

# Human Problem Solving in 2010

*Zygmunt Pizlo*

## Abstract

This paper presents a bibliography of 100 references related to human problem solving, arranged by subject matter. The references were taken from PsycInfo database. Journal papers, book chapters, and dissertations are included. The topics include human development, education, neuroscience, and research in applied settings, as well as animal studies.

## Introduction

Similarly to what I found in my reviews two and four years ago, the ratio of the number of journal papers (78) to the number of journals where the papers appeared (56) is barely greater than one. Both of these numbers are smaller by a factor of two compared to 2008 and similar to (but slightly smaller than) the corresponding numbers in 2006. The number of dissertations (11) is substantially smaller than the corresponding numbers in 2006 and 2008 (23 and 70, respectively).

There is no indication that volume of research on human problem solving is increasing. The number of published reports is substantially smaller than in other areas of cognition, such as perception or learning and memory. It seems that the lack of reliable experimental methodology, as well as the absence of theoretical foundations are responsible for this state of affairs. No doubt, studying problem solving is difficult. The underlying mental phenomena are complex and difficult to measure objectively. It seems to me that the current situation of our field can be changed by the use of computational models as ways of (i) explaining the mental mechanisms involved in problem solving and (ii) guiding empirical research. It is obvious to everyone that solving math or physics problems is a part of problem solving. Just look at Polya's books, starting with his wonderful "How to solve it?" (1945). So, the main problem with "problem solving" may not be related to the absence of a definition of the field. If someone were able to formulate a computational model that can solve math and physics problems the way good students do, we would have a real breakthrough in the study of problem solving. So, why not work on it? Similarly with games such as chess. There is already a very good

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Purdue University, Department of Psychological Sciences, 703 Third Street, West Lafayette, IN 47907-2081  
Email: pizlo@psyclops.psych.purdue.edu

chess playing algorithm, except that this algorithm has little to do with mental mechanisms. So, why not modify it and make it more similar to human chess players? Formulating decent computational models for solving math and physics problems or playing difficult games would be of great interest to cognitive psychologists. With such models at hand, it should be much easier to design interesting and informative experiments that would compare human and model performance. In fact, this is how research on visual perception, arguably the most mature and successful part of cognitive psychology, has been progressing during the last couple of decades. This conjecture points into the direction of interdisciplinary, collaborative research of cognitive psychologists and computer scientists interested in problem solving. The recent Dagstuhl Seminar on problem solving was a step in this direction. (See <http://www.dagstuhl.de/en/program/calendar/semhp/?semnr=11351>.) This approach is not entirely new—it was tried but failed half a century ago. The main reason for optimism at this point is the fact that both computer science and cognitive psychology are well developed sciences. In addition, existing computers can handle enormous problem spaces that could not have been tried in the 1950s. But being able to handle large problem spaces will not be sufficient. Intelligent, human-like problem solving will surely require forming adequate representations of a problem. The nature of problem representation was, in fact, the main topic motivating the Dagstuhl Seminar. Recall that the role of problem representation was emphasized by the Gestalt Psychologists almost 100 years ago. It seems that the Gestaltists were ahead of their time. Again, using the analogy with the field of visual perception, Gestaltists' theories of vision, presented in the 1920s and 1930s, could not "materialize" without the Information Theory (formulated in 1948), without computers (built in 1941) and without a formal theory of Inverse Problems (developed in the 1960s). Can "representational complexity"; a concept analogous to "computational complexity" be the missing theoretical tool that will prove critical in implementing the Gestalt ideas about problem solving? The first answers to this question may come at the next Dagstuhl Seminar that is being planned, as you read this introduction.

### List of Journals

(The number of publications per each journal, if greater than one, is shown in parentheses)

*ACM Transactions On Computer-Human Interaction*

*AI Communications*

*Animal Behaviour*

*Animal Cognition*

*Annual Review Of Neuroscience*

*Applied Cognitive Psychology*

*Artificial Intelligence In Medicine*

*Artificial Intelligence Review*

*Behavioral And Brain Functions*

*British Journal Of Psychology*

*Cognition*  
*Cognitive Processing*  
*Cognitive Science*  
*Cognitive Systems Research*  
*Computers & Education (3)*  
*Computers In Human Behavior (6)*  
*Current Anthropology*  
*Decision Sciences Journal Of Innovative Education*  
*Educational Psychology Review (3)*  
*Experimental Aging Research*  
*Hippocampus*  
*Human Brain Mapping*  
*Human Factors*  
*Human Physiology*  
*Human Resource Development Review*  
*Instructional Science*  
*International Journal Of Human-Computer Interaction*  
*International Journal Of Human-Computer Studies (2)*  
*Japanese Journal Of Educational Psychology*  
*Journal Of Experimental Child Psychology*  
*Journal Of Experimental Psychology: General*  
*Journal Of Experimental Psychology: Learning, Memory, And Cognition (3)*  
*Journal of Experimental Social Psychology*  
*Journal Of Machine Learning Research*  
*Journal Of Mathematical Psychology*  
*Journal of Problem Solving (4)*  
*Journal of the Operational Research Society*  
*Knowledge-Based Systems*  
*Learning And Instruction*  
*Memory & Cognition*  
*Mind, Brain, And Education*  
*Minds And Machines*  
*Neurocomputing: An International Journal*  
*Psychologia: An International Journal Of Psychological Sciences*  
*Psychological Bulletin (2)*  
*Psychological Methods*  
*Psychological Review (2)*  
*Psychological Reports*

*Psychological Science*  
*Quarterly Journal Of Experimental Psychology (6)*  
*Review Of General Psychology*  
*Review of Marketing Science*  
*Social Networks*  
*Spatial Cognition And Computation*  
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*Theoretical Issues In Ergonomics Sciencei*

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