Competence in Scientific Inquiry and Research

Beatriz C. Abreu, Suzanne M. Peloquin, Kenneth Ottenbacher

Key Words: professional competence • professional growth • role

The survival and expansion of the profession of occupational therapy depends on its ability to respond to continually changing environments. One of the most critical factors in this adaptation is the capacity of therapists to achieve competence in scientific inquiry and research. Competence in the role of researcher is necessary because it contributes to the development of the individual therapist, the profession, and the organization within which the therapist functions. The aim of this article is to review and elaborate on the competencies associated with the role of researcher and to propose a reconceptualization of the knowledge, skills, and attitudes that shape competence in scientific inquiry.

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can structure the various mechanisms used to hire, promote, or terminate individuals. Decisions based on competency are more sound than those based on intelligence or chemistry (American Compensation Association, 1996; McClelland, 1973; Mirabile, 1997; Spencer & Spencer, 1993). Delineation of the competencies that attach to various roles can also be used in the formulation of job descriptions, educational opportunities, and curricular proposals at the university level (AOTA, 1993; Mitcham, 1985). The criteria that together constitute the competence expected within any role can also serve as a guideline or standard that differentiates a high performer from an average or low performer (AOTA, 1993; American Occupational Therapy Foundation [AOTF], 1983; Mitcham, 1985).

Roles within occupational therapy are wide ranging and include practitioner, educator, fieldwork educator, supervisor, administrator, consultant, fieldwork coordinator, faculty program director, researcher–scholar, entrepreneur, student, support staff member, and occupational therapy aide. Although each of these roles associates with a fairly predictable set of criteria that designates its typical competencies, individual differences are also expected. Any role will be more specifically determined by the unique employment setting, job description, and method of service delivery as well as by the outcome competencies specified at various levels of professional practice, which range from novice to expert. Overall, however, competence in any role calls for a high caliber of service. Competence, including its more specific delineation, role competency, is an ethical obligation and a fundamental requirement of the profession (AOTA, 1994a; AOTF, 1983; Taughier, 1998).

Scientific Inquiry and Research: Delineations and Distinctions

The researcher–scholar role is assigned to any member of the occupational therapy profession who uses the methods of science, such as observation, reasoning, analysis, and interpretation (Gutman & Mortera, 1997; Mosey, 1989, 1992a). Therefore, competencies attached to the role of researcher–scholar include the capacity to observe, reason, analyze, and interpret. The profession's choice of terms to describe this role, namely researcher or scholar, suggests the breadth of functions associated with scientific inquiry. More colloquially, however, the term used to describe this broad role is that of researcher, which on closer analysis suggests a more narrow function. An apt analogy might be to narrow the role of occupational therapy practitioner by naming it modality user, as the forthcoming discussion will illustrate.

In 1980, the AOTA Representative Assembly was charged with the task of identifying the research competencies required by the occupational therapy profession (Mitcham, 1985). In 1983, the AOTF, a philanthropic organization dedicated to the science of occupational therapy, published the research functions needed by the profession (AOTF, 1983). In 1985, Mitcham developed a teaching guide so that educators could integrate these competencies into existing clinics and curricula (Mitcham, 1985). Figure 1 presents a reformating of the work of Mitcham and the AOTF.

To clarify the context within which research competencies have been established, key terms must be defined. Scientific inquiry is a systematic series of investigative actions directed toward (a) discovering, expanding, or generating new knowledge and (b) testing the applications of knowledge in practice through extrapolation from theories and empirical data (Mosey, 1989, 1992a; Zemke, 1989; Zemke & Clark, 1996a, 1996c). It should be noted that there are other forms of inquiry, such as historical, philosophical, and literary, to name a few. Persons who engage in these forms of inquiry often name themselves scholars because their functions are associated with the traditional methods of scholarship: logical studies characterized by accuracy, critical analysis, and thoroughness. Although scientific inquiry is the broad undertaking within which research serves as a tool, research is the instrument through which one accomplishes a scientific investigation (Mosey, 1992a).

There are two types of scientific inquiry: (a) basic, which is an investigation that expands or discovers new knowledge, such as theories, and (b) applied, which is an investigation aimed at achieving practical ends, such as developing and testing guidelines for practice or frames of reference (Mosey, 1992a). Mosey (1992a) argued that making clear distinctions between these two types of scientific inquiry and, further, between scientific inquiry and research projects is critical to establishing a coherent body of knowledge in occupational therapy. Controversy surrounds the promotion of and distinctions between these two types of scientific inquiry, with some advocating the merits of basic over applied (Clark et al., 1993; Gutman & Mortera, 1997; Mosey, 1989, 1992a, 1992b; Yerxa, 1981).

Controversy also surrounds distinctions made between the nature of a discipline and that of a profession. A discipline is commonly understood to be a branch of knowledge or learning, such as philosophy, anthropology, or physics, whereas a profession requires specialized knowledge and often an advanced degree (Webster's Collegiate Dictionary, 1995). Yerxa et al. (1989) believed that the advancement of basic scientific inquiry promises to enhance the occupational therapy profession by strengthening and promoting the knowledge base of the academic discipline, occupational science. Occupational science represents an approach to learning that emerged in 1989 at the University of Southern California (Clark et al., 1991; Clark & Larson, 1993; Zemke & Clark, 1996b). This academic discipline has created a community of scholars recognized as a group of skilled investigators who have critically examined the form, function, and meaning of occupation (Clark, Wood, & Larson, 1997).

Mosey (1989, 1992a, 1992b, 1993), on the other hand,
Pre-Research Skills - Required by all members of the profession

Basic Professional Education

Advanced Professional Education

Investigator / Scholar

Manager / Administrator

Master Clinician

Research Consumer - Application of existing "clinical" knowledge to practice

Research Consumer: a) application of existing "clinical" knowledge while retaining competence as a practitioner; b) application of existing "educational" knowledge in academic or clinical settings

&

Assist the investigator in research functions

&

Beginning Research Skills: Examining the relationship between health care systems, management, and OT practice (especially program evaluation)

&

Beginning Research Skills: Application of existing "clinical" and "management" knowledge

&

Beginning Research Skills: Application of existing "clinical" knowledge

&

To be an independent / interdependent investigator or scholar

Figure 1. Research functions needed by the occupational therapy profession (American Occupational Therapy Foundation, 1983; Mitcham, 1985). Note. OT = occupational therapy.

advocated applied scientific inquiry, emphasizing the pragmatic origin and functions of any profession within which the primary responsibility is to investigate applications of knowledge for the benefit of persons served. She believes that the goals of the profession related to scientific inquiry can be met by developing, refining, and evaluating the frames of reference that link theories to practice. Mosey (1992b) suggested the following partition of functions: The discipline should focus primarily, although not exclusively, on basic scientific inquiry, and the profession should focus primarily on applied scientific inquiry. This position generated a discourse that appeared as a series of articles (Carlson & Dunlea, 1995; Clark & Larson, 1993; Mosey, 1989).

Regardless of the focus of scientific inquiry—whether to acquire new knowledge or examine applications of existing knowledge—the relationship between scientific inquiry and research is the same. Scientific inquiry is the broad undertaking within which research serves as a tool. The intent and the scope of the research process is to focus on and prescribe the strategy that will structure the investigation. Technical competence in using the methods of research is but one of a set of competencies needed within a broader endeavor. Technical competence in research is of limited value without an understanding of the intent and scope of scientific inquiry. A tool that shapes and structures is of limited value until one knows what one is trying to build.

Qualitative and Experimental: Forms That Shape Research Functions

Controversy within the profession also surrounds the promotion of competence with particular research methods. Many occupational therapy researchers advocate the merits of research approaches based on qualitative methods as alternatives to traditional experimental approaches (Burke & Kern, 1996; Clark, Carlson, & Polkinghorne, 1997; Duchek & Thessing, 1996; Hasselkus, 1991; Kiellhoffer, 1982a, 1982b; Krefting, 1991; Mattingly & Gillette, 1991; Schwartz & Colman, 1988; Spencer, Krefting, & Mattingly, 1993; Yerxa, 1988, 1991). Others consider the two methods of examining and generating knowledge not only valid, but also valuable (Ottenbacher, 1992). Using Hofstadter's categories of information, Ottenbacher (1992) posited that the researcher who uses experimental methodology examines and interprets information at the element or reductionistic level, whereas the researcher using qualitative methodology examines and interprets information at the symbol or holistic level. Further, Ottenbacher believes that it is not feasible or wise to advocate a single method of
investigation for occupational therapy. The choice between the use of a statistical or a nonstatistical method for interpreting data in occupational therapy should be based on specific and relevant investigative questions and not on the popularity of any method or the degree of its promotion in the research literature (Ottenbacher, 1992). The nature of the investigative question must determine the process through which one seeks an answer. The capacity to determine which method of research best addresses the investigative question is another research competency.

As this introductory discussion has illustrated, the expected competencies associated with the role of researcher—here and henceforward used in its more colloquial sense to mean one who makes scientific inquiry—are multifaceted and complex. The researcher has a paid occupation that requires advanced education and training in the methods of science. The methods of science are not to be confused with research designs, which are strategies used for gathering and treating data (Mosey, 1992a). The major function of the scientific researcher in occupational therapy is to discover, examine, develop or refine, and evaluate the body of knowledge associated with the profession. The researcher does this through both basic and applied scientific inquiry, using qualitative methodology, quantitative methodology, or both (AOTF, 1983; Mitcham, 1985).

**Two Hierarchical Conceptualizations of the Role**

The role, as well as the competencies possessed by any one researcher, is influenced by the developmental factors of education and experience, as shown in Figure 1 (Christiansen, 1987; Ottenbacher, Barris, & Van Deusen, 1986; Petersen, Roberts, Loughlin, & Ludwig, 1992; Rogers, Hill, Holm, & Wasser, 1992). As presented in the professional literature, the range of responsibility and complexity within the role of researcher follows a specified continuum of competencies.

Mitcham (1985) described a hierarchy of research competencies for entry-level professionals within a web of social connections to others (see Figures 1 and 2). This range of increasingly complex behavioral patterns and research skills extends across four levels that are determined by education and experience: (a) the pre-research level in which problem-solving skills are evident; (b) the level of basic professional consumer and beginning researcher; (c) the level of advanced professional; and (d) the level of independent or interdependent investigator who validates, tests, develops, and refines practice (AOTF, 1983). The advanced professional possesses research skills that emerge within three other roles: master clinician, manager-administrator, and educator.

In its Position Paper on roles, the AOTA (1993) also alluded to a range, or scope, of roles for the researcher “from the individual who critically examines and interprets empirical studies to independent investigator” (p. 1097). The paper clusters a list of hierarchical key performance areas into entry-level skills, intermediate skills, high proficiency skills, and qualifications. Entry-level skills include the following:

- Practices and engages in research/scholarly activities.
- Reads, interprets, and applies scholarly information relative to occupational therapy.
- Collects research data.
- Assumes responsibility for the ethical concerns in research...
- Functions according to the AOTA Code of Ethics...
(AOTA, 1993, p. 1097)

By comparison, high proficiency skills include the following:

- Probes methods of science, theoretical information, or research designs to answer questions important to the profession.
- Conceptualizes the body of knowledge in the profession to develop theories, frames of references, or models of practice.
- Mentors novice researchers.
- Participates at the leadership level in professional, volunteer organizations. (AOTA, 1993, p. 1097)

Although these descriptions help to cluster competencies into recognizable patterns, they suffer from the lockstep attributes of any hierarchical system. Given the varied educational backgrounds, roles, and experiences of most persons, it is not surprising that many occupational therapists cannot place themselves neatly along this continuum. They do not see themselves as belonging in any one category or possessing any one level of skill. Competence in research is a complex matrix involving knowledge, skills, and attitudes, all interacting in a nonlinear fashion. This reality precludes a narrower conceptualization of novice, intermediate, and expert and suggests the merits of reframing research competencies to allow for differences. It also permits the formulation of a workable scheme to describe role competency.

**A Reconceptualization of Research Competencies**

A helpful shift in perspective might be to view the matrix of competence in scientific inquiry and research as the possession of three distinct strands of competence—knowledge, skills, and attitudes—that emerge from education and experiences. The conceptualization of required knowledge, skills, and attitudes shown in Table 1 emerged from the authors’ collective experiences and observations. The matrix offers a classification within which two axes—that of knowledge, skills, and attitudes and that of level of com-

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**Figure 2. Levels of research skills (American Occupational Therapy Foundation, 1983; Mitcham, 1985).**
The classification matrix aims to delineate three competence areas of the researcher with precision. The knowledge strand of competence includes various levels of learning in four areas: scientific inquiry, particular subject matter, research methodology, and organizational systems. The skills competence strand includes skills in investigation, communication, management or supervision, and leadership in critical reasoning. The attitudes strand of competence includes the advancing internalization of ethics, values, and affective responses related to scientific inquiry. The arrangement of the competencies represented in all strands, from simple to complex (beginning to advanced, novice to expert), is supported by the principles posited by Bloom (1956) and Krathwohl (1964) in their cognitive and affective taxonomies. Bloom and Krathwohl organized intellectual abilities and skills, as well as values and attitudes, as they related to educational objectives. Their taxonomies are highly regarded within the field of occupational therapy.

Table 1: Strands of Competence With Associated Competencies

<table>
<thead>
<tr>
<th>Component</th>
<th>Beginning</th>
<th>Intermediate</th>
<th>Advanced</th>
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<tbody>
<tr>
<td>Knowledge</td>
<td></td>
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<tr>
<td>Content area</td>
<td>Demonstrates basic knowledge on a particular subject.</td>
<td>Demonstrates expertise on a particular subject.</td>
<td>Is a leading authority on a particular subject.</td>
</tr>
<tr>
<td>Methodology</td>
<td>Plans and performs selected systematic procedures and data treatment (i.e., analysis, interpretation).</td>
<td>Plans and performs a variety of systematic procedures and data treatment.</td>
<td>Criticizes and selects the most appropriate methodology to answer and study relevant issues.</td>
</tr>
<tr>
<td>Organizational systems</td>
<td>Demonstrates awareness and understanding of the rules, ethical principles, rewards, and power structures within the working organization. Seeks helpful partnerships.</td>
<td>Examines and uses power structure and support systems to pursue investigations and establish partnerships.</td>
<td>Determines and conceptualizes models to advance organizational research missions. Establishes research focus and priorities.</td>
</tr>
<tr>
<td>Skills</td>
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<tr>
<td>Investigative</td>
<td>Identifies problems, sets goals, formulates plans, gathers data, analyzes the outcomes, and reaches conclusions collaboratively.</td>
<td>Independently examines findings for accuracy and relevance.</td>
<td>Independently determines credibility and usefulness of findings. Uses critical judgments.</td>
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<td>Communication</td>
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<tr>
<td>Written and oral</td>
<td>Expresses comprehension of research principles in oral and written form. Few publications and presentations.</td>
<td>Applies and teaches research principles in oral and written form. Moderate number of publications and presentations.</td>
<td>Synthesizes and critically evaluates research principles in oral and written form. Large volume of publications and presentations.</td>
</tr>
<tr>
<td>Research proposal writing</td>
<td>Collaborates in responding to a request for proposal.</td>
<td>Writes a persuasive research proposal.</td>
<td>Writes persuasive proposals. Critically evaluates strengths and weaknesses.</td>
</tr>
<tr>
<td>Grantsmanship</td>
<td>Limited opportunities for grantmanship. May collaborate with others in obtaining funds for investigation.</td>
<td>Obtains moderate amount of funding for investigations. Reviews grant proposals.</td>
<td>Conceptualizes, obtains, reviews, critiques, and approves grants.</td>
</tr>
<tr>
<td>Peer review</td>
<td>Limited opportunities for critical examination of scientific research results and publications.</td>
<td>Moderate opportunities for critical examination of scientific research results and publications.</td>
<td>Abundant opportunities for critical examination and evaluation of scientific communications.</td>
</tr>
<tr>
<td>Management and supervisory</td>
<td>Depends on supervision to control and direct research projects.</td>
<td>Requires minimal supervision to control and direct research projects.</td>
<td>Controls and directs research enterprises independently.</td>
</tr>
<tr>
<td>Leadership in critical reasoning</td>
<td>Demonstrates basic ability to conduct and lead critical reasoning.</td>
<td>Has a developing authority and ability to conduct and lead critical reasoning.</td>
<td>Is a leading research authority and educates on research enterprises and critical reasoning.</td>
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<tr>
<td>Attitudes</td>
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<tr>
<td>Ethics</td>
<td>Knows the implications of and adheres to the values of honesty, accountability, forthrightness, accuracy, and authenticity. Honors human and animal rights.</td>
<td>Promotes and adheres to the values of honesty, accountability, forthrightness, accuracy, and authenticity. Promotes human and animal rights.</td>
<td>Educates about and adheres to the values of honesty, accountability, forthrightness, accuracy, and authenticity. Advocates human and animal rights.</td>
</tr>
<tr>
<td>Values inquiry</td>
<td>Values applied and practical principles.</td>
<td>Values abstract principles and basic and applied scientific issues.</td>
<td>Values, conceptualizes, and critiques abstract principles.</td>
</tr>
<tr>
<td>Affect</td>
<td>Accepts value and the importance of research components in practice.</td>
<td>Has a passion for research knowledge and processes.</td>
<td>Advocates passion for research knowledge and imagination in the execution of processes.</td>
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</table>

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education. The matrix presented here is offered not as a rigid hierarchy, but as a dynamic interaction portraying a weave of competencies associated with the role of a researcher (see Figure 3).

Within this scheme, each strand of competence can be conceptualized as a distinct set of competencies (whether in requisite knowledge, skills, or attitudes). A person might have mastery of any one of four knowledge competencies at a beginning, intermediate, or advanced level. The knowledge strand would thus move from point to point of mastery as shown in Figure 3. The person's role competence would be perceived accordingly, with some knowledge competencies seen as more developed than others. For example, it would not be uncommon for a person to rate his or her knowledge of subject area and methodology at an advanced level, knowledge of scientific investigation at a beginning level, and knowledge of organizational systems at an intermediate level. In Figure 3, the strand of knowledge would move downward and inward through the triangle to touch various mastery points. The other two strands of competence could be represented similarly.

Each strand of competence—knowledge, skills, and attitudes—would move along the continuum formed by the sides of the triangle according to the level of mastery articulated for each competency on the strand. One person's competence could thus be understood and visualized as a weave or braid of three strands of competence. A job description could be constructed from an articulation of the levels of mastery required within the competencies associated with a particular job. A grid derived from Table 1 could plot a person's status or progress relative to the mastery of requisite competencies. Table 2 shows the authors' self-ratings on the matrix. Author 1 used the horizontal axis of the matrix as a linear continuum, plotting competency levels precisely. Authors 2 and 3 plotted mastery in a more general manner, checking competency levels more centrally. Each approach to the grid has utility.

This shift in perspective acknowledges more variations in competence than does the more fixed designation of distinct categories of performance or specified levels of mastery across all competencies. The conceptualization acknowledges the multiple ways in which research capacities emerge.

In addition to the earlier discussion of the definitions, dichotomies, and distinctions that have shaped the profession's views, other considerations suggest the merits of a conceptualization of competence that cuts across performance levels, professional roles, and practice settings. For example, research functions are often associated with the role of educator or faculty member (Gilkeson, 1992; Labovitz, 1986; Lanier, Hedl, & Christiansen, 1983; Masagatani & Grant, 1986; Parham, 1985a, 1985b; Rider, 1987). This assumption rests on the belief that the academic environment supports research and that an educator, in possession of an advanced degree, will "know how to do research" (Bloomer, 1995; Clark, 1986; DePoy & Gallagher, 1990). An educator may be a researcher or a scholar. Some educators are scholars, some are researchers, and others are both.
Table 2
Authors' Self-Appraisals

<table>
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<tr>
<th>Competency</th>
<th>Author 1</th>
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<th>Author 2</th>
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<th>Author 3</th>
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<td>Beginning</td>
<td>Intermediate</td>
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<td>Beginning</td>
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<td>Scientific inquiry</td>
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<td>Organizational systems</td>
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Our profession needs to respect and cherish scholars and researchers and allow that distinctions exist between these roles. Recommendations for partnerships between faculty members and clinicians often rest on the assumption that faculty members bring competence in research to the partnership, but this may not always be the case. Partnerships are excellent mechanisms for combining divergent competencies, but mastery in research should not automatically be ascribed to the faculty partner.

Many faculty members move to an academic role with little preparation for the role of researcher. Additionally, many clinicians, familiar with evidence-based practice and outcomes research, possess a level of mastery that some faculty members do not have. Some master clinicians can engage in the broad functions of scientific inquiry better than faculty members without expertise in a content area. The assumption that clinicians will be more novice or intermediate and faculty members more expert may not be correct. Partnerships ought to be based on a clear articulation of requisite competencies and on efforts to partner persons with complementary competencies. Arbitrary assumptions can be supplanted by clear discussions of competence. Such discussions may be prompted by self-appraisals similar to those featured in Table 2.

Two other issues bear mentioning. Although research findings in the occupational therapy literature show that therapists in academic settings publish more research than do therapists in clinical settings, it should not be assumed that clinicians know or value research less. Some faculty members may invest more time researching theoretically based questions because the academic culture supports that effort and affords opportunities to master research methodology. On the other hand, some clinicians may engage preferentially in researching practical questions. However, the valuation of research by both groups in the 1990s may be fundamentally the same.

When one strives to understand competence in research as a complex matrix of the competencies that structure it, the resulting conceptualization may still be an oversimplification. Given this caveat, the fundamental view that has shaped this conceptualization is that requisite competencies often transcend a designated professional role, educational level, and practice setting.

The reconceptualization offered here aims to advance the profession's capacity to name, describe, and develop the competencies associated with the role of researcher. The schema and conceptualization may serve as a starting point for continued discourse and refinement. The effort draws from and builds on the groundwork established by those who articulated research competencies in the 1980s and by the development of The Occupational Therapy Journal of Research, which is devoted to the advancement of knowledge through scientific methods (Llorens, 1981; Mitcham, 1985; West, 1981).

Conclusion
Changing environments press occupational therapists toward an adaptation that is central to the profession’s philosophy. Today’s health care environment increasingly calls for adaptation to the demand for competence associated with the role of the researcher. Keeping in mind the distinctions that have shaped the profession’s grasp of competence in scientific inquiry and the profession’s current conceptualizations of the competencies of the researcher’s role, we reframed the requisite knowledge, skills, and attitudes that constitute competence in scientific inquiry. The proposed reconceptualization acknowledges the multiple ways in which research capacities emerge and convey our beliefs that requisite competence in research can be fostered by diverse professional roles, educational levels, or practice settings. ▲
Acknowledgments

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R. Archives of Physical Medicine and Rehabilitation, 78, 1281.

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**CORRECTION**

To “Summary of Executive Board Conference Calls, February 16, February 18, March 16, 1998,” under the Association department (July/August 1998, Volume 52[6], p. 601):

Text in the fourth bulleted item reading, “Charge the Executive Director to finalize and implement a letter that addresses conflict of Internet considerations for AOTA leaders and appointees,” should read, “Charge the Executive Director to finalize and implement a letter that addresses conflict of interest considerations for AOTA leaders and appointees.”

The AJOT editorial staff regrets the error and hopes that readers were not inconvenienced.