

## Gender differences in learning style preferences among undergraduate physiology students

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**Wehrwein EA, Lujan HL, DiCarlo SE.** Gender differences in learning style preferences among undergraduate physiology students. *Adv Physiol Educ* 31: 153–157, 2007; doi:10.1152/advan.00060.2006.—Students have individual learning style preferences including visual (V; learning from graphs, charts, and flow diagrams), auditory (A; learning from speech), read-write (R; learning from reading and writing), and kinesthetic (K; learning from touch, hearing, smell, taste, and sight). These preferences can be assessed using the VARK questionnaire. We administered the VARK questionnaire to undergraduate physiology majors enrolled in a capstone physiology laboratory at Michigan State University; 48 of the 86 students (55.8%) who returned the completed questionnaire voluntarily offered gender information. The responses were tallied and assessed for gender difference in learning style preference; 54.2% of females and only 12.5% of males preferred a single mode of information presentation. Among the female students, 4.2% of the students preferred V, 0% of the students preferred A, 16.7% of the students preferred printed words (R), and 33.3% of the students preferred using all their senses (K). In contrast, male students were evenly distributed in preference, with 4.2% of the students preferring A, R, or K, respectively, while 0% of the students preferred V. Furthermore, 45.8% of female and 87.5% of male respondents preferred multiple modes [female: 2 modes (12.5%), 3 modes (12.5%), and 4 modes (20.8%); males: 2 modes (16.7%), 3 modes (12.5%), and 4 modes (58.3%)] of presentation. In summary, a majority of male students preferred multimodal instruction, specifically, four modes (VARK), whereas a majority of female students preferred single-mode instruction with a preference toward K. Thus, male and female students have significantly different learning styles. It is the responsibility of the instructor to address this diversity of learning styles and develop appropriate learning approaches.

visual; auditory; read-write; kinesthetic; VARK; learning modes; medical education; knowledge transfer

DO MEN AND WOMEN learn differently and/or have different preferred ways of learning? Are there male and female preferences in learning styles rooted in evolutionary biology and/or overwhelming social differences? Are these appropriate questions in this era of “political correctness” and why would we ask these questions anyway? We ask these questions because the answers may dramatically alter the ways in which we teach.

It is clear that there is an emotional debate regarding a gender gap in math and science (14). This debate is further inflamed by questions regarding “innate differences” between males and females and theories that claimed that women were biologically incapable of reason (14). However, despite the

passions and political correctness encountered by former Harvard President Larry Summers (Summers suggested that the gender gap in math and science might be due to “issues of intrinsic aptitude”), these are important questions that must be addressed by the academic community if we are to provide quality education.

The quality of physiology undergraduate education is vitally important whether students are preparing for a career or transitioning to medical or graduate school. Employers and postbaccalaureate educators presume that graduates of a physiology department have a certain set of knowledge and skills that will serve them well in their chosen career or in postgraduate education (5, 6). In addition, during undergraduate training, instructors of higher-level courses presume that students have learned material in prerequisite courses and will carry this information with them into future courses. Therefore, there is a strong need to improve learning and retention during undergraduate education to ensure that students are prepared to handle the challenges that they will face both in future courses and after graduation. As instructors, we need to find ways to improve instruction at all levels of education to improve student learning, retention, and motivation.

One way to improve student motivation and performance is to adapt teaching approaches to meet the different learning style preferences of our students (21). Learning style preferences are the manner in which, and the conditions under which, learners most efficiently and effectively perceive, process, store, and recall what they are attempting to learn (16). Although it is known that students have a variety of learning style preferences (20), it is unknown if gender differences in learning style preferences exists among undergraduate physiology students. Knowing the students’ learning style preferences will aide in the development of the most effective teaching approaches (25).

There are many methods available for assessing learning styles, with each method offering a distinctly different view of learning style preferences. The method used in this study defines the preference in learning style based on the sensory modality in which a student prefers to take in new information. The three major sensory modalities are defined by the neural system that is preferred when receiving information: visual (V), aural (A), and kinesthetic (K), collectively known as VAK. In other words, VAK categorizes student learning based on the sensory preference of the individual. This classification system was recently expanded by Fleming (11) to VARK to

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include another category: read-write (R, a mixed sensory modality that is not assessed under VAK).

Students with a V preference learn best by seeing or observing (drawings, pictures, diagrams, demonstrations, etc). Learners that prefer A are best suited to learn by listening to or recording lectures, discussing material, and talking through material with themselves or others. R-type learners learn through interactions with textual materials. K-style learners perform best by using physical experiences: touching, performing an activity, moving, lessons that emphasize doing, and manipulation of objects. Student learners are capable of using all of these sensory modes of learning; however, each individual has a unique preference, or set of preferences, in which one mode is often dominant (8). Learners with a single learning style preference are referred to as unimodal, whereas others preferring a variety of styles are known as multimodal. Of the multimodal learners, there are subclassifications for bi-, tri-, and quadmodal learners, who prefer to use two, three, or four styles, respectively.

We were interested in assessing the preferred learning styles of physiology undergraduate majors to determine if males and females have similar learning styles. Having this information may assist in the development and implementation of gender-specific teaching approaches that would maximize student motivation and learning by tailoring instruction to student needs. To achieve these aims, we tested the hypothesis that males and females have different learning style preferences. Fleming's (12) VARK inventory tool for assessing individual learning style preferences was administered to our undergraduate physiology majors.

## METHODS

**Design.** To test the hypothesis that males and females have different learning style preferences, the VARK questionnaire developed by Fleming was administered to our undergraduate physiology majors. VARK was selected due to its ease of use (a simple 13-question survey), its free availability online for both students in this study and for readers of this article who may wish to use this tool in their classroom, and its simplicity of online usage for students and instructors to learn more about their own, or their students', learning styles. In addition, this tool offers both students and instructors a method to enhance student learning by better understanding preferred modes of information transfer. The following are internet links for the VARK homepage and questionnaire: <http://www.vark-learn.com/english/index.asp> and <http://www.vark-learn.com/english/page.asp?p=questionnaire>. The VARK questionnaire (12) was administered to 86 students at the end of the semester in a capstone physiology course at Michigan State University. We administered the questionnaire as a hard copy that was completed in class; however, the VARK questionnaire is freeware that can be completed online. This study has been reviewed and approved by the human investigation committee of the institutional review board at Michigan State University (Project Approval No. X06-809).

**Procedures.** The VARK questionnaire was administered to junior- and senior-level undergraduates enrolled in a capstone physiology laboratory course at Michigan State University. The physiology capstone laboratory is a required course for physiology majors and is a hands-on course in which students work in groups to perform physiological experiments. Each session has a brief lecture and corresponding laboratory. Grades are based on a formal laboratory report in the form of a scientific paper written by each laboratory group for each weekly topic and a brief oral presentation of the data obtained. Grades are based on group work rather than individual performance.

Forty-eight of the 86 (55.8%) students who returned the completed questionnaire voluntarily provided gender information. This sample size represents a 55.8% response rate from the students in the class and is markedly above the level required to make conclusions about student preferences for receiving and processing information. The responses were tallied and assessed for gender differences in learning style preference.

**Analysis.** Data are reported as percentages of students in each category of learning style preference. The number of students who preferred each mode of learning was divided by the total number of responses to determine the percentage.

## RESULTS

Figure 1 shows the percentages of female and male students who preferred unimodal versus multimodal information presentation. Females preferred unimodal learning, whereas males preferred multimodal learning. Specifically, 54.2% of females and only 12.5% of males preferred a single mode of information presentation. Of the females who preferred multiple modes of information presentation (45.8%), 12.5% of the students preferred two modes (bimodal), 12.5% of the students preferred three modes (trimodal), and 20.8% of the students preferred four modes (quadmodal). Of the males who preferred multiple modes of information presentation (87.5%), some preferred two modes (bimodal, 16.7%), three modes (trimodal, 12.5%), or four modes (quadmodal, 58.3%).

Of the female unimodal learners, 4.2% of the students preferred V, 0% of the students preferred R, 16.7% of the students preferred A, and 33.3% of the students preferred K (Fig. 2, *left*). In contrast, males were evenly distributed in unimodal preference with 4.2% of the students preferring A, R, or K, whereas 0% of the students preferred V (Fig. 2, *right*).

Quadmodal was the preferred style among male multimodal learners, whereas females had a variety of preferences. Of the female students who preferred three modes of information presentation, some students preferred V, R, and K (4.2%), some students preferred V, A, and K (4.2%), and some students preferred A, R, and K (4.2%). Of the female students who preferred two modes of information presentation, some stu-

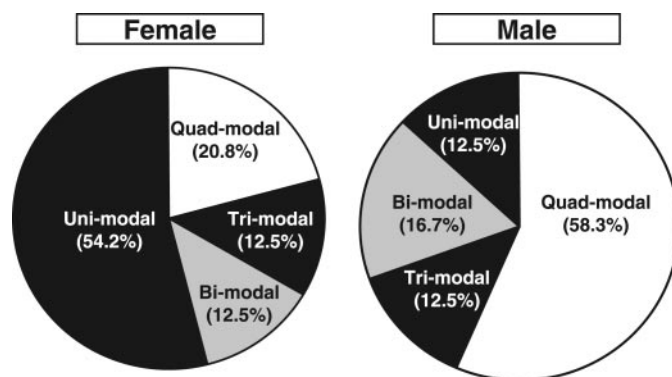


Fig. 1. Females prefer unimodal learning, whereas males prefer multimodal learning. *Left*: 54.2% of females preferred a single mode of information presentation. Of the females who preferred multiple modes of information presentation, some preferred two modes (bimodal, 12.5%), three modes (trimodal, 12.5%), or four modes (quadmodal, 20.8%). *Right*: 12.5% of males preferred a single mode of information presentation. Of the males who preferred multiple modes of information presentation, some preferred two modes (bimodal, 16.7%), three modes (trimodal, 12.5%), or four modes (quadmodal, 58.3%).  $n = 48$  respondents.

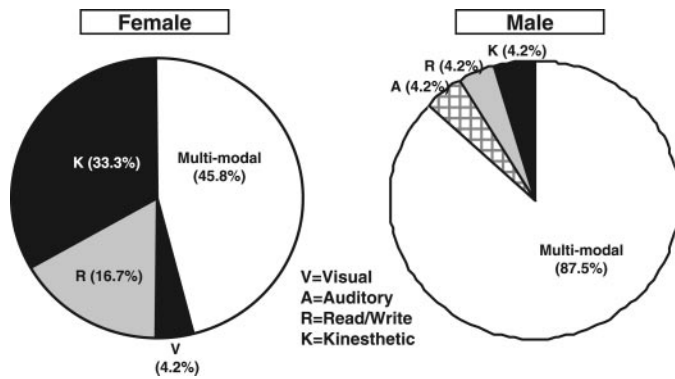


Fig. 2. Percentage of each gender that preferred visual (V), auditory (A), read-write (R), or kinesthetic (K) as their unimodal preference. *Left:* 4.2% of females preferred V, 0% preferred A, 16.7% preferred R, and 33.3% preferred K. *Right:* males were evenly distributed in unimodal preference with 4.2% preferring A, R, or K, whereas 0% preferred V.  $n = 48$  respondents.

dents preferred V and K (4.2%), some students preferred A and K (4.2%), and some students preferred R and K (4.2%). Of the students who preferred four modes of information presentation, all students preferred V, A, R, and K (20.8%; Fig. 3, *left*). Of the male students who preferred three modes of information presentation, equal percentages preferred V, R, and K (4.2%); V, A, and K (4.2%); and A, R, and K (4.2%). Of the male students who preferred two modes of information presentation, 8.3% preferred V and K, while equal percentages preferred A and R (4.2%), and R and K (4.2%). Of the students who preferred four modes of information presentation, all students preferred V, A, R, and K (58.3%; Fig. 3, *right*).

## DISCUSSION

The purpose of the study was to assess gender differences in learning style preferences among undergraduate physiology students. This study was performed as a followup to Lujan and DiCarlo's assessment of learning styles preferences among first-year medical students, which showed that among medical students, only 36.1% of the students preferred a single mode of information presentation. In contrast, most students (63.8%) preferred multiple modes of information presentation (20). In that study, the authors suggested that gender differences in learning preferences be assessed. To address this important issue, we administered the VARK questionnaire to physiology undergraduate students enrolled in a capstone laboratory course and asked students to voluntarily provide gender information.

The responses were tallied and assessed for gender differences in learning style preferences. Importantly, 87.5% of males but only 45.8% of females preferred multiple modes of presentation. Thus, in contrast to females, the majority of males preferred multiple modes of information presentation. Male students may adjust to the different teaching styles faced in a day or they may opt in and out of alternative strategies, such as being visual in cardiovascular physiology and reading/writing in respiratory physiology, for example (11).

In contrast, the majority of female students (54.2%) preferred a single mode of information presentation, either V, A, R, or K. Unlike male students, females preferred information to be presented in a single mode. Although female learners can use all of the sensory modes in learning, one mode is dominant

and preferred. Finally, only 12.5% of males preferred a single mode of information presentation. Some students, male or female, may prefer one of the modalities over the others so strongly that they struggle to understand the subject matter unless special care is taken to present it in their preference mode.

The knowledge of student preferred learning styles is vital if we, as educators, are to provide tailored strategies for individual students (11). Knowing students' preferred learning style also helps to overcome the predisposition of many educators to treat all students in a similar way (11) as well as motivate teachers to move from their preferred mode(s) to using others. In so doing, they can reach more students because of the better match between teacher and learner styles (1, 2, 9, 13, 17, 18, 21, 22, 24, 26). For example, there is a clear trend in university teaching to instruct all students in the same way (i.e., a straight lecture format). Educators use this lecture format because of the relative ease of information passing, the need to cover the content, a long history of traditional lecturing, and perhaps due to their own preferences in learning. The results of the VARK questionnaire should convince teachers to use multiple modes of information presentation. This may require instructors to stray from their own preferred mode(s) of teaching and learn to using a variety of styles, which will positively affect learning. By using a variety of teaching approaches, teachers will reach more students because of the better match between teacher and learner styles.

In some cases, it may be difficult to tailor coursework to the individual learning styles of each student. However, in these situations, by being aware of their learning style, the students may contribute to their academic success by promoting self-awareness and their use of learning strategies that work for their learning style (25). It is essential that an instructor's teaching style provide access for students with different learn-

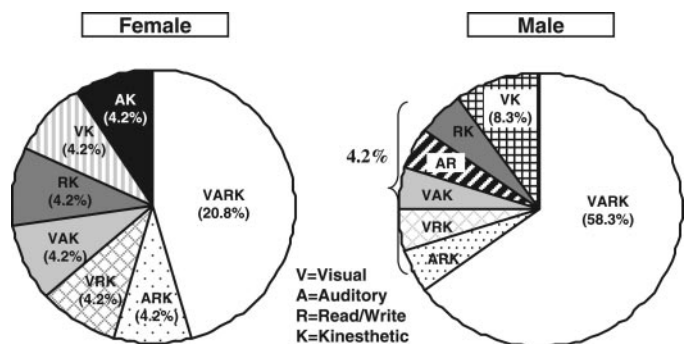


Fig. 3. Quadmodal is the preferred style among male multimodal learners, whereas females have a variety of preferences. *Left:* of the female students who preferred three modes of information presentation, some students preferred V, R, and K (4.2%); some students preferred V, A, and K (4.2%); and some students preferred A, R, and K (4.2%). Of the female students who preferred two modes of information presentation, some students preferred V and K (4.2%), some students preferred A and K (4.2%), and some students preferred R and K (4.2%). Of the students who preferred four modes of information presentation, all students preferred V, A, R, and K (20.8%). *Right:* of the male students who preferred three modes of information presentation, equal percentages preferred V, R, and K (4.2%); V, A, and K (4.2%); and A, R, and K (4.2%). Of the male students who preferred two modes of information presentation, 8.3% preferred V and K, while equal percentages preferred A and R (4.2%) and R and K (4.2%). Of the students who preferred four modes of information presentation, all students preferred V, A, R, and K (58.3%).  $n = 48$  respondents.

ing styles during the experiences of a course. The key to retaining a broad swath of students interested in science is differentiated instruction, a teaching style that derives from multiple pedagogical approaches and not a singular approach (25).

There is a large body of literature available on gender differences in learning, and providing a comprehensive review of this topic is beyond the scope of this paper. Briefly, a gender-based preference in learning style is only one area in which males and females are unique. It has been reported that males have a preference for rational evaluation and logic, whereas females use “elaborative” processing in which they tend to seek personal relevance or individual connections with the material being taught (19). In addition, males tend to be more achievement oriented, whereas females are more socially and performance oriented (7). The genders also differ in their beliefs about what is most important to student learning, with females ranking social interaction with other students and self-confidence as higher than males (3). Furthermore, males are likely to attribute their success in the classroom to external causes, such as teaching, whereas females generally see their success as being directly related to their efforts in the classroom (15). This suggests that males tend to be more externally focused, but females tend to be more introspective and self-critical.

*Limitations and strengths of VARK.* This survey has not been statistically validated and that represents a limitation to this study. Educational investigators have been attempting to find a way to validate VARK. Unfortunately, they have not been able to find a satisfactory statistical method that validates the four-factor model that is the basis of VARK. Dr. Marilla Svinicki at the University of Texas suggests that the problem is due, in part, to the wording of some of the items, which confuse the perspective of the learner with the individual with whom the learner might be communicating as well as the multiple options that an individual can choose in answering (12). To address this concern, the originators of the questionnaire ask each person who completes the questionnaire on their website (<http://www.vark-learn.com/english/index.asp>) to provide information about themselves. Most do. One question asks whether their VARK profile matches their perception of their preferences for learning. The other options are “don’t know” and “no match”. The percentages for those aged 19 or older are as follows: match = 58%, don’t know = 38%, and no match = 4%. Although self-perceptions are not always reliable, these results support the value of the VARK questionnaire.

Despite this limitation, there is substantial evidence for the existence of modality-specific strengths and weaknesses (for example, in visual, auditory, or kinesthetic processing) in people with various types of learning difficulty (23). Furthermore, a person’s preference as to whether tasks or activities are presented to appeal to auditory, visual, tactile or kinesthetic senses (modality preference) is an important consideration for educators (4).

Importantly, a number of strengths emerge from VARK analysis. For example, it offers a positive, inclusive affirmation of the learning potential of all students. The VARK philosophy encourages a belief that everyone can learn if their preferences are addressed. This view of learning encourages teachers to ask themselves an insightful and critical question, namely:

How can we teach our students if we do not know how they learn? (10).

In addition, VARK encourages teachers to respect differences and reject negative judgments about learners. VARK promotes the idea that students are able to learn in different ways, providing that the methods of teaching are appropriate to the students’ preferences. The approach encourages learners and teachers to believe that it does not matter how people learn as long as they do learn.

VARK also has support among practitioners and encourages a range of teaching and assessment techniques. VARK encourages flexibility and imagination in designing resources and in changing environmental conditions. It changes the teachers focus as they begin to respond more sensitively to the different learning preferences of their students. VARK also encourages teachers to reexamine their own learning and teaching styles. Finally, VARK encourages teachers and students to talk about learning and gives them a language (e.g., kinesthetic) that may legitimize behaviors, such as moving about the room, etc.

Another concern is that we did not provide or compare any (grouped) data about male and female learning/performance in the course. It would be important to know if a correlation between learning style and learning/performance exists. For example, did males score higher than females in the course? Did females learn faster or retain knowledge longer? We wish this were possible because it of great interest to the authors and will be the topic of future studies. However, the trouble with providing grouped performance data for this study is that the grades in the capstone physiology laboratory course are not individual but rather are a product of laboratory reports and presentations that were done as a group. Since all groups were of mixed gender, it is impossible to provide performance information for individuals. Furthermore, we did not conduct a followup study to assess knowledge retention. In future studies, we would like to study another course in which grades and performance are individualized and can be linked to student performance.

Since the survey was anonymous, it is difficult to make any definite conclusions that link a particular observation of student actions or performance to a type of learning style. Since there were a range of learning modalities among both genders, this type of commentary is difficult without knowing which student preferred which style. However, it was notable that the laboratory section with the highest percentage of K-type learners was observed by the instructor prior to the survey to be the most successful laboratory section that semester in terms of organization, efficiency, and overall performance.

*Future directions.* It has been established that there are a variety of learning styles present in the classroom, and, as such, there are some students that are not reached by the standard lecture format. Furthermore, this study demonstrated that there are gender differences in learning styles such that males tend to be multimodal and females tend to be unimodal. Several issues still need to be addressed. In particular, does learning style preference correlate with performance? Does student knowledge of their learning style allow them to perform better by adapting the information to their own preferred modality while studying or by finding study partners that can present the material in an alternative manner? Do K-style learners have the advantage in hands-on laboratory courses? Do A-style learners excel in the standard lecture format? Importantly, how does the

instructor tailor the lesson to accommodate all learners and does accommodating to learning preference really alter learning outcomes?

**Conclusions.** Student learning style preferences can be determined by the use of the VARK questionnaire, which can assist both the learner and educator in identifying individual student preferences in the manner in which information is presented. There is a significant difference in learning style preferences between males and females. As such, it is the responsibility of the instructor and the student to be aware of student learning style preferences to improve learning. As instructors, we need to assess and understand how to reach all students by understanding how to present information in multiple modes. We can help students more effectively, both in and out of the classroom, if we are aware of their learning style and can assist them in determining their preferences. As a student, it is vital to be self-aware of preferences to adjust study techniques to best fit each individual, even when the information and instruction provided does not match the preferred style.

It is important to note that the results do not suggest that there is an innate difference in aptitude between genders, nor is it promoting separation of genders in the learning process (i.e., separate science classes for males and females). This study asserts that males and females have difference preferences in learning style. As suggested by Lie et al. (19), this actually supports mixed gender classrooms and study groups to allow both genders the opportunity to learn from each other.

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