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—developed and applied 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 on 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 takes 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,
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.

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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 | Comprehensive Psychiatry |
| Acta Paediatrica | Computers & Education (8) |
| Acta Psychiatria Scandinavica | Computers in Human Behavior (4) |
| Addictive Behaviors | Contemporary Educational Psychology |
| Advances in Developing Human Resources | Creativity Research Journal (4) |
| Advances in Health Sciences Education | Critical Social Policy |
| AIP Conference Proceedings | Cultural Diversity and Ethnic Minority Psychology |
| American Annals of the Deaf | Current Directions in Psychological Science |
| American Journal of Community Psychology | Development & Change |
| American Journal of Primatology (2) | Developmental Cognitive Neuroscience (2) |
| Animal Behaviour | Developmental Neuropsychology |
| Animal Cognition | Drug and Alcohol Review |
| Annales Médico-Psychologiques | Early Childhood Education Journal (2) |
| Applied Cognitive Psychology (3) | Early Childhood Research Quarterly |
| Applied Psychological Measurement | Education & Treatment of Children |
| Applied Psychology: An International Review | Educational Technology Research and Development (3) |
| Archives of Suicide Research (2) | Electronic Journal of Research in Educational Psychology |
| Brain and Cognition (2) | Eurasia Journal of Mathematics, Science & Technology Education |
| Brain Stimulation | European Journal of Engineering Education |
| British Journal of Educational Psychology | European Journal of Psychology of Education |
| British Journal of Educational Technology (2) | Experimental Aging Research |
| British Journal of Health Psychology | Expert Systems: International Journal of Knowledge Engineering and Neural Networks |
| Bulletin of Educational Psychology | Family & Community Health: The Journal of Health Promotion & Maintenance |
| Canadian Journal of Occupational Therapy / Revue Canadienne D’Ergothérapie | Family Court Review |
| Child Development | Farmers Weekly |
| Chinese Journal of Clinical Psychology | Games and Economic Behavior |
| Cognition and Emotion | Group Decision and Negotiation |
| Cognitive Processing | Health Psychology |
| Cognitive Science | Human Factors and Ergonomics in Manufacturing & Service Industries |
| Cognitive Systems Research | Human Relations |
| Cognitive Therapy and Research | 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 |
The first figure represents the absolute value in 2012 for the given category, the second the change compared to 2010.


**DEVELOPMENTAL (16, +11)**


EDUCATION (39, +24)


**APPLIED (37, +18)**


NEUROSCIENCE (8, +3)


ARTIFICIAL INTELLIGENCE (7, -1)


COMPLEX PROBLEM SOLVING (18, NEW)


INSIGHT PROBLEM SOLVING (11, NEW)

J. Funke Human Problem Solving in 2012

CLINICAL (34, NEW)


Dissertations (36, +25)


Crrerar, A. M. (2012). Predicting career interests from problem-solving style with high school students. Retrieved from ProQuest Dissertations and Theses. (UMI 3452786.)


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**BOOK CHAPTERS (9, NEW)**


**BOOKS (7, +7)**


