Dichotomous Thinking in Nuclear Medicine Technology

Steven B. Dowd and Norman E. Bolus

School of Health-Related Professions, University of Alabama at Birmingham, Birmingham, Alabama

Dichotomous thinking is the natural human tendency to think in a binary manner (either-or). Although it is natural, dichotomous thinking can be simplistic and may lead to a lack of consideration of alternatives. In nuclear medicine, a predominant use of dichotomous thinking can lead to a very elementary way of thinking that may produce technologists who do not question why or how things are done. Adaptation and survival in today's health care environment require complex ways of thinking. This article describes dichotomous thinking and its problems and pitfalls in nuclear medicine practice and education, and suggests that dichotomous thinking can be extended to dialectical (contradictory ideas) modes of thinking.

Key Words: critical thinking; decision making; professional practice

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To some extent, all humans exhibit dichotomous or binary thinking, which is the tendency to view things as black or white, true or false, risky or safe, or on or off. The same is often true in the educational setting. Students are taught to think in terms of right or wrong, and often are told the "one right answer" to a problem.

Of course, there are situations in which one right answer exists, but there are many more situations in which there are multiple alternatives. This requires thinking along contradictory lines of reasoning, often called critical or dialectical thinking (*1*). Certainly managers, who are looking for individuals able to do many things (multiskilling) and adapt to a new health care environment, want to hire practitioners who are able to engage in thinking that extends beyond the simplistic "one right way" of doing things.

OVERVIEW OF DICHOTOMOUS THINKING

John Dewey, the dialectical philosopher and main proponent of progressive education in the U.S., was probably one of the first to note the relationship between humanity's predilection for thinking in terms of extreme opposites (known as either-ors), the corollary predilection to not recognize intermediate possibilities, and trying to bring about change through education (*2,3*). Dialectical philosophy is based on the principle that an idea or event known as the thesis generates an opposite known as its antithesis, which can then lead to a reconciliation of opposites (synthesis). A skilled teacher might, therefore, adopt the polar opposite view of a student to make that individual consider all the possibilities between the opposites and, perhaps, find an alternative solution in the middle. This is sometimes called a triadic approach, as it recognizes the existence of at least three alternatives instead of two.

More recently Perry (*4*) studied male students who had a dualistic world view of we-right-good versus other-wrong-bad. This view can be seen as an extension of Piaget and Inhelder's (*5*) description of heteronomy, in which children valued conforming to the commands of an authority figure. Perry's college students tolerated no gray areas and found comfort in agreeing with authority. Berlin (*6*) indicates that dichotomous thinking highlights extremes, superimposes a value hierarchy, neglects nuances of meaning and leaves us with limited possibilities for understanding and action. She argues, however, that using dichotomies as contrasting truths can broaden what we know and what we can do. This would expand on a true dichotomy that is a narrow set of either-or options.

Why is dichotomous thinking dangerous? If the status quo is accepted as good and change is viewed as bad, then this type of thinking does not accept change as a real possibility. This allows no new ideas to emerge. Not only are the old ways seen as the best ways, new ways are seen as wrong ways or even as evil. The research of Belenky et al. (*7*) described a group of individuals known as received knowers. These were individuals who expected others to tell them the truth. These individuals see the "truth-tellers" as those who are "right" and all other views as "wrong." She correlated this behavior with low self-esteem.

In the critical thinking literature, Paul (*8*) has noted the existence of monological or one-dimensional thinking, similar to dichotomous thinking, in that only one point of view is seen as valid. He also postulates the existence of "weak-sense critical thinkers" who have mastered some of the processes of

For correspondence or reprints contact: Steven B. Dowd, EdD, RT(R), University of Alabama at Birmingham, School of Health-Related Professions, 1714 Ninth Ave. South, Birmingham, AL 35294-1270.

critical thinking but not the underlying philosophical assumption, and are unwilling to use critical thinking to challenge their own views. They use critical thinking to "shore up their own beliefs."

A major theme in the adult education literature is the degree to which one becomes more relativistic in one's thought processes (*9*). Thus, experienced thinkers, to use an analogy from radiography, show an ability to appreciate longer-scale contrast, and the resultant increased information that is shown over short-scale contrast radiographs.

IS DICHOTOMOUS THINKING ALWAYS BAD?

Representing dichotomous thinking as always bad is, of course, itself a type of dichotomy. In fact, as a first step, it is often useful to dichotomize a thought or argument, as evidenced in the earlier discussion on dialectic philosophy. For example, in discussing ethical issues such as abortion or euthanasia, there are the obvious polar extremes of "for" and "against." With additional reasoning, it is easy to see that there are circumstances in which being either for or against in all instances would be overly limiting. Examples include abortion when giving birth might endanger the mother's life, or euthanasia when quality of life versus length of life becomes an issue. Thus, a useful definition might be that dichotomous thinking recognizes two alternatives and quickly assigns a value to them (e.g., good-bad), whereas dialectical thinking recognizes at least two alternatives, but develops an internal "balance sheet" that collects evidence before assigning a value to each choice.

The neurophysiology of learning and human development shows that dichotomies are natural. Bower's (*10*) experiments with the cognitive development of infants indicated that initial development is dichotomous. If an infant is given a toy to play with he will reach for the toy when it is placed in front of him. However, if the toy is covered with a blanket, he will not realize the toy is there regardless of its size or shape. The toy is either there or not there, two polar extremes. Later, infants develop the cognitive ability to recognize a toy in the abstract, realizing that the toy has not disappeared, but is only hidden. Infants learn through experience that out of sight or a changed perception (e.g., the toy under the blanket) does not necessarily mean something is not there. The initial thought patterns are dichotomous in nature and only through experience does that change. One interesting question is the extent to which this thought pattern is a constant. Does this explain an innate dichotomous thought process exhibited in adult human behavior?

Humans have limited "on-line" memory and naturally reduce complexities and categorize information in a way that emphasizes consistency rather than differences. This makes the external environment familiar and, ostensibly, under one's control (*6*). Popper (*11*) has argued that humans have an inborn disposition to search for environmental regularities.

Finally, what is a dichotomy to individuals in one culture may not be to individuals in another, another reason why dichotomies cannot always be considered good or bad. For example, Karno (*12*) found that competition and collectivism (an economic theory advocating collective control over production and distribution), traditionally considered dichotomous in scope in Western culture, were not considered as such by Chinese entrepreneurs.

DICHOTOMOUS THINKING IN NUCLEAR MEDICINE TECHNOLOGY EDUCATION

Allied health education, and many other forms of professional education, are well-known for teaching students how to do a task "the right way" (*13*). Instruction is often imparted by the lecture or demonstration method by an authority figure seen as the one who knows how to best perform that task. Little discussion of alternatives occurs. However, Perry (*4*) has noted that:

> When a teacher asks his students to read conflicting authorities and then asks them to assess the nature and the meaning of the conflict, he is in a strong position to assist them to go beyond simple diversity into the disciplines of relativity of thought, through which specific instances of diversity can be productively exploited. He can teach the relation, the relativism, of one system of thought to another. In short, he can teach disciplined independence of mind. . . Henry Adams said that if we are ever to do college lecturing again it should be in the company of an assistant professor whose sole duty would be to present to the students an opposite point of view.

Thus, the goal of any educational program should be to increase the students' knowledge and, in a sense, skepticism. This is best accomplished not through lecture alone, but with methods that also use dialogical and dialectical strategies such as question/answer sessions, problem-based learning and case studies.

Most allied health educational programs use structures such as behavioral objectives to assist in the delivery of course material. However, perhaps such methods consist only of an effective first step in the delineation of the educational experience and do not allow for deeper considerations of course material (*14*). Do current methods of educating students (i.e., by lectures and through a syllabus that is strong on objectives and the "right way" to do things but lacking in exploration of alternatives) lead to the production of graduates who are similar to Belenky's et al. received knowers (*7*)? Certainly many of the problems seen in today's radiologic science environment, such as students unable to problem solve and practitioners with low self-esteem, suggest this as a possibility.

One long-argued dichotomy, in all health professions, is that of education versus training. Unfortunately, education is often seen as something lofty and a higher calling, and training is seen as something negative or a lower-level function (*15*).

Certainly nuclear medicine needs technologists who are both well-educated and well-trained. A well-educated but untrained technologist would be unable to perform many routine patient care tasks. For instance, one can spend large amounts of time discussing how to perform venipuncture correctly, however, only through experience does a technologist truly become proficient in the art of good and accurate venipuncture.

On the other hand, a well-trained but poorly educated technologist would be able to perform those tasks specifically taught but would have difficulty in adapting procedures to meet special circumstances. In the field of nuclear medicine, new protocols and new procedures are constantly being developed. Flexibility in adapting to new procedures is a must for nuclear medicine technologists in today's health care environment.

What then should the goal be for educational programs in nuclear medicine technology? Should they offer primarily education and leave the training component up to the clinical site or the first job? Should they train, which is not something that institutions of higher education traditionally excel in? Or should they strike a balance (a dialectical viewpoint), a very difficult balance to maintain? These questions remain relatively unexplored although the primary duty of accredited programs is often felt to be to teach the essentials of entry-level practice. However, calls by administrators for graduates who are both critical thinkers and multiskilled can seem quite dichotomous. Certainly one of these goals can be achieved, but are both possible?

Heckman (*16*) notes that graduates of technical educational programs, due to trends in the workplace such as multiculturalism and downsizing, need nontechnical and problem-solving skills. He also notes that, "historically, however, a dichotomy has existed between vocational education and liberal arts education, which has limited the technical education curriculum to imparting specific job skills." He calls for a fusing of the technical curriculum and general education core to "address declarative and procedural knowledge within an applied context and enable students to develop the physical and conceptual tools necessary to link them." In a nuclear medicine technology curriculum, this would involve ensuring that liberal arts subjects are not seen just as prerequisites that appear to have no direct relationship to the clinical practice of nuclear medicine. For example, an instructor might show how the levels in Maslow's pyramid relate to patient needs or ask students to write a short paper showing how knowledge of organic chemistry concepts strengthens one's ability to understand how radiopharmaceuticals concentrate at their target sites.

DICHOTOMOUS THINKING IN NUCLEAR MEDICINE CLINICAL PRACTICE

The examples presented here are just some that may limit the ability of the technologist to successfully perform clinical practice. Certainly others exist. The following examples are based on the experiences of the authors.

Radiation Exposure

Is radiation exposure "safe" or "risky"? Patients, nurses and even technologists seem to polarize radiation exposure into these two extremes. Radiation exposure, even small exposures, may carry some small risk, since zero risk is essentially unprovable, but that does not make them "risky" (*17*). For example, it would be easy to correlate the relative risk of developing lung cancer from smoking one to nine cigarettes a day with that of exposure to 3.4 Sv (340 rad), based on the A-bomb survivors. Thus, the risk of getting lung cancer is four times that of nonsmokers if one smokes one to nine cigarettes a day. Likewise, the risk of getting lung cancer is four times greater in individuals exposed to 3.4 Sv radiation (*18*). That is equivalent to 10,000 chest x-rays or 1000 yr of natural background radiation exposure. Thus, one might conclude that lower doses of radiation are not "risky," and certainly not as risky as smoking. However, such a simplistic comparison does not take into account several factors, including the fact that radiation exposures such as those after the A-bomb are more likely to cause other types of cancers (leukemia, thyroid) than lung cancer or the synergistic effect that exposure to both xenobiotics could impart.

Most technologists have seen patients who pale at the mention of the word "radiation," and have known nurses who are afraid to enter the department due to their concern about radiation exposure. In reality, proper use of the as-low-as-reasonably-achievable principle (ALARA) recognizes risk in the medical use of ionizing radiation. On the other hand, there is a beneficial use of ionizing radiation in medical imaging. The benefit of ionizing radiation can be maximized by producing an examination of good quality. The risk can be minimized by using proper radiation protection practice. Thus, "safe" versus "risky" radiation exposure has to be weighed as more than simply a good versus bad viewpoint. One needs to realize what benefits can be obtained versus the risk of exposure both to the radiation worker and the patient. Thus, a dialectical viewpoint expands the dichotomy of "risky" versus "not risky" by realizing that there are small risks and large risks and even medium risks, and that any risk must be balanced by a concomitant benefit.

Ethical Issues

Technologists are responsible for confirming patient consent for examinations, which involves educating the patient and obtaining permission to proceed with the examination (*19*). One example of a dichotomous thinking "trap" is assuming that, since examinations are done for the good of the patient, patient refusal constitutes a failure. For example, consider a patient who presents for a ^{99m}Tc white blood cell study for fever of unknown origin. When the study is explained to the patient, he refuses because of religious beliefs against receiving blood. A dichotomous thinker might send the patient back to the unit and consider the examination a failure. However, an alternate option would be to communicate with the patient's physician, to see if an alternative, such as a ^{67}Ga scan, would be acceptable. This dialectic view recognizes that there is more than one alternative, that is either do the examination or not, as well as the fact that it is perfectly acceptable for a technologist to explore alternatives. In an era of expanded opportunities for care, such as physician assistants in radiology, multiskilling and technologists doing some basic film screening, is there a need for nuclear medicine technologists to become more knowledgeable about other imaging modalities?

Loss of Technologist Creativity and Caring

Although new technology is certainly good, as technology becomes excessively relied on, human effort may be lost. For example, as computer processing of studies becomes more standardized, the assumption becomes that there is one right way to do an examination, a way that may fail when parameters exceed so-called normal limits due to pathology or other circumstances.

Suppose a new way of performing a task became available, perhaps through a textbook or published article. The natural inclination of an individual unable to consider effective alternatives would be to consider that such change is "wrong," "unnecessary" or "change for change's sake only." This individual may be a weak-sense critical thinker, able to find the flaws in the arguments of others, but unable to confront the weaknesses of their own practice and come up with a "balance sheet" that indicates whether or not a new method really is better.

Another problem is the often-discussed dichotomy between "caring and curing," or as Locsin notes, "the perception of technology and caring as dichotomous is so pervasive that one who is technically proficient may often be assumed to be incapable of expressing caring" (*20*). Some technologists see affective concerns as "not their job," when in reality, clinical practice in the radiologic sciences, including nuclear medicine technology, is a delicate balance between the scientific (technical) aspects of the professional's role and the humanistic or caring aspects (*21*). Both attributes are needed to be an effective technologist.

CONCLUSION

The importance and realization of what dichotomous thinking is and how it affects nuclear medicine is valuable for those individuals shaping nuclear medicine technology education and practice. The profession needs an understanding of dichotomous thinking as the field becomes more standardized and increasingly subject to the "button-pushing" mentality. With current changes in health care, nuclear medicine technologists might want to decide if they want to expand their practice or remain narrowly focused on doing their job without adapting to change (*22*). The latter possibility, of course, could clearly lead to job extinction. Nuclear medicine technology needs experienced workers who can deal with a myriad of clinical situations using dialectical reasoning, not dichotomous thinkers who only turn switches on or off and see their role in the health care system as limited to technical tasks.

Also, nuclear medicine technology programs must strive to teach in an atmosphere that encourages students to ask why, recognize diversity of opinion and fact, and encourage dialectical thinking.

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