



Human Problem Solving in 2012

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Keywords:

problem solving, bibliography

This paper presents a bibliography of 263 references related to human problem solving, arranged by subject matter. The references were taken from PsycInfo and Academic Premier database. Journal papers, book chapters, and dissertations are included. The topics include human development, education, neuroscience, and research in applied settings. It is argued that researchers are more and more engaged with problem solving research because of its centrality in human actions and because society needs advice from science in understanding and solving complex problems.

Thinking and problem solving has been an issue in basic psychological research since its beginnings in the 19th century. The first ideas came from Oswald Külpe who—in the late 1890s—invented in his Würzburg lab the method of “systematic experimental introspection,” a technique that required extensive retrospective reports from trained subjects about their perceived internal processes during their problem solving activities while working on complex intellectual tasks. This method provoked Wilhelm Wundt, the experimentalist, who rejected introspection for methodological reasons. The early Gestaltists (Karl Duncker, Max Wertheimer) followed a systems approach to thinking that was based on perceptual processes of restructuring. Their problems relied on visualization and processes near to perception, forming a Gestalt solution out of the problem particles.

With the advent of behaviorism and with the reign of terror during World War II, that analysis of higher cognitive processes has gone lost. The recovered interest in problem solving in the times of the Cognitive Revolution around the mid 1950s led to an increasing interest in internal processes and the search for a General Problem Solver. But, as Stellan Ohlsson (2012) wrote in this journal, “Newell and Simon’s search for general problem solving strategies failed. Paradoxically, the theoretical vision that led them to search elsewhere for general principles led researchers away from studies of complex problem solving.” So, what is the stand of problem solving research in the 21st century in terms of published articles?

For the years 2006, 2008, and 2010, comprehensive bibliographies of problem solving research were collected and commented by Zygmunt Pizlo (see Pizlo, 2007, 2009, 2010). In his last review, he was a bit pessimistic: “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” (Pizlo, 2010, p. 52). With this bibliography from 2012, I want to bring a bit more optimism back to the reader: from my point of view, problem solving as a concept and as a research issue is gaining more interest than before.

Based on activities in 2011 and 2012, there is an emerging bulk of research on what is called “complex problem solving” in the tradition of Sternberg and Frensch (1991), Frensch and Funke (1995), as well as Dörner (1997), using microworlds and computer-simulated scenarios as tools for the assessment of problem solving (see Brehmer & Dörner, 1993; Gray, 2002). The growing interest has to do with several developments, one of them being a recent shift in the understanding of problem solving by the OECD (Organization for Economic Cooperation and Development, Paris) that runs the international large-scale assessment enterprise called PISA (Programme for International Student Assessment). PISA is intended to compare and improve the quality of national education systems because the next generation’s workforce needs better education than ever. On their webpage (<http://www.oecd.org/pisa/about-pisa/>), the OECD describes PISA as follows: “Since the year 2000, every three years, a randomly selected group of fifteen-year-olds take tests in the key subjects: reading, mathematics and science, with focus given to one subject in each year of assessment. The students and their school principals also fill in background questionnaires to provide information on the students’ family background and the way their schools are run. Some countries and economies also choose to have parents fill in a questionnaire. In 2000 the focus of the assessment was reading, in 2003 mathematics and problem solving, in 2006 science and in 2009 reading again.” In 2012, about 500,000 pupils from more than 60 countries have been assessed and the focus domain in that wave has been problem solving!

As I said before: there was a major shift in the conceptualization of problem solving competencies: whereas in PISA 2003 (when problem solving was first in the focus) analytical,

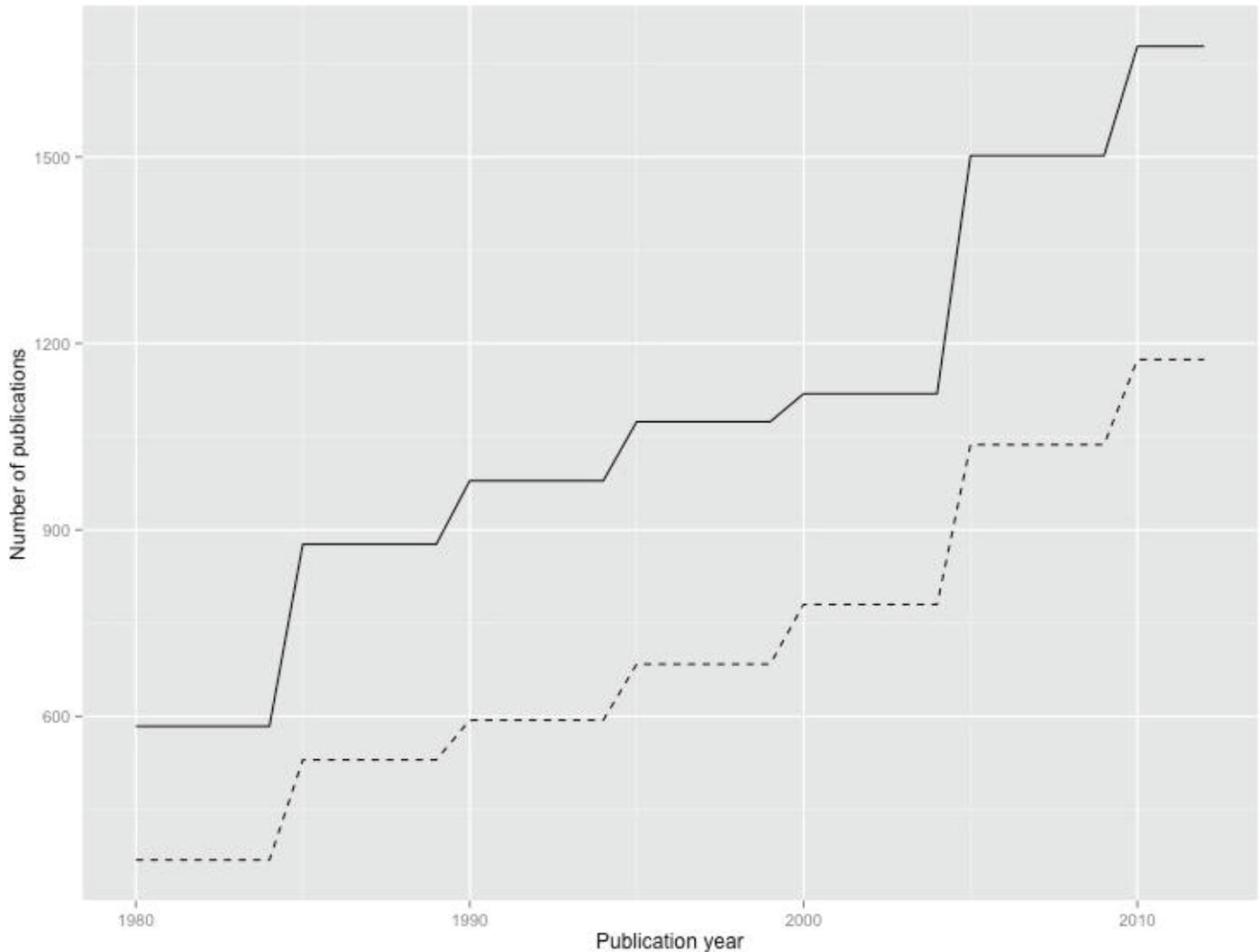


Figure 1.

Number of publications with keyword “PROBLEM SOLVING” in any field between 1980 and 2013, from PsycInfo database (in 5-year groups). Solid line: total number, dashed line: peer-reviewed publications only.

static problem solving was assessed by means of paper-pencil-tasks, in PISA 2012 (when problem solving was again in the focus) dynamic, interactive problem solving was assessed for the first time in PISA by means of computer-based testing (see Greiff et al., 2013).

Therefore, I see a growing interest in problem solving as an issue in itself. All world-wide or at least nation-wide operating large-scale assessments that are currently on the run besides PISA (e.g., ATC21, Assessment and Teaching of 21st Century Skills, <http://atc21s.org/>; P21, Partnership for 21st Century Skills, <http://www.p21.org/>; PIAAC, Program for the International Assessment of Adult Competencies, <http://nces.ed.gov/surveys/piaac/>) do include measures for problem solving. Problem solving is seen as a key competency in a world full of uncertainty (Osman, 2010) and full of potential obstacles on our way to societal goal states of peace,

food, and justice. Isn't that a success story? Accordingly, the absolute number of publications with the keyword “problem solving” (in all fields) per year that can be found in the PsycInfo database shows a steady increase (see Figure 1).

In the period between 2005 and 2010 especially, one can see a marked increase that supports my assumption of a growing interest in our issues, the increase in the total documents being steeper than in the peer-reviewed ones—once again a potential indicator for public interest that is responsible for the higher number of non-peer-reviewed papers.

The diversity of outlet journals has also increased: whereas in 2010, only 56 different journals were mentioned, in 2012 it is the amazing number of 171 journal titles from all fields of psychology and above. Concerning different sections in the following bibliography, in most areas slight to moderate increases can be documented, with education having a

strong growth from 15 to 39 publications. Reasons for that have been mentioned before. Also, the new clinical category (with $n=34$ starting on a high level) shows the high application interest in our topic. Against expectations, the “Neuroscience” category has only a small increase (from 5 to 9); maybe problem solving (as a coordinated action of higher order processes) is not easily analyzed by means of functional imaging techniques.

THREE “MAYBES” AS RECOMMENDATIONS FOR FUTURE BIBLIOGRAPHIES

1. Maybe the restriction to one year of publication activity is a time window too small for the identification of trends. To iterate the bibliography not every year but every two years seems reasonable—but to have a time window of one year might be a bit short. Recommendation 1: Why not choose a time window of two years that is reported every two years?
2. Maybe “problem solving” should not be the only keyword to search for. Research on complex problem solving, for example, comes under different labels like “dynamic decision making” (Coty Gonzalez, e.g., Gonzalez & Dutt, 2011), “complex dynamic control” (Magda Osman, e.g., 2010), or “naturalistic decision making” (Gary Klein, e.g., 2008). Search in databases is restricted to certain keywords that sometimes do not reflect the broader context and the similarities in content despite of different labels. Recommendation 2: Why not enlarge the search space in terms of broader keywords?
3. Maybe PsycInfo should not be the only database to rely on because interdisciplinary work on problem solving does not completely show up there. For example, my own work with the mathematician Sebastian Sager (on the optimization methods for complex problem solving in the case of the microworld “Tailorshop”; Sager et al., 2011) is published in one of the mathematical journals (SIAM Journal on Optimization) that were not indexed in PsycInfo. As a consequence, one should search for problem solving more carefully also in other related databases to reach a nearly complete coverage. Recommendation 3: Why not enlarge the search space in terms of more databases?

CONCLUSION

For me, the fate of problem solving research looks fine! For good or for bad, the world around us is full of problems (always remember the saying from Sir Karl Popper: “all life is problem solving”) and we are not finished with our research duties! Progress in theory is urgently needed, but as it happens often in science: with the advent of new research paradigms also new theoretical constructs do emerge. With the

advent of computer-based microworlds, new methods for process tracing have been (and still have to be) developed, new constructs have to be defined, theories have to be adjusted. I am quite optimistic that problem solving research is not only increasing in the next years but that society is in urgent need for new insights about the way humans deal with complexity and uncertainty.

ACKNOWLEDGMENTS

This research was supported by a grant from the German Research Foundation (DFG Fu 173/14-2) to the author.

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LIST OF JOURNALS

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

- Academy of Management Learning & Education
Acta Paediatrica
Acta Psychiatrica Scandinavica
Acta Psychologica Sinica (3)
Addictive Behaviors
Advances in Developing Human Resources
Advances in Health Sciences Education
AIP Conference Proceedings
American Annals of the Deaf
American Journal of Community Psychology
American Journal of Primatology (2)
Animal Behaviour
Animal Cognition
Annales Médico-Psychologiques
Applied Cognitive Psychology (3)
Applied Psychological Measurement
Applied Psychology: An International Review
Archives of Suicide Research (2)
Brain and Cognition (2)
Brain Stimulation
British Journal of Educational Psychology
British Journal of Educational Technology (2)
British Journal of Health Psychology
Bulletin of Educational Psychology
Canadian Journal of Occupational Therapy /
Revue Canadienne D'Ergothérapie
Child Development
Chinese Journal of Clinical Psychology
Cognition and Emotion
Cognitive Processing
Cognitive Science
Cognitive Systems Research
Cognitive Therapy and Research
Comprehensive Psychiatry
Computers & Education (8)
Computers in Human Behavior (4)
Consciousness and Cognition: An International Journal (5)
Contemporary Educational Psychology
Creativity Research Journal (4)
Critical Social Policy
Cultural Diversity and Ethnic Minority Psychology
Current Directions in Psychological Science
Development & Change
Developmental Cognitive Neuroscience (2)
Developmental Neuropsychology
Drug and Alcohol Review
Early Childhood Education Journal (2)
Early Childhood Research Quarterly
Education & Treatment of Children
Educational Technology Research and Development (3)
Electronic Journal of Research in Educational Psychology
Eurasia Journal of Mathematics,
Science & Technology Education
European Journal of Engineering Education
European Journal of Psychology of Education
Experimental Aging Research
Expert Systems: International Journal of Knowledge
Engineering and Neural Networks
Family & Community Health: The Journal of
Health Promotion & Maintenance
Family Court Review
Farmers Weekly
Games and Economic Behavior
Group Decision and Negotiation
Health Psychology
Human Factors and Ergonomics in
Manufacturing & Service Industries
Human Relations
Industrial Marketing Management
Instructional Science
Intelligence
Intelligent Data Analysis
International Journal of Early Years Education
International Journal of Geriatric Psychiatry (4)
International Journal of Intercultural Relations
International Journal of Psychophysiology
Japanese Journal of Special Education
Journal for the Education of the Gifted
Journal for the Scientific Study of Religion
Journal of Applied Psychology
Journal of Autism and Developmental Disorders
Journal of Behavior Therapy and Experimental Psychiatry
Journal of Business Ethics (2)
Journal of Classroom Interaction
Journal of Clinical Nursing

- Journal of Cognition and Culture
 Journal of Cognitive Education and Psychology
 Journal of Community Psychology
 Journal of Constructivist Psychology
 Journal of Economic Behavior & Organization
 Journal of Educational and Developmental Psychology
 Journal of Educational Psychology (3)
 Journal of Educational Technology & Society (2)
 Journal of Experimental Child Psychology
 Journal of Experimental Psychology: General
 Journal of Experimental Psychology:
 Learning, Memory, and Cognition
 Journal of Interactive Learning Research
 Journal of Learning Disabilities
 Journal of Loss and Trauma
 Journal of Management Studies
 Journal of Marketing Research
 Journal of Neural Transmission
 Journal of Occupational Health Psychology
 Journal of Pragmatics
 Journal of Problem Solving
 Journal of Public Relations Research
 Journal of School Psychology
 Journal of Science Education and Technology (2)
 Journal of Social Work in End-of-Life & Palliative Care
 Journal of the Indian Academy of Applied Psychology
 Journal of the Learning Sciences
 Journal of the Neurological Sciences
 Knowledge-Based Systems (2)
 Kuram ve Uygulamada Eğitim Bilimleri
 L'Année Psychologique
 Learning and Individual Differences
 Learning Disability Quarterly
 Medical Teacher
 Memory & Cognition
 Metacognition and Learning (2)
 Mind & Society
 Neural Networks
 Neurocomputing: An International Journal (3)
 NeuroImage
 Neuropsychologia
 Organizational Research Methods
 Paidéia
 Pakistan Journal of Psychological Research
 Palliative Medicine
 Personality and Individual Differences
 PLoS ONE
 Population Health Management
 Prevention Science
 Psicologia dell'educazione
 Psychiatria Hungarica
 Psychiatry Research
 Psycho-Oncology
 Psychological Medicine
 Psychological Reports
 Psychological Test and Assessment Modeling
 Psychologie Française
 Psychologische Rundschau
 Psychology
 Psychology in the Schools
 Psychology of Men & Masculinity
 Psychonomic Bulletin & Review (2)
 Psychotherapie Psychosomatik Medizinische Psychologie
 Quality & Quantity: International Journal of Methodology
 Rehabilitation Psychology
 Research and Theory for Nursing Practice:
 An International Journal
 Research in Developmental Disabilities
 Research in Nursing & Health
 Scandinavian Journal of Caring Sciences (2)
 School Social Work Journal
 Science Education (2)
 Social Development (2)
 Social Networks
 Social Psychiatry and Psychiatric Epidemiology
 Social Science International
 South African Journal of Psychology
 Studia Psychologica
 Systems Research and Behavioral Science (2)
 Teaching and Teacher Education
 The Academy of Management Perspectives
 The Diabetes Educator
 The International Journal of
 Creativity & Problem Solving (4)
 The Journal of Creative Behavior (82)
 The Journal of Educational Research
 The Journal of Mathematical Behavior (5)
 The Psychologist
 The psychology of learning and motivation (2)
 Theoretical Issues in Ergonomics Science
 Thinking & Reasoning (2)
 Thinking Skills and Creativity (2)
 Work: Journal of Prevention, Assessment & Rehabilitation
 Zeitschrift für Erziehungswissenschaft
- GENERAL (47, +12)**
- The first figure represents the absolute value in 2012 for the given category, the second the change compared to 2010.
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