RESEARCH METHODS AND STATISTICS

Distinguishing interpretation from fact (DIFF): A computerized drill for methodology courses

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It is important for psychologists to distinguish between statements of fact and opinions in the research reports they read or hear. Surprisingly, this basic skill is not readily observed in undergraduate students. A computerized laboratory activity is described that permits students to practice this discrimination, and demonstration data are reported to support the effectiveness of the exercise.

A staple of undergraduate programs in psychology is coursework on the principles and methods of psychological research. However, not every student in the undergraduate methodology course aspires to be a scientist. For most, the class is a hurdle en route to a career in the "practitioner" side of the famous "Boulder model." As educators, we tell students that an understanding of research design is important irrespective of the aspect of psychology one may pursue as a career. The clinician as well as the scientist must be able to review, understand, and evaluate published findings—skills that are just as vital for reading research on the effectiveness of particular therapeutic interventions, for example, as for comprehending studies of brain, cognition, and behavior.

An important basic skill in the evaluation of psychological research is the ability to distinguish statements of fact from statements of interpretation, inference, and opinion. Every published research report contains a long list of facts: demographics of the sample, descriptions of the apparatus, details of the procedure, data, and statistics. This information is essentially unassailable; that is, the reader is typically obligated to accept these statements as factual. The procedures might be poorly conceived and executed, or the data may fail to conform to established principles or prior findings. Nevertheless, the reader is compelled to accept as true that the procedures and data were exactly as reported.

In contrast, of course, are the numerous statements in most publications that represent inferences or interpretations based (one hopes) on these facts. Authors must interpret prior literature, draw conclusions from their own findings, and speculate on implications and theoretical mechanisms. Although these interpretative statements may indeed be true, they are always subject to challenge and debate. Thus, one may acknowledge the veracity of reported data and methods but still reject the conclusion that the authors proffer on the basis of those data. In fact, much of the literature in psychology is built on the debate between researchers regarding the implications of existing data and the manipulations, controls, and statistics that will support particular interpretations and rebuff others.

If students are actually to become competent in reviewing research findings, whether these appear in scientific journals or the popular press, it is essential that they distinguish between facts that must be explained and interpretations that may not be valid. This would seem to be a basic skill that requires little training. In contrast, classroom discussion of research findings with undergraduates has revealed the distinction neither to be apparent nor to be habitual for these students.

For example, I frequently assign a library activity during the early sessions of undergraduate laboratory courses (e.g., research methods, cognitive psychology, learning). The activity involves assigning each student several randomly selected keywords from topics that will be covered during the term, and sending the students on a "scavenger hunt" to find journal articles related to each keyword. The students then read and summarize each article, noting the procedures, findings, and theoretical or practical implications. In an era of electronic searching, finding the articles has proven to be the easy part. Surprisingly, the aspect of the assignment in which students have performed most poorly is differentiating facts from interpretations in the abstracts they have found.

Development of this task and paper was supported by grants from the Army Research Office (DASW01-97-K-0002 and DAAL03-92-G-0382) and the National Institutes of Health (HD-06016). The software described here is available in executable or source form, with minimal additional documentation, from the author. A sample file of abstracts can also be provided. For information on this program or other laboratory drills written by the author, contact D. A. Washburn, Department of Psychology, Georgia State University, Atlanta, GA 30303 (e-mail: dwashburn@gsu.edu).

Typically, the students uncritically accept published inferences as factual, failing to realize that such interpretations are tentative and may be wrong even if the students themselves lack the knowledge to challenge them. Occasionally, statements of fact are dismissed as opinion, particularly if they are inconsistent with the student's prejudices or intuitions.

THE DIFF ACTIVITY

The present laboratory activity was designed to assist students in learning to distinguish between statements of fact and opinion in research reports. It yields the additional benefit of exposing students to the methods, phenomena, and issues that may be found in contemporary publications. It was designed for undergraduate methodology courses, but could also be used in content-based laboratory courses (e.g., cognitive, developmental, social, learning). Earlier versions of the drill were not computerized but required students to identify facts as opposed to interpretations in printed abstracts. The computerized version displays abstracts on the screen and probes students to respond to specific statements. This makes it easier to score responses while still incorporating unlimited topic-specific abstracts.

The activity is supported by two QuickBASIC 4.5 programs: DIFF-I.EXE and DIFF-S.EXE. It can be administered on DOS, Windows 3.1, or Windows '95 platforms and requires one to use a mouse to respond. The programs are part of a large battery of pedagogical tasks, tutorials, and computerized drills written by the present author and are available for laboratory classroom use.

DIFF-I.EXE is the program that instructors use to prepare abstracts for presentation to the students, to select specific probe sentences or phrases, and to indicate whether each is a statement of fact or an opinion (or interpretation, inference). To make it easy to obtain abstracts, the DIFF-I.EXE program uses ASCII text files downloaded from PsycLIT (or any similarly constructed ASCII file). It is easy to download abstracts from the PsycLIT service onto diskettes.¹ Each record contains the article title, authors, reference information, abstract, and other information. DIFF-I.EXE strips extraneous information from each abstract, generating a file (DIFF2.TXT) that consists of the series of abstracts (with title, author, and bibliographic information), each separated by a single space (see the Appendix for an example). This text file, of course, can be altered with a word processor or text editor if the instructor wishes to add, alter, or delete selected entries.

The DIFF-I.EXE program then prints each full abstract on the screen and prompts the instructor to select a probe sentence or phrase to be presented to students. Any passage of text can be selected, as long as it can appear on three or fewer lines on the screen. The instructor merely clicks the mouse button on the first character of the sentence or phrase and releases the button on the last character of the sentence or phrase to be selected. This text is then presented on the screen so that the instructor can indicate whether students should call it a statement

of fact or an interpretation. (Unfortunately, the program, like the students, cannot distinguish automatically between these types of statements!) Errors by the instructor can be discarded, and the instructor can select as many passages from each abstract as is desired and can stipulate that each is either a fact or an interpretation. For example, one can easily select 50 trials (probe statements) from about 20 unfamiliar abstracts in about 20 min of set-up time. DIFF-I.EXE presents the abstracts to the instructor in the order in which they appear in the DIFF2.TXT text file, using the blank line between each abstract to indicate the boundary between problems. Again, the instructor is free to use as many or as few abstracts or probe sentences as is desirable. The probe sentences or phrases are then stored in their own text file (DIFF3.TXT), together with information to indicate the abstract or problem from which each is selected and the answer that is correct for that trial. In addition, a parameter file (DIFF.PAR) is generated automatically to record the number of abstracts and the number of probe sentences that are available.

To administer the drill, the instructor should copy the DIFF2.TXT, DIFF3.TXT, DIFF.PAR, and DIFF-S.EXE files onto each student's computer and run the DIFF-S.EXE program. This task selects randomly from the probe statements that the instructor has designated and presents the statement, together with the corresponding abstract and bibliographic information, to the student. The student is then prompted to indicate whether the statement is factual in nature or is an interpretation or inference. If the student responds in accordance with the instructor's answer, a tone sounds, and the visual feedback "CORRECT!" appears on the screen. Errors are followed by a buzz and the word "WRONG!" Each response is recorded in an ASCII data file (DIFF.DTA), together with the date, time, and student identifier. This data file permits subsequent analysis of responding as a function of abstract, problem type, or other variables. When all of the probe statements have been presented, the task ends and displays the percentage of responses that were correct. It typically takes about 30 min to perform 50 trials, depending primarily on the number of different abstracts to be read.

DEMONSTRATION DATA

The following data illustrate the effectiveness of the DIFF drill. Students ($N = 42$) completed 100 trials of the DIFF-S.EXE task. As I typically do, I defined "fact" and "interpretation" prior to initiating the activity, but provided no other instruction. Rather, students are permitted to practice on the distinction across trials of the DIFF activity. These 100 statements, sampled from 50 different abstracts, were presented in random order to each student. In the first 25 trials, students averaged only 62% accuracy. Note that this level of accuracy does not differ reliably from chance ($z = 1.56, p > .05$), supporting the contention that students lack skill in distinguishing factual from interpretative statements. In the last 25 trials,

the students correctly responded to an average of 86% of the trials. This percentage is both reliably better than chance and a significant improvement over the first 25 trials ($z = 4.67$ and 2.61 , respectively; $p < .05$).

Of course, this demonstration study lacks both a control group and a performance criterion that differs from the treatment. Still, it seems unlikely that experience with any control laboratory activity would benefit fact/interpretation discrimination as effectively as the present exercise. In addition, it is not clear from this demonstration exactly what the students learned that allowed them to distinguish facts from interpretations with increasing precision. Perhaps they simply learned to recognize the key words that signaled inferential statements (e.g., "it seems," "we conclude," "I believe"); but this skill itself may be sufficient to prevent the kinds of confusions that are so common in students. In any case, the activity invariably led to questions and discussions about the specific examples of facts and inferences. These discussions were frequently heated, but always quite instructional.

CONCLUSION

Psychology is a discipline prone to controversy, debate, and sensationalism—witness the whirlwind surrounding

research on intelligence, for example. Across careers within the field, it is important to be able to review and evaluate the latest information derived from research or clinical reports. The present drill should help build basic skills necessary for this ongoing activity, particularly the ability to discriminate fact from interpretation. These skills are not usually, but arguably need to be, stressed in psychology coursework. Moreover, it seems likely that this laboratory exercise will sensitize students to the scientific attitudes of skepticism and tentativeness. The drill also serves to increase familiarity with recent methods and findings in particular fields within psychology. Finally, one may find the present programs to be useful not as a laboratory exercise but rather as an assessment tool to index the degree to which the ability to read published abstracts critically improves as a function of instruction.

NOTE

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APPENDIX

This is the format for the DIFF2.TXT text (ASCII) file read as input by DIFF-S.EXE. It will be produced automatically when DIFF-I.EXE is used with a PsycLIT download, or it can be produced manually by typing abstracts according to this format:

```
TI: Distinguishing interpretation from fact (DIFF): A
computerized drill for methodology courses
AU: Washburn, -David-A.
JN: Behavior-Research-Methods-Instruments-and-Computers 1998
[volume and page information would go here]
AB: It is important for psychologists to distinguish
between statements of fact and opinions in the research reports they read
or hear. Surprisingly, this basic skill is not readily observed
in undergraduate students. A computerized laboratory activity is
described that permits students to practice this discrimination,
and demonstration data are reported to support the effectiveness
of the exercise.
TI: [The title of the next abstract here, and so forth]
.
.
.
End of file [This is the last line in the DIFF2.TXT file.]
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APPENDIX (Continued)

This is the format for the DIFF3.TXT file, containing probe phrases and related information, used by DIFF-S.EXE. It is produced automatically when DIFF-I.EXE is used with a PsycLIT download, or it can be produced manually:

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Problem = 1
this basic skill is not readily observed in undergraduate
students

INFER
Problem = 1
A computerized laboratory activity is described that permits
students to practice this discrimination

FACT
Problem = [continue with other probes from this abstract,
or from new problems or abstracts]
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