate medical school, Northern Ireland.

**Participants** 290 first year undergraduate students.

**Main outcome measure** Medical students' ability to discriminate right from left using the Bergen right-left discrimination test.

**Results** Test scores ranged from 31 to 143 on a scale of 0-144 (mean 112 (standard deviation 22.2)). Male students significantly outperformed female students (117.18 (26.96) v 110.80 (28.94)). Students who wanted to be surgeons performed significantly better than those who wanted to be general practitioners or medical doctors (119.87 (25.15) v 110.55 (27.36) v 112.50 (26.88)). The interaction effect for sex and career wishes was not significant ( $P=0.370$ ). Students who used learnt techniques to help them discriminate scored significantly less than those who did not ( $P<0.001$ ). Students had greater difficulty in discriminating right from left when looking at the forward view rather than the back view ( $P<0.001$ ).

**Conclusions** Male students were better than female students at distinguishing right from left, and aspiring surgeons were better than aspiring general practitioners or medical doctors. Students had more difficulty with the forward view than the back view.

The ability to discriminate right from left calls on several higher functions including memory, visuospatial processing, language, integration of sensory information, and sometimes mental rotation.<sup>1</sup> Some people have difficulty in distinguishing right from left in themselves and in others.<sup>2,3</sup> Correctly discriminating right from left is important in the practice of medicine. Confusing a patient's right side from their left can result in surgery, procedures, and investigations being carried out on the wrong side.<sup>4</sup> Such mistakes may occur more frequently than is reported,<sup>4</sup> and prevention should start at undergraduate level.<sup>5</sup>

Medical students perform better than psychology or law students in right-left discrimination tests, but data are limited.<sup>6</sup> We aimed to assess medical students' perceived and actual right-left discriminatory ability; to identify characteristics associated with this ability; and to identify any techniques used to aid discrimination.

## METHODS

We invited all first year students at the School of Medicine, Queen's University Belfast who attended a clinical skills programme to participate. Consenting students completed an anonymised questionnaire to ascertain their sex, age, and career wishes. We used the Oldfield handedness inventory to determine hand preference.<sup>7</sup> Students recorded their perceived discriminatory ability on a five point Likert scale. We also asked them to record any techniques that they used to aid discrimination.

We used the Bergen right-left discrimination test to measure participants' ability to discriminate right from left.<sup>8</sup> In this test, participants are shown a series of line figures, which have a white head when viewed from the front and a black head when viewed from the back. Hands are circles at the end of the figures' arms. The test has three subsections—all figures viewed from the back, from the front, and alternating views from the back and front. Participants indicated the right or the left hand of the figure by marking the appropriate "hand" circle. Each subsection consists of 48 figures, and participants had 90 seconds a subsection to complete as many items as possible; this gave a maximum potential score of 144 and a minimum score of 0. Subsections were administered in a counter-balanced sequence to account for order effects.

To meet the assumptions of the parametric tests used (that the residual scores are normally distributed), we squared the test scores and used transformed variables in all analyses. We used analysis of variance to examine differences in the test scores between men and women and between career wishes, with post hoc Tukey tests to explore all pairwise comparisons among career wishes, and to determine whether these variables interacted significantly. Handedness and order of presentation of

the figures were controlled for. We used an independent *t* test to compare students who used a discrimination technique and those who did not. We then used analysis of variance to compare the different discriminatory techniques, Pearson's correlation coefficient to examine the association between test scores and participants' perceived discriminatory ability, and repeated measures analysis of variance to examine the effect of figure position (front, back, or mixed) on test scores.

**RESULTS**

**Participants**

All 290 students participated. Mean age was 19 years (range 18-26); 42% (121/290) were male and 58% (169/290) were female (table 1). About 32% (93/290) of students were considering a career in general practice, 27% (79/290) a career as a medical doctor, 24% (70/290) a career in surgery, and 17% (48/290) other careers. Only 15% (42/290) were left handed and 85% (248/290) were right handed.

**Techniques used to aid right-left discrimination**

Many students (32%; 94/290) used techniques to help them discriminate right from left (table 2).

**Table 1 | Characteristics of participants**

Characteristic	Proportion of participants (n)
Sex:	
Male	42 (121/290)
Female	58 (169/290)
Career aspiration:	
General practitioner	32 (93/290)
Medical doctor	27 (79/290)
Surgeon	24 (70/290)
Other	17 (48/290)
Hand preference:	
Left	15 (42/290)
Right	85 (248/290)
Perceived ability to discriminate right from left:	
Very good	26 (76/290)
Good	43 (126/290)
Average	20 (57/290)
Poor	9 (25/290)
Very poor	2 (6/290)

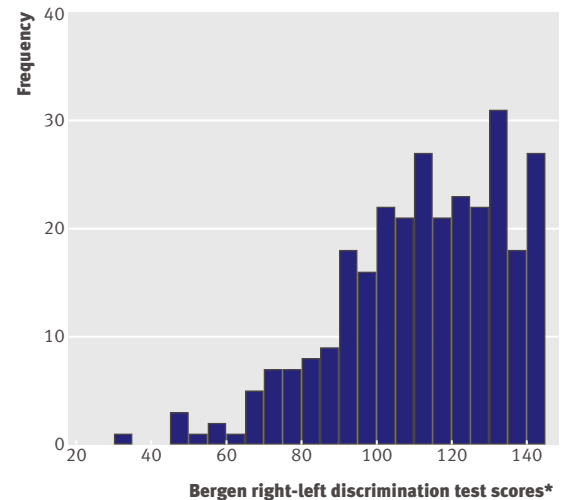
**Table 2 | Proportion of participants who reported the use of different categories of right-left discriminatory techniques**

Discriminatory technique category	Proportion of participants (n)
Relates to a physical activity	49 (46/94)
Relates to a unilateral body feature	27 (25/94)
Relates to a unilateral dress or accessory feature	7 (7/94)
Use of word association	10 (9/94)
Other	7 (7/94)

**Bergen right-left discrimination test scores**

Test scores ranged from 31 to 143 (mean 112 (standard deviation 22.2); figure). Table 3 shows the test scores according to subgroup. The order of presentation of the front, back, and mixed views did not affect test scores ( $F_{2,233}=1.325$ ,  $P=0.268$ ), and neither did the participants' handedness ( $F_{1,233}=0.137$ ,  $P=0.711$ ).

Male students performed significantly better than female students ( $F_{1,233}=5.859$ ,  $P=0.016$ ). We also saw a significant association between test scores and career wishes ( $F_{2,233}=4.157$ ,  $P=0.017$ ); post hoc Tukey tests



**Participants' scores on the Bergen right-left discrimination test. \*Scale of 0-144**

**Table 3 | Bergen right-left discrimination test summary scores according to subgroup**

	Mean scores	Standard deviation
Presentation order:*		
Back, front, mixed	113.95	27.10
Front, mixed, back	112.05	26.14
Mixed, back, front	116.92	25.37
Dominant hand:*		
Left	114.69	22.16
Right	113.92	22.29
Sex:*		
Male	117.81	26.96
Female	110.80	28.94
Career wishes:*		
General practitioner	110.55	27.36
Medical doctor	112.50	26.88
Surgeon	119.87	25.15
Used discrimination technique:*		
No	117.77	19.00
Yes	102.14	24.40
Figure orientation:†		
Back view	41.55	7.98
Front view	37.36	9.72
Mixed view	33.69	9.00

\*Scale of 0-144.

†Scale of 0-48 for each subsection.

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

In clinical practice confusing right and left can have serious consequences for patient care and safety

Some people have difficulty in discriminating right from left in themselves and others

**WHAT THIS STUDY ADDS**

Medical students vary in their ability to discriminate right from left

Medical educators need to emphasise the importance of differentiating right from left and for students to develop checks when making right-left decisions

indicated that students who wanted to be surgeons performed significantly better than those who wanted to be general practitioners ( $P=0.003$ ) or medical doctors ( $P=0.047$ ). The interaction effect for sex and career wishes was not significant ( $F(2,233)=1.000$ ,  $P=0.370$ ).

Perceived discriminatory ability was significantly associated with test scores ( $r=0.387$ ,  $P<0.001$ ). Students who used techniques to help them discriminate had significantly lower test scores than those who did not ( $t=5.342$ ,  $P<0.001$ ). We found no significant difference between the technique used and the score ( $F_{4,75}=0.442$ ,  $P=0.778$ ).

The orientation of the figures significantly affected the scores ( $F_{2,482}=99.059$ ,  $P<0.001$ ). Scores were significantly higher for the back view than for the front view ( $t=6.843$ ,  $P<0.001$ ) or the mixed view ( $t=14.683$ ,  $P<0.001$ ). Scores were significantly higher for the front view than for the mixed view ( $t=6.995$ ,  $P<0.001$ ).

**DISCUSSION**

Male students were better than female students at discriminating left from right. Aspiring surgeons performed better than aspiring general practitioners or medical doctors. Students had more difficulty with the forward view than the back view.

The differences between men and women are in keeping with other studies<sup>3,9,10</sup> and may result from brain lateralisation, whereby males perform better in largely right hemisphere tasks, such as spatial ability, and females perform better in left hemisphere dominant tasks, such as verbal ability.<sup>11</sup> Imaging studies indicate that right-left discrimination is mostly a right hemisphere task.<sup>12</sup> However, the test used depended on participants answering as many questions as possible in a given time. Males are often better at such tests, and this may account for some of the differences seen in our study.<sup>13</sup>

We found no differences between right handed and left handed students. Some studies have shown right handers to be better at discriminating between right and left,<sup>2,14,15</sup> but others report no difference.<sup>3,16</sup>

Even at this early stage of training, students' career aspirations were associated with their test score. Students aspiring to be surgeons had significantly higher scores than those who wished to enter general practice. Perhaps students who think they are better at

right-left discrimination are more attracted to specialties that place greater demands on spatial ability, such as surgery. Further research is needed to determine if right-left discrimination ability, and other spatial tasks, are associated with career aspiration and attainment. It would also be important to determine if students who were less able to discriminate improved after medical training.

Around a third of students reported using techniques to help them discriminate right from left—these students scored lower on the test. Perhaps students who do not use such techniques have a greater natural ability to discriminate than students who do.

Medical practitioners usually face patients in the front position. Our results indicate that medical students have greater difficulty in right-left discrimination in this position, perhaps because mental rotation is required.<sup>17</sup>

Wrong sided patient events can have serious consequences.<sup>4,18,19</sup> Our study cannot determine whether medical students' right-left discriminatory ability directly affects patient safety. However, as well as learning relative anatomical directions such as superior and inferior, students should be told the importance of correctly differentiating right from left and that this can pose problems for some people. Measuring the discriminatory ability of students who report such problems may make them more vigilant and help them develop strategies to prevent errors in clinical practice. Further research would help clarify any associations between right-left discriminatory ability and patient safety, and whether this ability is influenced by fatigue or distraction.

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