ARTICLE
Promoting Information Competency in Biological Psychology

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Information competency refers to skills that allow a student to identify appropriate sources of information, evaluate information critically, and use it ethically. Although the sudden increase of information available in electronic form has stimulated interest in information competency, the basic principles apply to all sources of information, including print. Information competency is especially critical in biological psychology. New discoveries in the neurosciences are featured every day by the mainstream media. As a society, we are being asked to make informed decisions about increasingly complex concepts, as in the case of the recent California proposition regarding stem cell research. Ideally, our students will become community leaders who will help shape these and other policy decisions, but the assumption of this role requires skills that extend long after the completion of a particular course or degree. Because of the perceived complexity of biological psychology, students new to the discipline may be reluctant to venture out into the experimental literature. A variety of activities are presented here that will build student confidence and shape information competency. Although these exercises can be used in a variety of disciplines, they are particularly well suited to biological psychology. The various exercises lend themselves to different levels of student expertise. Many of the exercises are quite appropriate for all levels and abilities, including graduate level students. As a bonus, these activities involve students in writing about biological psychology, providing a foundation for the writing of formal term papers or research reports.

Key words: information competency, writing, biological psychology, critical thinking

Herb Cohen (2003), an internationally recognized expert on negotiation, is fond of pointing out that most people believe nearly everything they read. If something is in print, it must be true. Those of us in academia try to stress critical thinking skills, but we generally give students few opportunities to practice their new skills. By providing them with carefully crafted textbooks and peer-reviewed articles, we are exposing them to great information but limited practice in critiquing that information. In spite of our best intentions, we may be turning students into overly trusting readers when instead, we should be producing skeptics.

Among the many fascinating impacts of the explosion of electronic sources of information is a new opportunity to engage our students in the critical evaluation of information. While some internet sites are carefully reviewed, there are no universal procedures for screening information before it is posted. Anyone with a few dollars a month to spare can host their own site and put up just about anything. As Herb Cohen would predict, many people are going to view this information with a great deal of trust. As an example, the Freberg family website features family interests in track and field (Freberg, 2002). Much to our astonishment, we were informed that a peer-reviewed journal article had actually referenced a little online survey we ran regarding the weightlifting regimens of shot putters and discus throwers. Our initial response was shock and horror that a fellow researcher would use this information in such an authoritative way. It was not a bad little survey, but it was not intended as publishable research. Our second thought, however, was to ask the questions, “Why are we distressed about the use of this information? How would we explain to a student why we would not want him or her to use this kind of information as a reference in a term paper or research project?”

The answer to these questions involves information competency. As outlined by the Association of College and Research Libraries (ACRL, 2000), the information literate person is able to:

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one’s knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally

Determining the extent of information needed is usually a task for which faculty provide specific guidance. In our writing assignments, we typically specify a minimum number of references to be used. Additional guidelines regarding the currency of references to be used may be offered. Hopefully, by modeling ideals in our assignments, students will become increasingly independent in making judgments in this area. Accessing the information effectively and efficiently is really the domain of the librarian. On most campuses, library staff members often teach small unit courses on library searching, and students should be encouraged to take advantage of these services. In addition, it is worthwhile to consult with campus librarians about possible guest lectures, in which they can

assist students with Boolean terms and other search techniques. In our experience, the class time used for these activities is very worthwhile. The core competency addressed by the activities described in this paper is the critical evaluation of information resources.

CRITICAL EVALUATION OF RESOURCES

The evaluation process involves the consideration of a number of factors, including: relevance/appropriateness to a research topic, currency, authority/credibility, coverage, and accuracy (Alexander & Tate, 1999). Table 1 includes a rating sheet that students can use to jumpstart their thinking about the critical evaluation of information sources.

Resource Evaluation Criteria

Relevance/Appropriateness
- Is the format/medium of the information useful for your assignment?
- If you need primary sources, is this a primary source?
- Is the information comprehensive enough for your needs?
- Does the information express a particular point of view?
- Is the information directed toward a general (vs. specialized) audience?
- Should a naïve reader know this information in order to understand your assignment?

Currency
- Is there an indication of when the information was created/published?
- Is the information regularly updated?
- Is the information still valid for your topic?

Authority/Credibility
- Is there information on the author/producer of the source?
- Is there information on the author/producer's credentials?
- Does the information come from an "authoritative" source?
- Is there contact information for the author/producer?
- Is there any apparent conflict of interest?

Coverage
- Does the information source cover the topic extensively?
- Is the information abridged (e.g. table of contents/summary only)?
- Is full-text information available only to subscribers?

Accuracy
- Is the information presented as fact (vs. opinion)?
- If the information is presented as fact, can it be assessed for accuracy (i.e. are there footnotes or references)?
- Does the information appear to be biased?

Table 1. Criteria used to help students evaluate the resources they are consulting.

Relevance

In order to take the first step in making reasoned decisions about the relevance and appropriateness of a resource, students need a clear understanding of the distinction between the popular and scholarly press. Invariably, this distinction causes considerable confusion and warrants enough discussion time to ensure student understanding. While there are plenty of gray areas in this distinction (*e.g.* a 2001 article on self-esteem in *Scientific American* by Roy Baumeister, or an explanatory article with no author information published on a medical organization's website), providing clear criteria to students can be very helpful. Table 2 includes some distinctions that can be made between the scholarly press and the popular press. Once this distinction is made, it is helpful to reinforce the concepts by specifically requiring the use of one or both types of sources for appropriate assignments.

Currency

Currency is of course a relative matter. Some topics are very "hot," and it is an easy matter to retrieve a great deal of information published within the last few weeks or months. In other cases, a student might complain that his or her topic simply has not been of interest recently. If a student cannot find enough recent information on the risk of suicide associated with antidepressant medication, we know that he or she is not looking too hard. On the other hand, a student interested in sensory preconditioning in rats may find relatively less recent work. Requirements for currency should be adapted to the topic under study.

When discussing currency, it might be useful to let your students know the approximate timeline required to put a peer-reviewed study into print. They need to understand that even the most "current" research in the literature may actually have been done a year or two previously. Electronic journals are accelerating this turnaround time, and it is also useful, in our view, to challenge students with the risks of putting research results out that quickly. In biological psychology, currency is obviously essential, as our knowledge base is growing exponentially. Those of us who are somewhat removed from our graduate school years can make long lists of "facts" that we faithfully memorized which are no longer believed to be true. Here again, however, we need to emphasize the benefits of "tried and true" concepts that have stood the test of time. Facts that have been supported repeatedly need not be discarded the first time a conflicting report surfaces in the literature.

Authority & Credibility

Class discussions of authority and credibility can be lively indeed. Credibility begins with credentials. Within the first day or two of a new term, most instructors manage to drop a few hints about academic credentials by commenting on alma maters and the fact that a very long time was spent in graduate school. Imagine students' reactions if one walked in, told students he or she had a high school diploma but had read extensively about biological psychology, and proceeded to lecture. We would hope they might walk out in protest, but this is not necessarily the case. As our colleagues in social psychology often remind us, there are many ways to fool people into thinking that you have authority in areas where your knowledge is no better than the next person's.

Judging authority and credibility can be both empowering and frightening to the novice student. The concept that they as students can actually sit as critics or judges of work that they may see as that of an expert in the field may take some getting used to. If this appears to be a stumbling block for students, introducing them to areas of

disagreement among authorities might reduce some of the stress. The often lively discussions of the heritability of intelligence demonstrate strong, reasoned opinions by experts on both sides. An essential mindset for creative research is being able to focus on how knowledge in a subject area can be improved. Instead of requiring students to repeat what is known, we need to focus their attention on the unknown.

	Scholarly Press	Popular Press
Author	A noted expert; a person who has personally conducted the research being described	A journalist; a person who has not personally conducted the research being described
Content	Includes summaries of the methodology used, the resulting data, and a statistical analysis	Does not contain details of procedure, results, and statistical analysis
Writing level	Is written to an audience of peers, as opposed to laymen	Is written to a general audience
Peer review	Yes	No
Sources	Includes frequent references	Rarely includes references

Table 2. Distinctions between scholarly and popular publications.

Coverage

The coverage criterion asks the student to evaluate the depth of the information presented. Does the source merely restate the conclusions of a research study? Or is enough information provided about the method used and other details that allow for a more thorough critical evaluation? A headline in today's news claims that "Moderate alcohol use may reduce dementia risk in women." The questions our students need to learn to ask include: Is this an all-too-frequent example of journalistic inference of causality from correlational data? Or did the researchers actually assign women randomly to groups and test the outcomes of various levels of alcoholic intake on cognition? Knowing how the researchers proceeded (yes, it turned out to be a correlational study) allows us to evaluate the outcome and its implications more accurately.

Accuracy

Finally, we come to the criterion of accuracy. Asking beginning biological psychology students to comment on the accuracy of published research is rather like asking them "Does your professor show expertise in his/her discipline?" How can we ask a novice to make a judgment like that? Obviously, we have to start a little less ambitiously. Students definitely can perceive bias versus a more objective view, and science is supposed to be objective. An excellent model of this type of objectivity is the work of Simon LeVay (1991) on correlations between the size of INAH-3 and sexual orientation in men. As an openly gay man, LeVay could easily have used his data to push an agenda. Instead, his discussion includes a careful consideration of alternate interpretations of his findings, demonstrating his objective approach. His willingness to consider multiple views of his data bolsters the readers' sense of fairness and accuracy. We can also evaluate accuracy by comparing different resources relevant to the same question. Although there is a surprising paucity of efforts to replicate LeVay's original study, Byne et al. (2001) also report finding a difference in INAH-3 in heterosexual and homosexual males. The authors further conclude that HIV status, one of the original possible confounds of LeVay's study, did not influence INAH-3 size. These conclusions are doubly interesting, since Byne typically argues that homosexuality is not primarily biological in origin (*c.f.* Byne, 1997). To our knowledge, no laboratories have reported findings that directly dispute LeVay's. Majorities do not necessarily rule in biological psychology, but when a number of laboratories are reporting similar data, the likelihood that the data are real is increased. Students have presumably been exposed to the idea that an experiment that can be replicated may be considered reliable. It is just a step then to the idea that information that is reported by various sources may also be reliable. The exercises that follow are designed to explore these areas of evaluation.

THE ASSIGNMENTS

Seven information competency assignments are described below that can be adapted for use in a wide variety of courses. Student directions for the assignments are also provided in Table 3.

Assignment 1: The Challenge Article

For this assignment, you will want to provide a controversial reading. For example, psychologist Richard DeGrandpre has a widely circulated article on the internet entitled, "Is your ADHD support group a front for the pharmaceutical industry?" The core of DeGrandpre's article is the fact that Novartis, maker of Ritalin, has made substantial financial donations to the ADHD advocacy organization, Children and Adults with Attention Deficit Disorder (C.H.A.D.D.).

The first step in the challenge article assignment is to cross-check DeGrandpre's facts. Can the donations from Novartis to C.H.A.D.D. be verified using other sources? Did the DEA actually publish a report that said "there is an abundance of scientific literature which indicates that methylphenidate shares the same abuse potential as other Schedule II stimulants?" Can you feel your personal biases about this subject kicking in right about now?

The next step is to investigate the author. Who is Richard DeGrandpre? What else has he written? Who references him? Fortunately, current search engines make this a fairly easy task. The first item to come up on Google is the fact that DeGrandpre is the author of a 1999 book entitled *Ritalin Nation.* Armed with this information, students can search for reviews of *Ritalin Nation.* A search on PubMed shows DeGrandpre to be the author of twelve articles, primarily in the area of behaviorism as applied to cigarette smoking. Students can be asked to respond to the question of whether DeGrandpre's areas of expertise are relevant to his essay on Ritalin.

Assignment Instructions for Students
(all assignments are five-page papers)

Assignment 1: The Challenge Article
- Choose a controversial reading from a popular press source.
- Examine five of the author's main points using scholarly resources
- Investigate the author and comment on possible biases

Option for more advanced students:
- Rewrite a controversial article in a manner you believe to be more objective

Assignment 2: Comparing Bibliographies
- Select two scholarly papers published within the last calendar year that address the same issue
- Retrieve five of the references listed in each paper, and apply the criteria listed in Table 1 to each.
- Based on your analysis of the references used by each paper, identify which paper has the better bibliography, and why.
- *Option for more advanced students:*
- Devise a quantitative rating scheme based on Table 1 by assigning weights to the different criteria.
- Reevaluate your references using your quantitative scheme and comment on the similarity or difference of these results to the results of your qualitative analysis.

Assignment 3: The Update
- Locate a review article that is at least three years old
- Provide citations of ten articles that should be added to the article
- Provide a rationale for why each article should be included

Assignment 4: The Experts
- Identify three experts in an area of interest to you (a quick glance at the references cited in your text should help you figure out who these people are)
- Compare and contrast their ideas and methods
- Identify who influences your thinking the most and the least, and describe why you think this is the case

Assignment 5: Classic Sources
- Select and retrieve a classic scholarly study cited in your textbook. The topic of the study should be one that is likely to have received coverage in the popular press (e.g. ADHD or suicide risks of medication)
- Retrieve two sources that cite your study from each of the following types of work:
- Other scholarly papers
  - o Textbooks
  - o Popular press articles
  - o Websites
- Comment on how accurately the source was represented by those who cited it. If the citation is misleading, identify what should be changed to make it more accurate.
- Comment on any similarities and differences you see in the ways your classic article was represented by the different types of resource.

Assignment 6: The Evaluation Reaction Paper
- Identify your personal opinion a topic prior to reading papers
- Read and briefly summarize five scholarly papers on the topic
- After reading the papers, determine if your opinion is the same or different and consider why your opinion stayed the same or changed
- Identify which article(s) most influenced your thinking about the topic and why
- Identify which article(s) least influenced your thinking about the topic and why

Assignment 7: Journal Comparison
- Retrieve one issue from each of these two journals (Instructor should specify some choices). These issues should be published in the last calendar year.
- After reading the two issues, compare and contrast the journals on the following points:
  - o What is their intended audience?
  - o What types of content do they cover?
  - o Do they have a characteristic "style?"
  - o Do the directions for authors vary?

Options for more advanced students:
- An interesting insight may be gained from evaluating the time sequence in each journal for acceptance, revision, and publication dates. Develop a table comparing these features and compare and contrast your results.
- If you have a paper in preparation for a senior thesis or lab work, comment on how you would approach finding the most appropriate place to submit your work.

Table 3. Assignment instructions for students. Also available at: www.laurafreberg.com/infocomp_instructions.htm

DeGrandpre's article is richly referenced, although in the copy found online, no reference list follows the article. Students can be asked to trace down the author's references and provide feedback about his use of the resource. Was he true to the conclusions of his sources? Or did he filter out the parts that did not agree with his thesis? Were the references used themselves biased or objective?

For very advanced and capable students who are up for a challenge, a final twist on the challenge article assignment is to ask them to rewrite the article in a way that represents the best of information competency.

Assignment 2: Comparing Bibliographies
For this assignment, you will need to find two current papers that cover very similar topics. For instance, both Jick et al. (2004) and Valuck et al. (2004) have published quite recently regarding the risk of suicide among those treated with antidepressant drugs.

Students should be asked to review the bibliographies of each paper, which usually means that they will need to retrieve many if not all of the papers listed. Based on their review, they need to make a value judgment as to which paper has the best references, and why. A variation of this assignment is to ask students to devise a quantitative rating scheme for evaluating the references, perhaps using Table I as a starting point. After completing their quantitative review, do they get the same answer as before? Making these value judgments teaches students how to determine if the bibliography includes good references from primary sources, from recent articles in peer reviewed journals, and if the authors have good credentials (for instance, are they at a university, or the drug company that makes the product under investigation?).

Assignment 3: The Update

You can provide a review article or assign your students the task of identifying one, with the specification that it must be at least three years old. The easiest way to do this is to use the review[pt] (pt stands for "publication type") command along with your subject in PubMed's search. This limits the returned articles to literature reviews.

For example we can begin with a review article by Bloem et al. (2001) entitled "Postural instability and falls in Parkinson's disease." Remarkably, one has to navigate to the 100th page of the listings of Parkinson's disease review articles to find one that was published in 2001. Now that the review article is in hand, our task is to decide which articles, review and otherwise, should be added to it to bring it up to date. As part of the assignment, a rationale should be provided for the inclusion of each article. To make this assignment less cumbersome, it might be humane to provide a specific number of articles to be added. This has the added benefit of forcing students to set priorities among "competing" articles, which requires thoughtful judgment and evaluation.

Assignment 4: The Experts

The first step in this assignment is to select three experts who write in a particular area of interest. For example, one could have a fair amount of fun with Steven Pinker, Benjamin Whorf, and Noam Chomsky and their respective views on the origins and nature of language. For additional ideas, students may be referred to the *Behavioral and Brain Sciences* website (www.bbsonline.org), which contains a section entitled "Controversies in Neuroscience." Original research relevant to each controversy is included in the site (BBS Online).

Students could be asked to compare and contrast the ideas of the experts, which of course would require them to obtain a reasonable familiarity with each person's work. The twist to this assignment is that students are further asked to take sides. Which expert influences them the most? Why? This is not a bad reality check for all of us to experience periodically. We know that there are authors whose work is so respected that we believe them with very little additional persuasion. Once in awhile, it is probably a good idea to step back and ask yourself why you do this.

Assignment 5: Classic Sources

One of the distinctions that we need to make in discussions of information competency is the difference between primary and secondary sources. Many students in our experience place a little too much faith in secondary sources, including their textbooks. Textbook authors can see the dangers lurking on the other side. Has the textbook author done justice to the intent of the original author in the sentence or two of space allowed by his or her editors?

This assignment allows students to compare an original "classic" article to the retelling of the author's conclusions in later work. Select a classic study, such as the Gazzaniga et al. (1962) article on the results of split brain operations in humans. Obviously, this article has been widely cited. Students can search for and evaluate citations of this article in the scholarly literature, in textbooks, in popular press articles, and most entertainingly of all, in websites. Again, the primary question here is how true to the original are these other sources?

Assignment 6: The Evaluation Reaction Paper

One of the keys to being an objective scientist is recognizing where your own biases live. One of us (LF) has an extreme skittishness about manipulating the biochemistry of the nervous system (with caffeine serving as a notable exception). Years of graduate school spent administering just about every known psychoactive substance to long-suffering rhesus monkeys led to strong feelings. To avoid any further bias, there is a need to be extra-cautious when approaching drug outcome studies. It would have been easy to believe the doomsday hysteria about "crack babies," yet the data did not support these predictions. Spending some time identifying our biases and reflecting on how these can filter our information processing can be a very enlightening and useful exercise.

This assignment begins with a topic chosen by either the professor or student. The topic of repressed memory of childhood sexual abuse has been used with great success in this assignment, but there are obviously large numbers of appropriate topics. The student will obtain five sources relevant to the topic. These can be limited to a particular type of source, such as scholarly articles or websites, or left open to the students' discretion. In a reaction paper, the student will identify their opinions (if any) regarding the topic prior to and after doing their reading, noting any changes that occur. Students identify which of the five articles influenced their opinions the most and the least, and why. It is important to reassure students that you are not looking for a "right answer" on this assignment. Their grades should not be based on whether or not they changed their minds, but rather on the quality of their thinking as they examine their opinions.

As a warning to faculty, the outcomes of this assignment can be disappointing. It is frustrating to see students carefully evaluate and appreciate literature that runs counter to their opinions, and then state that they still believe their original ideas anyway. Even more discouraging are comments that popular press articles

were more influential because they were "easier to read" or "more interesting" than scholarly articles. Instead of causing us to tear our hair, these statements can be useful in guiding further discussions (and possibly further practice) involving information competency.

Assignment 7: Journal Comparison

Students either select or are assigned two journals that typically cover similar material. For instance, we could look at *Behavioral Neuroscience (www.apa.org/journals/bne)* and *Behavioral and Brain Sciences* (www.bbsonline.org). As a side note, the "in-cites" website at www.in-cites.com/index.html provides some very interesting comparison data, including which journals, authors, and papers are cited more frequently. This and similar sites provide handy tools for familiarizing students with the journals relevant to a research discipline.

After surveying samples of the two journals, students can be asked to respond to questions about the intended audience of the journals, their content, and style. This can be an especially useful exercise for students who are preparing their own research articles. You can further require them to choose the most appropriate journal for their article submission.

ASSIGNMENT OUTCOMES

Students initially react to information competency assignments with some trepidation, as they typically have not done this type of task before. Faculty can expect to spend about half an hour in an initial explanation of each assignment, with more discussion on particulars as students become more involved with their work.

The most common approach is to assign one of the options to all students, but it is also effective to offer students a choice of activity. If a choice is given, it is helpful to reassure students that the difficulty of a particular assignment will be taken into account in grading. Otherwise, they might avoid tackling one of the more difficult assignments, such as rewriting the challenge article.

One of the pitfalls that faculty should expect when using these assignments is considerable confusion and need for discussion regarding the difference between the popular and scholarly presses. However, since this is such an important distinction for students to make, it is well worth the time needed for clarification. Another consistent outcome is the persistence with which students hold to their original opinions. Although they carefully evaluate the resources, they typically report that the articles with the greatest influence on their opinions are the ones that support their original points of view. While this may seem somewhat discouraging, this outcome provides opportunities for valuable class discussion.

These assignments are perhaps most valuable when they are used as a prelude to a second, more formal research paper. Students who have completed an information competency assignment frequently select references that are more appropriate for a research paper than students who have not had the information competency experience. Instead of merely paraphrasing previous work in an uncritical manner, the students become more likely to show evidence of critical evaluation in their literature reviews.

CONCLUSIONS

The exercises described in this paper are not original. Many creative and generous people have shared their suggestions about building information competency via the internet. We have attempted to select and adapt assignments that seem particularly well suited for a course in biological psychology. These assignments can easily be adapted to other disciplines and to a variety of ability and experience levels. These exercises have the additional advantage of introducing students to writing in the area of biological psychology in a guided way, which easily can lead up to writing formal term papers and research papers.

Developing information literate citizens has never been more important. In the November 2004 election, California voters were asked to make a major decision about the future of stem cell research in the state. Based on experience with students entering a first course of biological psychology, it is likely that most of those voters would be hard pressed to give a reasonable definition of exactly what a stem cell is. This is not an isolated incident. As our technology advances, including the ability to alter genes and clone, we need an informed population with the background and wisdom to make the right choices. Our students can be the community leaders in this area, if we take time to build the skills they need to take on this role. Long after they have forgotten which part of the brain is damaged in cases of transcortical motor aphasia as opposed to transcortical sensory aphasia, they will remember the techniques we have modeled and practiced for critically evaluating the wealth of new information that will become available in their lifetimes.

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APPENDIX

Useful web resources on information competency including assignments and tutorials:

- UC Berkeley Library Tutorial: Finding Information on the Internet
  www.lib.berkeley.edu/TeachingLib/Guides/Internet/FindInfo.html
- CSU Information Competence Tutorials
  www.lib.calpoly.edu/infocomp/modules/index.html
- University of Texas Information Literacy Tutorials
  tilt.lib.utsystem.edu
- CUNY Information Competency Tutorials
  ols.cuny.edu/tutorial
- Evaluating Web Tutorials (by J. Alexander & M.A. Tate)
  www.widener.edu/Tools_Resources/Libraries/Wolfgram_Memorial_Library/Evaluate_Web_Pages/659

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