LEARNING STYLES OF PILOTS CURRENTLY QUALIFIED IN UNITED STATES AIR FORCE AIRCRAFT[1]

Craig A. Kanske, Sky Views, L.L.C.
Moore, Oklahoma

ABSTRACT

Kolb's Learning Style Inventory was used to identify the predominant learning styles of pilots currently qualified in United States Air Force aircraft. The results indicate that these pilots show a significant preference for facts and things over people and feelings. By understanding the preferred learning styles of the target population, course material can be developed that take advantage of the strengths of these learning styles. This information can be especially useful in the future design of cockpit resource management training. The training program can be developed to demonstrate both that there are different learning styles and that it is possible to take advantage of the relative strengths of each of these learning styles.

INTRODUCTION

The purpose of this study was to determine the learning styles of pilots currently qualified in United States Air Force aircraft. How students learn is impacted by how the material they are to learn is presented. Studies have shown that more effective learning is achieved when programs take into account the learning styles of the target population (Wooldridge, 1995). Increasing student learning, the desired outcome of all instruction, requires developing an ability to recognize students' learning styles and use techniques that increase the probability of achieving success (Anderson & Adams, 1992).

Craig Kanske, Ed.D., is a retired Air Force pilot and instructor pilot in the E-3 Flight Crew Training program at Tinker Air Force Base, Oklahoma. He is also an adjunct instructor in the Aviation Education Department at Oklahoma State University—Tulsa, Tulsa, Oklahoma; and in the Aviation Department of Southeastern Oklahoma State University at the Oklahoma City Aviation Education Alliance, Tinker Air Force Base, Oklahoma. He earned a Master of Science in Systems Management from the University of Southern California and a Doctor of Education in Aviation and Space Education from Oklahoma State University.

[1]Complete text can be found in: Kanske, C. A. (1998/1999). The learning styles of pilots currently qualified in United States Air Force aircraft (Doctoral dissertation, Oklahoma State University, Aviation and Space Program 1998). *Dissertation Abstracts International*, 9918799.

The study of learning styles has its roots in the field of psychology. There have been two main paths for study as research has moved forward from these roots. One path has followed the classic Pavlovian stimulus-response approach, using reinforcement of successful completion at each step in a sequential learning process. The other path has focused instead on the cognitive processes in learning. Researchers conducting current studies of learning styles have mainly chosen this second path, focusing on the cognitive processes of the learner (Sims & Sims, 1995).

The Myers-Briggs Type Indicator, field dependence/field independence, and brain hemispherocity studies are all examples of measures for cognitive based learning. Another example is the Kolb Learning Style Inventory. There are many other approaches to measuring learning styles, with diverse terminology and measurement instruments. The common ground for all of these approaches, however, is that they attempt to describe the learning styles of the individual by measuring the individual's behavior during the learning process. Through this measurement, each instrument attempts to describe how the individual takes in and processes information. Sims & Sims (1995) provide an apt summary, stating that "…regardless of how that process is described, it is dramatically different for each person" (p. 194).

Kolb's (1984) approach to measuring this learning process is through the experiential learning model. The experiential learning model proceeds from the assumption that all learning is influenced by the prior experiences of the individual learner. Because of this assumption that prior experience influences each new learning event, learning can be viewed as a continuous process. How the learner progresses through this process, or uses this process, becomes the focus for defining that learner's learning style.

The experiential learning model describes four phases of the continuous learning experience. Concrete experience is involvement with the learning event, absorbing the surroundings and activities as they happen. Reflective observation is reviewing the experiences and attempting to determine what is new and different about the experience, and what is similar to previous experiences. Abstract conceptualization is the process of integrating these experiences and reflections into a modified view of the learner's environment. Finally active experimentation is the process of testing this new world view (Kolb, 1984).

The "perfect" learner would use all four modes of learning equally, and would shift around the learning model smoothly with each new learning situation. The "normal" learner, on the other hand, develops a preferred mode of learning. Whether this preferred style is adopted as the result of

positive reinforcement in earlier, similar situations (Schmeck, 1988) or rises from deeper, personality based roots, the effect is that the learner tends to "specialize" in a specific style of learning. Identifying this preferred style of learning is the focus of learning style research.

Kolb's (1985) Learning Style Inventory uses twelve sentence stems with four endings each to measure preferred learning style. Each of the sentence endings indicates a preference for one of the four learning modes associated with the experiential learning model. Summing the responses for each of the twelve sentences yields a set of numbers between 12 and 48 which represents the degree to which the learner emphasizes each of the four learning modes. These scores provide an indication of the balance between the learning modes for the learner.

Because the four stages of the experiential learning model represent polar opposites of two learning scales, it is possible to use the individual element scores to derive a number which represents the individual's position along each of these scales. In Kolb's (1985) Learning Style Inventory this is done by subtracting the score for concrete experience from the score for abstract conceptualization and subtracting the score for reflective observation from the score for active experimentation.

The range of 12 to 48 on each individual learning mode yields range extremes of plus or minus 36 for the active experimentation minus reflective observation and abstract conceptualization minus concrete experience scales. These formulas provide a numerical representation of a learner's relative emphasis for the types of learning represented by each axis. There is no qualitative differentiation between the learning modes; rather this process provides a way to display the results in a linear presentation showing the relative strength of a specific style for an individual.

The quadrant of the graph, formed by these two scales, which contains the combined score for the individual defines that learner's predominant learning style.

Within the experiential learning model the quadrant formed by concrete experience and reflective observation is called divergent learning. The diverger prefers being a part of the learning experience, and thinking about what has happened during that experience. The opposite preference lies in the quadrant formed by abstract conceptualization and active experience and is called convergent learning. The convergent learner takes multiple observations of many events and brings them together into the answer to a specific problem.

The other two quadrants produce assimilative and accommodative learners. The quadrant formed by reflective observation and abstract conceptualization is called assimilative learning. The assimilator is the inductive reasoner who can put together coherent theories based upon observations, integrating multiple observations into a cohesive explanation of the events. The active experimentation/concrete experience quadrant produces the accommodative learner. The accommodator gets things done and is part of the action.

Knowing which learning style the learner prefers provides important information for course design. There is disagreement among researchers over whether it is better to match the preferred learning style to ease the learning process, or to mismatch the style to force the learner to "stretch" into another style. Regardless of which method is preferred, however, there is agreement that this decision must be designed into the course as opposed to being the result of ignoring the possibility that differences in learning styles exist (Sadler-Smith, 1996).

PILOT LEARNING STYLES

The emphasis in pilot training has followed the Pavlovian instead of the cognitive path. Courses for pilot training are based upon task lists which the student must master to successfully complete the training program. The task is presented, demonstrated, and then the student practices until the task is mastered. Appropriate feedback is provided by the instructor during the practice session. There is no effort spent on determining the cognitive based learning style of the student.

In this age of technology and information there is an effort to move some of this training into the classroom using computer based training and simulation (Thiesse, Newmeyer, and Widick, 1992; Treiber, 1994). It is in this effort to apply new technologies to pilot training that understanding learning styles can be helpful in course design. Once the learning style of pilots is understood, the decision to match, or mismatch, these styles can be a conscious one instead of being left to chance.

Currently the predominant learning style of pilots is not well understood. Three studies by Quilty (1995, 1996, 1997) have addressed the global versus analytical cognitive bias of pilots with differing levels of experience. Studies by the United States Air Force (Carretta & Siem, 1988) have focused on predicting the chances of a specific individual successfully completing the Undergraduate Pilot Training program. This study used Kolb's (1985) Learning Style Inventory to identify the predominant

learning styles of pilots currently qualified to fly United States Air Force aircraft.

METHODOLOGY

Initially developed in 1976, and revised in 1984 (Kolb, 1976, 1984), the Learning Style Inventory has been used, and validated, in such diverse studies as comparing learning styles between high school and college students (Matthews & Hamby, 1995), a cross-cultural comparison of the learning styles between Western and Oriental learners (Auyeng & Sands, 1996), and comparisons of the learning styles among European management training students (Jackson, 1995). Recent validation studies such as that conducted by Willcoxson and Prosser (1996) have proven the continued usefulness of the LSI as a measure of predominant learning styles. Based on this history of use no pre-test evaluation of the Learning Style Inventory was conducted for this study.

The sample for this study was generated by the data retrieval section of the Air Force Personnel Center (AFPC). According to S. Heitkamp (personal communication, April 13, 1998) the data storage system has a built in randomization process for extracting names from the master personnel file based on the specified sort criteria. Using this built in system a list of 600 pilots was drawn at random from the Air Force Master Officer Personnel File. Copies of the Kolb Learning Style Inventory and an accompanying demographic data questionnaire were mailed to these 600 United States Air Force pilots in March 1998. Two hundred thirty-three surveys were returned by the end of June 1998, with completed and usable instruments. Another 63 surveys were returned by the United States Postal Service as undeliverable. The return of 233 of 537 surveys provided a 43.8 percent response rate for the study.

The original sample size was chosen using methodology developed by Krejcie and Morgan (1970) to provide a 95 percent probability of matching the population of 14,000 pilots in the United States Air Force. The rank structure of the final sample very closely approximated this population, with slightly fewer captains than expected, and slightly more majors than expected. Table 1 shows the distribution of the sample relative to the population for rank structure, gender, ethnicity, and type of aircraft flown.

Sample distributions for gender and ethnicity also closely approximated population distributions. The sample held 5 percent females and 95 percent males compared to a population of 2.5 percent female and 97.5 percent male. Sample distributions for ethnicity were within two percentage points in all categories. The distribution of the sample based upon type of aircraft

flown was within 3 percent of the population distribution for all types of aircraft. Distribution comparisons for female pilots were not meaningful due to the small number in the sample.

Chi-square analysis of the expected distribution of the sample for rank, gender, and ethnicity produced a statistically significant match between the sample and the population. A Pearson product moment of 28.50146999, with 12 degrees of freedom returns a probability of < 0.005 of achieving the sample distribution by random chance.

Table 1. Sample vs. Population Distributions

	Sample percent	*Population percent*
Grade Distribution		
2LT	3.4	2.0
1LT	5.1	5.0
CPT	48.1	54.0
MAJ	27.9	24.0
LTC	15.5	15.0
Gender Distribution		
Female	5.2	2.4
Male	94.8	97.6
Ethnic Distribution		
American Indian/Alaskan	1.3	0.3
Asian/Pacific Islander	0.4	1.0
Black (non-Hispanic)	1.7	2.0
Hispanic	1.7	1.0
Other	2.6	1.0
White (non-Hispanic)	92.3	94.7
Aircraft Distribution		
Fighter/Attack/Reconnaissance (FAR)	27.5	33.7
Tanker/Transport/Bomber (TTB)	57.1	60.1
Helicopter (HELO)	5.2	5.3
Other/None	0.0	0.5
Both	9.9	0.0

FINDINGS

Kolb's (1984) norming process for the Learning Style Inventory produced median scores of 5.9 for active experimentation minus reflective observation and 3.8 for abstract conceptualization minus concrete experience. The sample result of 5.93 for the active experimentation minus reflective observation axis shows there is no greater emphasis placed upon active experimentation or reflective observation by pilots than is shown in

the general population. The sample result of 8.39 for abstract conceptualization minus concrete experience, however, is significant. Two-tailed t-test probability is less than .0001 for achieving this result at random. Pilots show a significantly stronger tendency to emphasize abstract conceptualization over concrete experience.

Based on this concrete experience and abstract conceptualization data, it can be said that the average pilot in the United States Air Force significantly emphasizes things and thought over people and feelings. The reflective observation and active experimentation data reflects a preference for active participation over observation; however, this preference is not statistically different from the preference shown by the population at large when compared to the norming sample (Kolb, 1984).

Descriptive statistics for the sample, showing the scores for each of the six learning style measurements, are shown in Table 2.

Table 2. Survey Results—Descriptive Statistics

	Mean	Median	Standard Deviation
Concrete Experience	23.85	20.00	10.28
Reflective Observation	28.98	28.00	6.47
Abstract Conceptualization	32.24	32.00	7.23
Active Experimentation	34.91	37.00	9.10
Abstract Conceptualization minus Concrete Experience	8.39	11.00	14.86
Active Experimentation minus Reflective Observation	5.93	9.00	12.41

LEARNING STYLES

Plotting active experimentation minus reflective observation and abstract conceptualization minus concrete experience as the "X" and "Y" axes of a grid forms a matrix which can be used to define the quadrants of the experiential learning cycle. Kolb (1984) used this graphic representation to plot the four learning styles (Figure 1). The median scores for active experimentation minus reflective observation (5.9) and abstract conceptualization minus concrete experience (3.8) define the intersection.

The mean values from the sample were 5.93 for active experimentation minus reflective observation and 8.39 for abstract conceptualization minus concrete experience. When plotted on the style grid these mean values fall on the boundary between Converger and Assimilator. Medians for the sample were 9.0 for active experimentation minus reflective observation and 11.0 for abstract conceptualization minus concrete experience. The
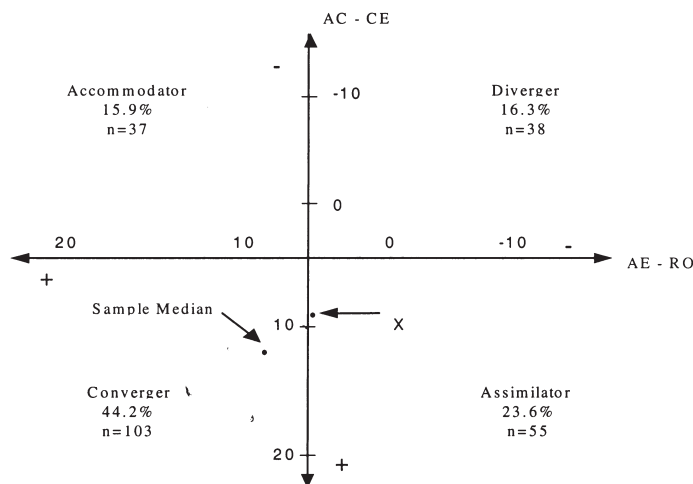
AC - CE

Accommodator
15.9%
n=37

Diverger
16.3%
n=38

-10

0

20   10   0   -10

AE - RO

Sample Median

10

X

Converger
44.2%
n=103

Assimilator
23.6%
n=55

20

Figure 1. Style Grid

plot for these median values falls within the Converger learning style. When individual responses are plotted on this grid 15.8 percent (n = 37) are accommodators, 23.6 percent (n = 55) are assimilators, 44.2 percent (n = 103) are convergers, and 16.3 percent (n = 38) are divergers.

This distribution of learning styles is significant (p < .0001) relative to a hypothetical distribution of 25 percent in each style as would be shown in a random sample of the population at large. This significance corresponds to the predictive nature of the Learning Style Inventory (Kolb, 1984). In the case of pilots currently qualified in United States Air Force aircraft, the predominant learning style is convergence. A secondary learning style is assimilation. Divergent and accommodative learning styles are each used by significantly small groups of pilots within the study group.

The analysis of pilots' learning styles was based upon average data for the entire sample. Demographic data was collected for military rank, gender, ethnicity, type of aircraft flown, and number of flying hours. In all categories except ethnicity the convergent learning style was the predominant selection at a statistically significant level. Analysis of learning styles by ethnicity was not accomplished due to the small numbers of non-white ethnic groups within the sample.

CONCLUSIONS

The predominant learning style of pilots currently qualified in United States Air Force aircraft is the convergent learning style. This learning style fits within the predictive nature of Kolb's (1985) Learning Style Inventory as demonstrating traits which are valuable in specialist and technical fields. There are implications for future course design to match this learning style.

Learners with the convergent style prefer to know how it works as opposed to who says it works. These learners want to do it themselves rather than being shown how to do it, but they would rather be shown that it works than take an expert's word that it works. This will be especially important in the design of computer based training modules which introduce new equipment and technology to pilots during training courses. How the system fits together, and why it works, are more important to convergers than just being told that the system works.

The secondary learning style for pilots currently qualified in United States Air Force aircraft is the assimilative style. This style is included as a secondary learning style because of the relationship convergent and assimilative learning styles have relative to concrete experience and abstract conceptualization. Both styles show a preference for abstract conceptualization over concrete experience. The choice between a preference for active experimentation over reflective observation is the difference in learning preference which separates the converger from the assimilator. Although more individuals fell into the converger learning style than the assimilator learning style, the sample mean, very close to the dividing point between these two styles, was used in considering the assimilative style as a secondary learning style for the pilots in this study.

There are similar considerations for designing future courses for the accommodative learners in the class. They share the converger's desire to know how something works rather than who says that it works. Their preference for reflective observation, however, can lead them to look for all the available alternatives and overlook the fact that they have a workable solution already. Building into the training program justifications for limiting the scope of information will be important for the assimilative learner.

Taken together, the predominant converger learning style and the secondary assimilative learning style support the effectiveness of the current training program. The abstract conceptualization focus shared by these two learning styles works well with the demonstration/performance mode of teaching because of the focus on how things work as opposed to who says these things work. By seeing how things are done, and

understanding the implications, the abstract conceptualizer can work from the individual parts to create a whole.

The balance between reflective observation and active experimentation shown by the mean score of the sample also supports the current training program. This balance between careful observation and risk taking, and looking at problems from many angles and putting this information into action form the basis for sound decision making in the time-critical nature of aviation.

In short, the very things which are used to predict successful completion of Undergraduate Pilot Training (Carretta & Siem, 1988) are the factors which appear in the predominant learning style of current United States Air Force pilots. The sorting process coincides with two elements of the experiential learning model. The first element is socialization, where working in aviation tends to emphasize certain characteristics within the individual due to the requirements of the task. The second element is the process of the individual tending to gravitate towards a field where the requirements match that individual's personal characteristics. This process of specialization provides a basis for the predictive nature of the learning style inventory and the experiential learning model (Kolb, 1984).

One of the current areas of emphasis in aviation training is crew resource management. This training program emphasizes skills in relating to other individuals, both on the crew and in positions which interact with the crew focusing on team coordination, attitudes, behaviors, and communications (Driskell & Adams, 1992). Addressing learning styles within crew resource management training courses can provide an additional approach to defining the issues for all crewmembers. Understanding individual differences provides a critical stepping stone toward improvement within these areas.

Pilots with the predominant converger learning style "…would rather deal with technical tasks and problems than with social and interpersonal issues" (Kolb, 1985, p. 7). The focus of crew resource management training is these very social and interpersonal issues. The characteristics of the convergent learner, as well as the other learning styles, should be incorporated into course design for crew resource management training. Analyzing the different learning styles, including the differences between the styles and the strengths and weaknesses of each style, allows the group to make better use of the skills available through its individual members (Sims & Sims, 1995).

Incorporating learning styles into the design of crew resource management training provides an opportunity for better understanding of

the fact that there are different approaches to the same problem. Understanding the differences in the approach and bias associated with each learning style, and focusing on the learning style instead of the individual, personal conflict over differences and misunderstandings are possible (Sharp, 1997). This approach to the interpersonal issues associated with functioning as an aircrew member provides an opportunity to address these issues in a way that is compatible with all four learning styles.

IMPLICATIONS AND RECOMMENDATIONS
FOR FURTHER STUDY

This study identified the convergent learning style as the predominant mode of learning for a statistically significant portion of currently qualified pilots in the United States Air Force. A statistically significant distribution of learning styles among these pilots was also identified. The information gained through this process provides a starting point into understanding how pilots learn. The convergent learning style is consistent with the technical nature of aviation, the decision-making requirements of flying, and the necessity to process large amounts of information during a flight.

Further study of the relationship among these three areas is appropriate. Such studies would be useful in determining if correlations exist between learning styles, cognitive biases, and successful completion of aviation training programs. It would also be informative to know where, if anywhere, within the training process the sorting for learning styles and cognitive bias occurs.

This study further examined only currently qualified United States Air Force pilots. A study comparing the learning styles of those individuals completing Undergraduate Pilot Training with the learning styles of those who failed to complete the course would be informative. Such a study would necessarily include observations of the cause for failure to complete the training program. Currently, qualified pilots exist who do not fall within the predominant learning style. Understanding why certain individuals do not successfully complete Undergraduate Pilot Training may provide information which will allow more individuals with these minority learning styles a greater chance of success in the training program.

The predominant learning style for all of the pilots in this study was convergence. This style held a statistically significant position regardless of gender, degree type, total flying experience, or military rank, which is also an indicator of age. Why pilots share a predominant learning style, regardless of other factors which indicate a tendency towards different preferred learning styles, is a matter for further study. Information on what

factors are shared by pilots, which become dominant factors in determining preferred learning style, could be correlated with success and failure rates for pilot training.

This study, and the above recommendations, applies to the training of pilots in the United States Air Force. With almost 150 colleges offering professional pilot degree programs (Schukert, 1995), and current interest in the requirements for a non-technical doctoral program in aviation (Johnson, 1997), the learning styles of students within these programs are appropriate for study. A study focusing on college and university participants would provide correlational data for comparison to pilots training in the United States Air Force training program.

In addition to the cognitive bias studies conducted by Quilty (1995, 1996, 1997) on college students in aviation, and corporate and airline pilots, studies of the primary learning styles of these groups of pilots are also appropriate. Correlational studies among these groups would also then be possible. These groups of pilots would also provide an opportunity for longitudinal studies to determine the stability of learning styles over the career of a pilot. Such longitudinal studies would be useful when comparing career changes within aviation.

Understanding how pilots learn has significant implications for effective training of current and future pilots. While learning style research has investigated many learning situations, aviation students have not been studied. The academic and personal benefits associated with matching, or intentionally not matching, learning styles have been identified in many areas. It is appropriate to bring this understanding to the aviation training and education community. Incorporating the findings of academic research into the training of pilots, academically and professionally, can provide this same opportunity to enhance the learning process in this field of study.

SELECTED BIBLIOGRAPHY

Anderson, J. A., & Adams, M. (1992, Spring). Acknowledging the learning styles of diverse student populations: Implications for instructional design. *New Directions for Teaching and Learning, 49 (Teaching for Diversity)*, 19–33.

Auyeng, P., & Sands, J. (1996, November). A cross cultural study of the learning styles of accounting students. *Accounting and Finance, 36*, (2), 261–275.

Carretta, T. R., & Siem, R. M. (1988). *Personality, attitudes, and pilot training performance: Final analysis*. (Air Force Human Resources Laboratory Technical Paper 88–23). Brooks Air Force Base, TX: Manpower and Personnel Division.

Driskell, J. E., & Adams, R. J. (1992, August). *Crew resource management: An introductory handbook*. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration Research and Development Service. (NTIS No. PB93-101525)

Jackson, T. (1995, June). European management learning: A cross-cultural interpretation of Kolb's learning cycle. *Journal of Management Development, 14*, (6), 42–51.

Johnson, J. A. (1997). Curriculum Design Issues in Developing a Doctor of Philosophy Program in Aeronology. *Journal of Air Transportation World Wide (On-line journal), 2* (1), 81–92. http://unomaha.edu/~himbergr/aviation.html.

Kolb, D. A. (1976). *The learning style inventory: Technical manual*. Boston: McBer and Company.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, N.J.: Prentice-Hall.

Kolb, D. A. (1985). *Learning style inventory: Self-scoring inventory and interpretation booklet*. Boston: McBer and Company.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Education and Psychological Measurement*, 30, 607–610.

Matthews, D. B., Hamby, J. V. (1995, March-April). A comparison of the learning styles of high school and college university students. *The Clearing House, 68* 4, 257 (5).

Quilty, S. M. (1995). Cognitive learning preferences among corporate aviation pilots. In R. S. Jensen & L. A. Rakovan (Eds.), *Proceedings of the Eighth International Symposium on Aviation Psychology, Vol. 2*, (pp. 815–819). Columbus: The Ohio State University.

Quilty, S. M. (1996). Cognitive learning bias of college students in an aviation program. *Journal of Air Transportation World Wide (On-line journal), 1*, http://unomaha.edu/~himbergr/aviation.html.

Quilty, S. M. (1997). Cognitive learning preferences among airline pilots. In R. S. Jensen & L. A. Rakovan (Eds.), *Proceedings of the Ninth International Symposium on Aviation Psychology, Vol. 2*, (pp. 409–414). Columbus: The Ohio State University.

Sadler-Smith, E. (1996, July). Learning Styles: A holistic approach. *Journal of European Industrial Training, 15* (7), 29–37.

Schmeck, R. R. (Ed.). (1988). *Learning strategies and learning styles*. New York: Plenum Press.

Schukert, M. A. (1995). Collegiate pilot education: An overview of contemporary pilot degree programs, sponsors and graduates. *Journal of Studies in Technical Careers, 15* (4), 197–206.

Sharp, J. E. (1997, June). Applying Kolb learning style theory in the communication classroom. In M. A. Dyrud, Focus on teaching. (learning styles). *Business Communication Quarterly, 60*, (2), 124–135.

Sims, R. R., & Sims, S. J. (Eds.). (1995). *The importance of learning styles: Understanding the implications for learning, course design, and education*. Westport, CT: Greenwood Press.

Thiesse, J. L., Newmeyer, D. A., & Widick, L. L. (1992). FBO and airport internships for university aviation students: Benefits for students, universities, and the aviation industry. *Journal of Studies in Technical Careers, 14* (4), 253–264.

Treiber, K. (1994, December). *Sweaty palms! Virtual reality applied to training*. Paper presented at the annual meeting of the American Vocational Association Convention, Dallas, TX.

Willcoxson, L., & Prosser, M. (1996). Kolb's Learning Style Inventory (1985): Review and further study of validity and reliability. *British Journal of Psychology, 66*, 247–259.

Wooldridge, B. (1995). Increasing the effectiveness of university/college instruction: Integrating the results of learning style research into course design and delivery. In R. R. Sims & S. J. Sims (Eds.) *The importance of learning styles: Understanding the implications for learning, course design, and education* (pp. 49–68). Westport, CT: Greenwood Press.