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## **'What...you can't tell left from right?' Medical students experiences in making laterality decisions**

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## TITLE

'What...you can't tell left from right?' Medical students experiences in making laterality decisions

## RUNNING HEADER

Laterality, wrong-sided surgery, error, skill deficit

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## CONFLICTS OF INTEREST

The authors declare no conflict of interests

## **RESEARCH ETHICS**

This study received ethical approval by the Research Ethics Committee (School of Medical, Dentistry and Biomedical Sciences, QUB) (Ref 17.09v3). Written informed consent was obtained from all subjects in this study.

## **AUTHOR CONTRIBUTIONS**

All authors contributed to the conception and design of the study. GG and CB lead on analysis. GG drafted the initial manuscript. All authors reviewed and approved the final manuscript.

DRAFT

## INTRODUCTION

### Laterality errors in healthcare

Wrong-sided procedures represent some of the most catastrophic errors in healthcare. Adverse events such as removing the wrong kidney or operating on the wrong side of the brain can result in serious patient harm, even death [1-5]. Despite the efforts of many, these never events continue to occur and in some incidences are increasing [6-7]. Laterality errors are not only restricted to surgical disciplines, occurring in many specialties including anaesthetics (e.g. wrong-sided nerve block), ophthalmology (e.g. wrong-eye injection), respiratory medicine (e.g. wrong-sided thoracentesis) to name but a few [5,8-9]. Though difficult to truly quantify, evidence would suggest that such reported wrong-sided errors are an underestimate [10].

Adverse patient events occur when errors and latent conditions in a healthcare system become aligned [11]. They are often multifaceted in origin but individual human error is considered to be a common root cause, particularly in laterality errors [10,11]. Distinguishing *right* from *left* is assumed by many to be an innate skill – such as discriminating *above* from *below*, or *in front* from *behind*. However, evidence would suggest that a significant proportion of our population, including medical students, experience difficulty with left/right discrimination (LRD) - compared to other spatial orientations [12-16]. Categorising those individuals that have *difficulty* with LRD remains unclear. In one study, 17% of women and 9% of men self-reported *difficulty* with LRD [17]. In terms of medical students, one study reported that just over half of a cohort of medical students scored less than 77% in an objective LRD test [13]. To place this in context, around 10% of the population worldwide are affected by the specific learning difficulty - dyslexia [18]. In a study from Scotland, approx. 2% of medical students were noted to have dyslexia, though this may be under-estimated due to several factors including non-disclosure [19].

LRD is a complex neuropsychological process involving many higher cerebral functions [12,20]. It is unclear why some individuals have difficulty with LRD, though a genetic basis and cerebral hemispherical asymmetry have been postulated as factors [21]. There is no conclusive evidence that handedness is associated with LRD ability [13, 22-24]. Some studies suggest

males have greater LRD ability [4-5, 24-25]. It remains unknown how individuals, who have a proneness in making laterality errors, manage LRD in a high-risk industry such as healthcare.

### **Laterality training in medical education**

Spatial orientation is of fundamental importance in medical training. Locating a region on a patient - permits interventions and/or investigations to be targeted appropriately and safely. Medical curricula emphasise the importance of spatial orientation; whether distinguishing *proximal* from *distal* or *superior* from *inferior*. However, LRD is often considered to be taken for granted and derives little attention [26]. Given that not all medical students have equal LRD ability, there have been calls to raise its awareness in medical education [13, 26-27]. The lived experiences of LRD among medical students remains unknown. Elucidating such experiences may provide new understanding to the challenges that many medical students may encounter in their professional development and training [13]. By doing so, may guide future pedagogical practice in an attempt to address this issue and potentially minimise laterality errors.

### **OBJECTIVE**

To gain deep insights into the lived experiences of LRD among medical students.

### **METHODS**

#### **Ethics**

Ethical approval was given by the School of Medicine Research Ethics Committee, Queen's University Belfast (QUB) (Ref 17.09v3). Written consent was obtained from all participants.

#### **Conceptual orientation**

Hermeneutic phenomenology allows researchers to explore individuals lived experiences of a phenomena [28]. By bringing such experiences to the fore, can permit conscious reflection and new perspectives about the phenomena under investigation. Given that we wanted to develop a deep understanding of medical students lived experiences of LRD, we choose hermeneutic phenomenology. Such an approach can provide nuanced insights that can often lie below surface awareness. Furthermore, it recognises the importance of context and how

this can shape the experience of the phenomena (e.g. medical student learning environments)[28].

### **Reflexivity**

Hermeneutic phenomenology necessitates researchers to be aware and reflect on their subjectiveness during the interpretative process [28]. Therefore during the study, the research team were continually reflexive - whilst remaining firmly rooted in the data and principles of the hermeneutic process. As a team, we collaboratively interpreted the data and shared our understanding of participant's experiences. We recognised as researchers, the challenges of truly 'bracketing off' our experiences from the interpretative process. Therefore in order to enhance our connectedness with our participant's experiences, the research team discussed and reflected on their own experiences and the emerging interpretation of subjects lived experiences of LRD during the study.

### **Setting, Recruitment and Sampling**

The study was carried out in a university where the medical degree follows a five-year undergraduate curricular model, with a greater clinical focus in years 3-5.

Phenomenological based research typically recruits small numbers in order to permit deep insights, compared to the broader sights gained from a large sample [29]. Therefore we aimed to recruit up to 10 participants. Essential to the research question, we wanted to explore a range of medical students' experiences – including those that were, and were not, challenged with LRD. Evidence indicates that perceived LR discrimination ability is a satisfactory indicator of actual ability [13]. Therefore, fourth year medical students were invited by email to participate. A matrix of willing participants and their characteristics of gender and perceived LRD ability was used to aid a purposeful sampling method. Sampling was complete once we were content that we had a reasonable spread of gender and perceived LRD ability amongst participants (Table 1).

[Suggest inserting table 1 here]

## Data Capture

Willing participants were interviewed on a one-to-one basis (by GG and CB). Interviews were exploratory in nature and framed around their LRD experiences as medical students. It was made clear that their responses would be anonymised – therefore aiming to reduce any bias towards just reporting positive experiences. Interviews were open ended but were aligned to the research objective. Initial opening questions included ‘*Can you share with me your experiences of making LR decisions?*’ and ‘*Do these experiences have any bearing on you making LR decisions in your day-to-day activities as a medical student?*’. As participants expressed their experiences, further unplanned questions were required to explore these in more depth. GG and CB continually shared and reflected on their experiences as the interviews were conducted.

Data was collected until the researchers (GG and CB) were satisfied that they had a sufficient sample to provide a thick and rich interpretation of participants experiences of LRD. Interviews were transcribed verbatim and anonymised using pseudonyms.

## Analysis

Template Analysis was used to analyse data in this study because of its fit with the hermenutic approach used in this study [30]. It permitted a structured approach between analysing participants’ reported lived experiences, researchers interpretation and how the data contributed to the whole understanding of LRD by medical students (i.e. *the hermeneutic circle*).

Prior to analysis, the researchers (GG and CB) brought to the surface their assumptions and experiences in order to assist their reflexive and interpretative approach to the analysis process. Initially tentative *a priori* codes were devised, which were guided by our research aim. We applied tentative *a priori* codes to identify relevant text in three initial transcripts. *A priori* codes were modified, omitted or new ones added in response to reading of the transcripts. These codes were then clustered to identify preliminary themes and used to develop an initial template. This template was then applied to the remaining transcripts and progressively refined. Finally all transcripts were coded against the definitive template. During

this process there was continual ‘dialogue’ between participant’s experiences and our interpretation (i.e. the ‘hermeneutic circle’).

## RESULTS

Ten participants took part in the study generating 183 minutes of interview data. Analysis yielded four main themes 1) Discriminating right from left: An unconscious or conscious task 2) ‘What....you can’t tell right from left?’: an undesirable skill deficit 3) Concealment and 4) ‘But you’re going to be a doctor!’: Impact on professional identify formation.

### Discriminating left from right: An unconscious or conscious task

For some, LRD was mostly an unconscious decision; they automatically were able to distinguish laterality extra-egocentrically (i.e. determining left from right in an object or another person) and egocentrically (i.e. determining left from right in one’s self).

*“... if someone told me to turn left, I’d know straight away to turn left, I wouldn’t have to work out which way was left...” [Walter]*

However, for others it was more a conscious process, using cognitive strategies to assist their decision-making. These adaptive strategies followed a similar sequence and generally occurred in a short time frame, but could take longer. The following subthemes describes the steps of these adaptive strategies.

*“... whenever you are placing the pads\* of the defibrillator on the chest, I really have to think about that... [which is the left side]” [Emma]*

*[\*One of two pads that has to be placed on the left side of a patient’s chest before administering a high energy electric shock in a cardiac arrest]*

### Cues to determine egocentric laterality

Participants determined laterality egocentrically by using cues which were either a bodily manoeuvre (e.g. moving the right hand in a writing motion to indicate ‘write with right’) or a visual marker (e.g. wrist watch)

*“I wear a watch on my left hand and I kind of know that this is the hand that I would pick my pen up to write with [left hand]” [Frances]*

### *Mental projection of own laterality extra-egocentrically*

After establishing laterality egocentrically, this enabled participants to determine laterality extra-egocentrically.

*“I do have to think and make a conscious decision... to decide whether it's left or right... I find myself kind of developing techniques like... looking at my own hand and comparing it... in my mind's eye I'd be kind of pivoting myself round... just shifting my body round just to make sure... [Helen]*

Participants would visually track their own established right or left side onto the object or person. In the context of a patient, if the participant was facing in the same direction as the patient (*i.e. facing the patients back*) they mentally projected their own laterality, in a direct vector, onto the patient - thereby establishing laterality in the patient. However when participants were in an opposite position (*i.e. face-to-face with a patient*) they had to mentally rotate their own laterality onto the patient (*i.e. projecting their own laterality onto a patient they would have to cross the mid-line between themselves and the patient*). Participants often used a motor-spatial manoeuvre (*e.g. moving their shoulder or partly turning around to face the same direction as a patient*) to mentally assist place themselves in the same orientation as the patient and labelling laterality on the object or person.

### *Safety netting*

After establishing laterality, participants often repeated the process as a checking mechanism, often more than once. This process was mediated by factors that were perceived as increasing the risk of making a laterality error – such as distraction and their emotional state (*e.g. if they felt embarrassed about determining laterality*). Interestingly these factors could also mediate those individuals who were unconsciously able to distinguish right from left, to also use a similar conscious checking process. Finally, participants experienced that such ‘double checking’ could act as a ‘safety net’ when discriminating right from left.

### ***‘What....you can’t tell right from left?’: an undesirable skill deficit***

Individuals who were challenged with LRD - felt *different*. Their *differentness* was experienced as a shortcoming and not in keeping with society’s normative expectations. Dependent on the circumstances, such perceived shortcomings had different impacts. When participants had to discriminate right from left in a relatively trivial matter (e.g. taking a right or left turn on a car journey) they generally accepted their shortcomings in a neutral manner. However there were circumstances when participants experienced more negative emotions. If they were, or had potential to be, judged by others – this could evoke more emotions such as frustration and embarrassment. For those that could unconsciously discriminate right from left, some indicated that they were unaware that others could experience difficulty in LRD.

*“...how on earth does someone get their left and right confused...” [Mark]*

When participants, who could unconsciously discriminate right from left, became aware of others who had difficulty in LRD, they often sympathised with them. Gestures of acceptance were often offered for their deficit, which often could be humorized.

*“... my friends have teased me about it [having difficulty with LRD]...it’s been gentle teasing, it’s never anything serious...”*

*[Melanie]*

Those that were unaware that others could have difficulties in their LRD often expressed more negative attitudes to these individuals. Conveying the sentiment that LRD should be an innate skill for all, including healthcare professionals.

*“...I was astounded that people didn’t know their right from left...and this is an intelligent girl [i.e. medical student who had difficulty with LRD]...” [Kate]*

## Concealment

Individuals who had difficulty with LRD often tried to pass as being 'normal'. When they were in situations that others might judge their LRD abilities, they often made efforts to conceal their adaptive strategy. Concealment was an attempt for these individuals not to be labelled as having a skill deficit.

*"... do try and mask because it's not something spoken about....you don't want to be seen to weak... definitely not among medical students.."* [Emma]

Any externalised features of this adaptive strategy were often 'covered' up by a number of methods. Either by suppressing their visuo-spatial manoeuvres or by carrying out their visuo-spatial manoeuvre out of view from other parties, especially peers and patients.

*"... my phone is normally... in my right pocket... I put my hand on it and then I know it's my right....so I wouldn't want to be letting on to a patient that I couldn't do it [i.e. LRD]"* [Melanie]

## **'But you're going to be a doctor!' Impact on professional identity formation**

Participants described that societal expectation for all doctors, including medical students, is that they should innately be able to correctly discriminate right from left.

*"...I work in a shop and all the staff know that I'm training to be a doctor, so any time I make a mistake [Laterality error], I get the 'oh, but you're going to be a doctor, you can't be doing that'..."* [Frances]

Being medical students often promoted frustration for those that were challenged in LRD. This came into sharp focus when having to discriminate right from left in front of a patient, their peers or healthcare professionals. Showing to struggle in LRD was experienced as a deficit on their professional ability. This often triggered participants to critically reflect on their professional development. Having difficulty with LRD was not seen as a sole factor in

future career decisions. However they would often question that certain specialities (e.g. surgery, orthopaedics) would be less compatible with their perceived skill deficit.

*“...it’s just embarrassing....wouldn’t look good for patients... I don’t know if I want them [i.e. medical student / doctor] operating on me” [Helen]*

Such participants shared experiences and expressed a notion that they felt more prone to make laterality errors.

*“...I’m just more aware that I’m probably at an increased likelihood of making a mistake compared to other colleagues...” [Emma]*

Given that participants did not have direct responsibility for patient care, such potential risks were considered negligible. However, the experience could induce frustration and question their ability to be a safe doctor of the future.

In summary, our results opened up rich layers about medical students experiences regarding LRD. LRD is not an unconscious task for everyone, and the context of being a medical student introduces stigma and potential impact on their professional development.

## **DISCUSSION**

By using a hermeneutic phenomenological approach, our study set out to gain rich insights into the lived experiences of LRD among medical students. For many LRD is an unconscious effortless process that is taken for granted. However for others, it represents a conscious cognitive process that can induce negative emotions and attitudes for medical students. They are very aware that others find LRD an innate task. Our findings provide an insightful window into the nuanced experiences of medical students, and the challenges that many face, with this common task.

### The 'normals', the 'wise' and the 'stigmatised'

Participants affirmed the notion that LRD is not innate for all [12-16]. For individuals who can unconsciously discriminate left from right, such an ability is largely regarded as a societal norm - especially for doctors. When they encounter individuals, who do not have this innate ability, there is potential to discredit them. Context and circumstances can extenuate this reaction, particularly in the healthcare setting.

Individuals who experienced difficulty in LRD felt different. Such *othering* represented a labelling of these individuals as being subordinate. This sense of *otherness* was largely unwelcomed. Acquaintances of these individuals often become wise to their apparent skill deficit and extended gestures of support. However, in circumstances where they did not know the other individual, especially in a professional context, being 'found out' could bring about negative experiences. Stigmatisation is a process by which the reaction of others *spoils normal identity* [31]. Being labelled as having a skill deficit, such as a difficulty with LRD, was a discrediting process. This experience was especially evident in, and in the anticipation of, social interactions where their skill deficit was perceived not a fit with the social expectation of being a medical student. Such experiences of not being 'normal' are supported with the notion that stigma is often defined and reinforced through social interactions [28]. Such an experience prompted medical students to critically reflect on their inabilities and the undesired attitude that others had, or might have, towards them. To this extent, participants would attempt to 'unspoil' themselves by concealing their deficit and trying to pass as being 'normal' when in the presence of others [31]. Interesting parallels can also be drawn with medical students who have dyslexia. Such individuals can also experience feelings of inadequacy, shame and stigma. For many, they too often conceal their specific learning difficulty in fear of negative attitudes by others [32].

### Adaptive strategies

When individuals, who had difficulty with LRD, were placed in circumstances where they had to make laterality decisions, they often utilised adaptive strategies. Such a finding is supported by previous research, however it is worth noting that despite using assistive cues, such individuals are still challenged in discriminating right from left. [13]. After establishing laterality egocentrically, a number of further steps are required to identify laterality extra-

egocentrically. Importantly mental projection of their own laterality on to the object or person was required and mental rotation if the person was directly facing them. It comes as no surprise that with these extra steps, LRD extra-egocentrically is more challenging when face to face with a person (common in healthcare) compared to facing in the same direction [13].

Individuals who were challenged with LRD, perceived a potential proneness in making laterality errors. It could be argued that such additional conscious steps, compared to those that can unconsciously discriminate, places extra demands on working memory [33,34]. Critically, working memory is considered to have a limited capacity [33]. Therefore, in circumstances where an individual is required to divide their attention between consciously discriminating right from left and other tasks (such as adaptive strategies, concealment, dealing with frequent distractions in clinical practice, negative emotions). It could be postulated these extra demands are more taxing on working memory and could increase the chance of error and have an impact on patient safety. On the other hand, taking time to discriminate right from left may also mitigate against making a laterality error (i.e. *system 2* thinking which is more methodical and slower compared to *system 1* thinking which is more fast and imitative) [35]. Though beyond the remit of this study, future research would be important to establish if such variation in LRD ability is in anyway linked to laterality errors and adverse patient events.

#### Impact on professional identify formation

For the most part, having difficulty with LRD had minimal impact on medical students' professional development. Adaptive strategies permitted them to mostly overcome their apparent skill deficit. Though this has to be considered in the context that medical students do not have direct responsibility for patient care and are less likely to cause an adverse patient event. However, their professional identity of being a safe doctor of the future was challenged when their LRD ability was judged by others. In order to pass as being 'normal', medical students managed the impression they projected. Various concealment strategies were used to mask their skill deficit, particularly in, and in anticipation of, judgemental contexts.

Medical students who had difficulty with LRD imagined that their skill deficit would increase their proneness to making a laterality error and this provoked negative reactions. Such circumstances trigger a critical reflection on their ability on being a competent future doctor and question their suitability for future career specialities (e.g. surgery). Career selection is a complex, longitudinal and continuous process for medical students and doctors [36]. Though beyond the scope of the study, students did voice that such experiences made them less inclined to consider surgical specialties as future careers – which resonates with previous research [13].

Again, interesting parallels can also be drawn with individuals who are affected by dyslexia. Such individuals often express that their specific learning difficulty has an influence on their career pathway and decisions as medical students [32].

### Limitations

The findings of the study have to be considered within its limitations. The hermeneutic phenomenological approach in this study allowed us to explore in depth the LRD experiences in a group of medical students in one institution. We only focused on more senior medical students. Their experiences may well differ from junior medical students, other medical schools and indeed – junior doctors. Given the conceptual orientation in this study, generalisability was not an objective. Therefore, whilst our data provided a thick rich description of medical students LRD experiences, they cannot be generalised to the broader community of medical students. It should also be acknowledged that some individuals may have withheld disclosing events due to potential shame and embarrassment. Though every effort was made to support participants and provide confidentiality in our interviews.

Finally, researchers were known to participants as faculty, though their contact teaching time with students in this course was minimal. Every effort was made to permit participants to speak freely. Two of the three authors (GG and MD) in this study have previously researched LRD. There is risk that this may have had an impact on our interpretation of participant's experiences. However, the research team were continually reflexive throughout the study in order to acknowledge and manage their perspectives, experiences and interpretation.

## Implications and future research

This study has implications for pedagogical practice and medical degree curricula. Firstly, our findings support the need to raise the importance of laterality training, in addition to other spatial orientations, for medical students. The assumption that LRD is an intuitive skill for all is unfounded and needs to be addressed in medical curricula (for example in the teaching of anatomical positions and orientations, in the teaching of clinical skills and in the ordering of diagnostic tests). With increasing focus on human factors training in medical education, the importance of LRD should be emphasised. There should be heightened awareness among medical students, educators and clinical teachers - that LRD is not an effortless task for all. Furthermore individuals should be encouraged to extend support to those that are challenged with LRD by providing assistance in their decision making and cross checking were appropriate in a non-judgemental manner.

Individuals who are challenged by LRD need to be afforded opportunities for support in making such laterality decisions. Given that they are undertaking a complex conscious skill, and that working memory is fragile and limited, they need to seek circumstances that reduce distraction and take time to make such decisions [33-34,37]. Surgical checklists aim to provide these circumstances [38]. However, laterality decisions are not confined to surgical theatres. Even in apparent low-level risk situations, such individuals need to be provided with techniques such as tactical pauses and seeking cross-checks to ensure that have made the correct laterality decision [39]. Such techniques could be introduced into simulation teaching activities that emphasises human factors training.

Lastly, there needs to be a change in culture in reducing the potential stigma associated with having difficulty with LRD. Laterality errors can happen to anyone. We need to drive forward the acceptance that LRD is not effortless for all and we need to offer support in a non-judgemental fashion. Such findings should be brought to attention of those that design and deliver medical degree curricula. Objectively determining whether individuals who are challenged with LRD are more prone to making laterality errors would be worthy of further investigation. Equally, research LRD in other groups (e.g. practicing clinicians, other

healthcare professionals such as dentists, nurses, podiatrists) would be of interest to explore how they make LR decisions in actual clinical practice.

## CONCLUSIONS

This study challenges normative expectations that LRD is an effortless task for all. Individuals who are challenged with LRD, have to carry out a complex conscious process in order to determine right from left. For the most part this process is relatively effortless. But the context of being a *medical* student, can place extra demands and pressures. Medical education needs to respond by raising the profile of this challenge that faces many of our medical students, and extending support to assist them in the interests of their professional training and safe patient care. It's not *right* to be *left* in ignorance about LRD.

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