The Preferred Learning Styles of Neurosurgeons, Neurosurgery Residents, and Neurology Residents: Implications in the Neurosurgical Field

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■ OBJECTIVE: **To delineate the learning style that best defines a successful practitioner in the field of neurosurgery by using a validated learning style inventory.**

■ METHODS: **The Kolb Learning Style Inventory, a validated assessment tool, was administered to all practicing neurosurgeons, neurosurgical residents, and neurology residents employed at Chang Gung Memorial Hospital, an institution that provides primary and tertiary clinical care in 3 locations, Linkou, Kaohsiung, and Chiayi. There were 81 participants who entered the study, and all completed the study.**

■ RESULTS: **Neurosurgeons preferred the assimilating learning style (52%), followed by the diverging learning style (39%). Neurosurgery residents were slightly more evenly distributed across the learning styles; however, they still favored assimilating (32%) and diverging (41%). Neurology residents had the most clearly defined preferred learning style with assimilating (76%) obtaining the large majority and diverging (12%) being a distant second.**

■ CONCLUSIONS: **The assimilating and diverging learning styles are the preferred learning styles among neurosurgeons, neurosurgery residents, and neurology residents. The assimilating learning style typically is the primary learning style for neurosurgeons and neurology residents. Neurosurgical residents start off with a diverging learning style and progress toward an assimilating learning style as they work toward becoming practicing neurosurgeons. The field of neurosurgery has limited opportunities for active experimentation, which may explain why individuals who prefer reflective observation are more likely to succeed in this field.**

INTRODUCTION

The training of neurosurgeons is complicated by an extensive base of knowledge that must be acquired while practicing in a high-stress environment with significant time restrictions and limited personnel. Neurosurgical training differs from general surgical training in that there are fewer opportunities for hands-on learning, and most of the initial experience that residents gain must be through observation and discussion. Although published data are available concerning the learning styles most commonly found in medical students, nurses, general surgical residents, and general surgeons, no studies have looked at the neurosurgical specialty. Neurosurgeons, neurosurgical residents, and neurology residents may have a specific learning style that indicates success in the neurosurgical field. The concept of a learning style refers to the method by which a person gains knowledge and skills through the perception, processing, storage, and recall of information (1, 7, 9). There are many models and measures of learning styles described in literature, and Kolb's Learning Style Inventory (LSI) is one of the most commonly used (1-6, 8, 9).

Kolb's LSI is based on Kolb's theory of experiential learning, which separates learning into a 4-stage cycle of concrete experience (CE) through immersion; reflective observation (RO) and the reviewing of the experience; abstract conceptualization (AC) and the formation of generalizations and interpretations; and active experimentation (AE), which includes testing the implications of concepts in new situations (1, 5, 9, 11, 13, 16). This cycle repeats continuously as the testing of concepts leads to a new experience that starts the whole process over again. The Kolb LSI is a forced choice assessment that consists of 12 items that ask individuals to rank 4 sentence endings that correspond to the 4 learning modes (CE, RO, AC, and AE) (4, 6, 13, 22). Although these modes are interdependent, they can be separated into 2 dimensions, the perception continuum (AC-CE) and the processing continuum (AE-RO) (2, 4, 11, 13). These dimensions are related dialectically, meaning that the individual chooses one end

Key words
- KOLB learning style inventory (LSI)
- Learning style
- Neurology
- Neurosurgeon
- Neurosurgery

Abbreviations and Acronyms
AC: Abstract conceptualization
AE: Active experimentation
CE: Concrete experience
LSI: Learning Style Inventory
RO: Reflective observation

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Citation: World Neurosurg. (2014) 82, 3/4:298-303.
http://dx.doi.org/10.1016/j.wneu.2014.04.067

*Journal homepage: **www.WORLDNEUROSURGERY.org***

*Available online: **www.sciencedirect.com***

1878-8750/$ - see front matter

of the spectrum, which automatically excludes the other end (2, 11, 13). An individual prefers doing versus watching or is more prone to feeling instead of thinking (2, 4, 13). The scores for the 12 items measure an individual's relative emphasis on each of the 4 modes and determine the learning style of the individual (4, 5, 13). The 4 learning styles consist of accommodating (CE/AE), diverging (CE/RO), assimilating (AC/RO), and converging (AC/AE) (1, 2, 4-6, 9, 13, 14, 16, 18).

This study uses the Kolb LSI to determine the most prevalent learning style among neurosurgeons, neurosurgical residents, and neurology residents. Studies have shown that specific environmental demands, such as educational specialization, required skills for professional tasks, and adaptive competencies, influence the learning styles of individuals; we hypothesized that there is a distinct learning style that successful neurosurgeons, neurosurgical residents, and neurology residents exhibit. The purpose of this study is to define the predominant learning styles of neurosurgeons, neurosurgical residents, and neurology residents and show any differences between these groups.

METHODS

Participants and Setting

In 2010, 38 neurosurgeons, 24 neurosurgical residents, and 19 neurology residents practicing at Chang Gung Memorial Hospital in Linkou, Kaohsiung, and Chiayi were administered the Kolb LSI. Informed consent was obtained from all participants.

LSI

The Kolb LSI, Version 3.1, consists of 12 sentence fragments followed by 4 phrases for sentence completion that are ranked from 1–4 based on which completion phrase best describes the participant with 4 being the most accurate descriptive phrase and 1 being the least accurate phrase. This tool allows the characterization of learning styles into 4 groups: converging, accommodating, assimilating, and diverging.

Analysis

The data were compiled in a Microsoft Excel (Microsoft Corp., Redmond, Washington, USA) spreadsheet. The dominant learning style within each group—neurosurgeons, neurosurgical residents, and neurology residents—was determined as well as the dominant learning styles in each residency group based on year of residency. Statistical analysis was performed with SPSS 17.0 using Pearson χ^2 test (SPSS Inc., Chicago, IL).

RESULTS

Although the overall response rate was 100% (81 of 81 participants), after examination, 86% (70 of 81) of the surveys were completed correctly. Amongst the individual groups, response rates for acceptable surveys were 82% for the neurosurgeons, 92% for the neurosurgery residents, and 89% for the neurology residents. The general distribution of the data is shown in **Figure 1**.

Analysis of the data showed that neurosurgeons preferred the assimilating learning style (52%), followed by the diverging learning style (39%); the converging (6%) and accommodating (3%) styles were least prevalent. Neurosurgery residents were slightly more evenly distributed across the learning styles; however, they still favored assimilating (32%) and diverging (41%) over converging (9%) and accommodating (18%). Neurology residents had the most clearly defined preferred learning style with assimilating (76%) obtaining the large majority and diverging (12%), converging (6%), and accommodating (6%) combined consisting of less than a quarter of the neurology residents. A comparison of the learning styles of the 3 groups and the breakdown of each individual group are shown in **Figure 2**. Pearson χ^2 test was used to identify significant differences between groups. A significant difference was found between neurosurgery residents and neurology residents in general ($P = 0.049$). Neurology residents were found to have a significantly higher incidence of the assimilating learning style over the diverging learning style compared with neurosurgeons ($P = 0.049$) and neurosurgery residents ($P = 0.013$), whereas the only significant difference between neurosurgeons and neurosurgery residents consisted of the higher incidence of the accommodating learning style in neurosurgery residents ($P = 0.040$).

A breakdown of learning styles by residency year showed that among neurosurgery residents, the accommodating learning style was found only in the first (33%), second (50%), and fourth (20%) residency years. The assimilating learning style was found in all residency years: first (34%), second (50%), third (33%), fourth (20%), fifth (33%), and sixth (25%). Diverging learning style appeared in all but 1 residency year: first (33%), third (67%), fourth (40%), fifth (67%), and sixth (50%). The last learning style, converging, was present in only the fourth (20%) and sixth (25%) years. For neurology residents, the assimilating learning style was the only learning style found in the first, second, and fifth years. The third (50%) and fourth (75%) years still reported most neurology residents preferring the assimilating style. The diverging style appeared in both the third (17%) and the fourth (25%) years, whereas converging (16%) and accommodating (17%) styles appeared only in year 3. A visual representation of the breakdown of the residency groups by year is provided in **Figure 3**. The small sample size in which the incidence of specific learning styles was zero for certain residency years resulted in the inability to determine significance; however, the data are interesting to examine when looking for possible trends among residents as they progress through their residency.

DISCUSSION

Kolb's LSI has been applied to evaluating practitioners and trainees in many fields. Studies have shown that there is a strong correlation between professions and specific learning styles (1-6, 9-12, 14, 16-18, 20-22). The accommodating learning style describes individuals who are hands-on learners; rely on intuition over logic; and take a practical, experiential approach (4, 6, 10, 14, 22). They are good at adapting to changing circumstances and use a trial-and-error method of problem solving instead of thought and reflection (4, 5, 11, 13). These people are attracted to new challenges and experiences, carry out plans, and are at ease with people and rely on others for information (4-6, 9, 11, 13, 16). People with an accommodating learning style set targets and actively try different ways to achieve an objective making them useful in roles requiring action and initiative (1, 4, 6, 13, 16).

The assimilating learning style is favored by individuals who are concise and logical (4, 9, 13, 16). They excel at compiling a wide range of information and organizing it into a clear logical format that can be used to create models and theories (4-6, 9, 11, 13, 14, 22).