

How Residents Learn Predicts Success in Surgical Residency

Ralph C. Quillin III, MD, Timothy A. Pritts, PhD, Dennis J. Hanseman, PhD, Michael J. Edwards, MD, and Bradley R. Davis, MD

Department of Surgery, University of Cincinnati, Cincinnati, Ohio

BACKGROUND: Predictors of success in surgical residency have been poorly understood. Previous studies have related prior performance to future success without consideration of personal attributes that help an individual succeed. Surgical educators should consider how residents learn to gain insight into early identification of residents at risk of failing to complete their surgical training.

METHODS: We examined our 14-year database of surgical resident learning-style assessments, Accreditation Council for Graduate Medical Education operative log data of graduating residents from 1999 to 2012, first time pass rates on the American Board of Surgery Qualifying and Certifying examinations, and departmental records to identify those residents who did not complete their surgery training at our institution. Statistical analysis was performed using the chi-square test, Wilcoxon rank-sum, and regression analysis with significance set at $p < 0.05$.

RESULTS: We analyzed 441 learning-style assessments from 130 residents. Surgical residents are predominantly action-based learners, with converging (219, 49.7%) and accommodating (112, 25.4%) being the principal learning styles. Assimilating (66, 15%) and diverging (44, 10%) learning styles, where an individual learns by observation, were less common. Regression analysis comparing learning style with case volume revealed that residents who are action-based learners completed more cases at graduation ($p < 0.05$ for each). Additionally, surgical residents who transferred to a nonsurgical residency or nonphysician field were more likely to learn by observation ($p = 0.0467$).

CONCLUSIONS: Surgical residents are predominantly action-based learners. However, a subset of surgical residents learn primarily by observation. These residents are at risk for a less robust operative experience and not completing surgical training. Learning-style analysis may be utilized by surgical educators to identify the potential at-risk

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COMPETENCIES: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills

BACKGROUND

Predictors of success in surgery residency are poorly understood. Studies that have examined the topic largely relate prior academic performance in medical school and scores on standardized tests with success in surgical residency.¹⁻³ However, these studies fail to consider the personal attributes that help an individual succeed. Surgical educators should consider how residents learn, because the highest level of learning and subsequent success is achieved in an environment congruent with an individual's style of learning.⁴⁻⁶

The Kolb learning style inventory (LSI) is a reliable and validated tool for the self-assessment of an individual's learning style.⁷ This inventory is based on David Kolb's theory of experiential learning, where learning occurs when an individual perceives and then processes information, creating knowledge.^{8,9} Results from the inventory are reported on a 2-dimensional graph (Fig. 1A) based on how an individual perceives (vertical axis) and processes information (horizontal axis). Perception of information may vary from experiencing physical events or interactions (concrete experience, "CE") to developing intellectual constructs, such as ideas and theories (abstract conceptualization, "AC"). This information is then processed through either reflection (reflective observation, "RO") or action (active experimentation, "AE").⁸

Ideal learning incorporates each of these different components. However, learners develop preferences for different methods and subsequently develop unique learning

Correspondence: Inquiries to Ralph C. Quillin III, MD, Department of Surgery, University of Cincinnati, 231 Albert Sabin Way, ML 0558, Cincinnati, OH 45267-0558; fax: +1-513-558-8677; e-mail: quillirc@email.uc.edu

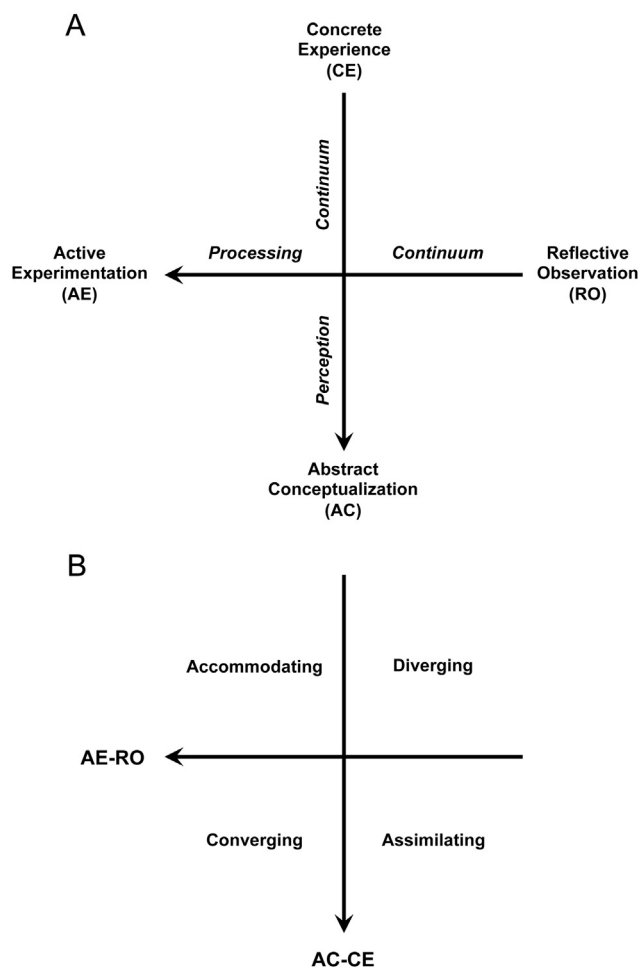


FIGURE 1. Classification of learning styles based on the Kolb LSI. (A) The LSI reports how an individual perceives information (experiencing “CE” to thinking “AC”—vertical axis) and how they process information (reflecting “RO” to acting “AE”—horizontal axis) when they learn. (B) The 4 different learning styles are identified to a specific quadrant through the subtraction of the perception continuum components (AC-CE) and processing continuum components (AE-RO) of the LSI.

styles.^{8,10} Individuals are categorized into 4 different learning styles (Fig. 1B). Diverging learners learn by observation, viewing concrete situations from many different points of view, and like to gather information from many different sources. Assimilators prefer to observe rather than take action when they learn and are less focused on people and more interested in ideas and abstract concepts. Conversely, accommodators prefer to learn by doing and rely on their gut feeling and others, rather than their own analysis, to solve problems. Finally, convergers are action-based learners who make decisions based on their own ability to solve problems and prefer not to deal with social or interpersonal issues.¹¹

Learning-style analysis has been applied to a variety of fields and learning styles are generalized within occupational groups.¹² Studies of medical students have shown that students with a given learning style are more likely to enter

a particular medical specialty.¹³ Learning-style analysis has been applied to evaluate trainees and physicians in a variety of medical fields including internal medicine,¹⁴ pediatrics,^{15,16} anesthesia,¹⁷ family medicine,¹⁸ and surgery,^{6,19,20} with each specialty having a characteristic learning style. However, no study has examined the association of surgical resident learning style with success in surgical training. In this study, we hypothesized that resident learning styles were associated with operative volume, success on surgical boards and attrition from surgical residency.

METHODS

The Kolb LSI (HayGroup, Boston, MA) was administered yearly to categorical general surgery residents at the University of Cincinnati’s Department of Surgery from 1999 to 2012. Accreditation Council for Graduate Medical Education operative log data of graduating general surgery residents were examined. First time pass rates on the American Board of Surgery Qualifying Examination (ABSQE) and American Board of Surgery Certifying Examination (ABSCE) were examined. Finally, records from the Department of Surgery’s Division of Education were queried for those residents who began but did not complete their surgical training at our institution. Statistical analysis was performed using linear regression analysis, the chi-square test for categorical variables and the Wilcoxon rank-sum test for ordinal variables. All statistical analyses were performed using SAS Version 9.2 (SAS Institute, Cary, NC). Significance was defined as $p < 0.05$. This study was approved by the University of Cincinnati’s institutional review board.

RESULTS

Surgery Resident Cohort

From 1999 to 2012, 130 residents trained in general surgery at the University of Cincinnati’s Department of Surgery (Table 1). Of these residents, 115 completed residency or were currently training at the time of our analysis. Over the 14-year period, 126 residents (96.9%) completed 441 learning-style inventories. Surgical residents were predominantly action-based learners, with converging and accommodating being the principal learning styles, whereas the observation-based learners, assimilating and diverging, comprised the minority of learning styles.

Learning Styles and Operative Volume

Our previous work suggested that general surgery resident learning styles do not change over the course of their training.⁶ We examined each resident’s first documented learning style. Using multiple linear regression analysis, a

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