245 BOSTON STUDIES IN

THE PHILOSOPHY OF SCIENCE

Creativity, Psychology and the History of Science

Edited by Howard E. Gruber and Katja Bödeker



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CREATIVITY, PSYCHOLOGY AND THE HISTORY OF SCIENCE

Edited by

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PREFACE

Jürgen Renn

Psychologists have often exploited the history of science as a reservoir of examples for studies of creativity. In the same vein, historians of science occasionally refer to psychological research in order to enrich narrative accounts with insights into the working of the human mind. Howard Gruber's contributions to the understanding of creativity are path-breaking because they distinguish themselves from these one-sided approaches. They stand out with their profound understanding of both the historical and the psychological dimensions of scientific creativity. Gruber's insights are based on a combination of detailed case studies and the development of a theoretical framework that is closely integrated with his historical investigations. His work is part of the larger enterprise of conceiving human thinking as an evolving system driven by the reflection of interactions of the subject with the real world, an enterprise launched by Jean Piaget with whom Gruber collaborated intensively.

This book offers a comprehensive survey of Gruber's work and focuses on the heritage he left behind for building a historical theory of the development of human knowledge in which individual creativity can be understood within its changing historical contexts. It covers a broad array of his work and opens with two introductions, one by Katja Bödeker, which places this work within the framework of different theoretical approaches bearing on the relation between psychology and the history of science. The second introduction is written by Howard Gruber himself and offers a masterfully succinct account of his evolving systems approach.

The idea for this book emerged during a memorable visit of Howard Gruber and his wife Doris Wallace to the Max-Planck-Institute for the History of Science in the summer of 1999.

The plan to assemble Gruber's widely dispersed publications into this collection and hence reveal the hidden bonds that make evident the coherence of his life work was first conceived by my friend and colleague Peter Damerow, who also suggested the name of Katja Bödeker as a collaborator on this project.

Katja Bödeker, a student of Wolfgang Edelstein, director emeritus of the Max Planck Institute for Human Development, is a psychologist and historian of science working in the interdisciplinary tradition founded by Howard Gruber. In her dissertation she has analyzed intuitive physical knowledge developed in widely differing cultural backgrounds. She has thus significantly contributed to our understanding of the interplay between universal and culture-specific dimensions in the knowledge underlying scientific thinking. Her familiarity with both the wide range of theoretical approaches in cognitive psychology and the questions of historical epistemology, as pursued at the Max Planck Institute for the History of Science, made her an ideal cooperation partner for Howard Gruber. During an extended visit with Howard Gruber and Doris Wallace in New York, this cooperation grew into a friendship. Last but not least, it is also Doris Wallace's unfailing engagement and encouragement that enabled this ambitious project to be brought to a successful conclusion.

In the last months before its completion, this joint endeavor was overshadowed by Howard Gruber's grave illness. To our great chagrin, his unexpected death unfortunately prevented him from seeing the book published. All of us who have known him will forever miss his wisdom and wit, his friendliness and human warmth. May this volume serve as a reminder of what one can achieve in a life with a purpose.

INTRODUCTION

Growth of knowledge is not the subject of a single dedicated discipline. Even within psychology, the acquisition, development and transmission of knowledge are addressed by sub-disciplines such as developmental psychology, expertise research, cognitive psychology, or creativity research, each pursuing the topic in a theoretically and methodologically distinct way. Outside the realm of psychology, historians of science analyze historical forms of knowledge and how they change, whereas anthropologists focus on the interaction between knowledge and its cultural and linguistic contexts—just to give two examples. This disciplinary variety testifies that growth of knowledge transcends the confines of a single discipline.

Though academic division of labour is generally appreciated as one of the most innovative ways of conducting science, the disciplinary splitting up of a topic often rests on presuppositions which may lead a research enterprise into false directions. So, for instance, the psychological perspective on the growth of knowledge is often ahistorical. The evolution of cognitive constructs, such as number, the species concept, or the idea of the self, is taken to proceed according to developmental stages or laws which hold universally, irrespective of historical or cultural determinants. Furthermore, historical underpinnings of the topic itself—such as the changing use of knowledge, its storage or distribution—are mostly disregarded. How, therefore, can research on the growth of knowledge be conducted which doesn't run into disciplinary reductionism? The answer seems to be straightforward: Research on the growth of knowledge should be interdisciplinary!

Yet the magic word "interdisciplinarity" exposes rather than solves the problem. What would interdisciplinary research on the growth of knowledge look like? Would it mean large conferences with participants from various disciplines? Would it mean the establishment of new research centers which are no longer organized along traditional disciplinary lines?

This volume presents another way of conducting research on the growth of knowledge, which crosses intra- and interscientific frontiers. This volume is a collection of the writings of Howard E. Gruber. In academic psychology, Gruber is widely known for his outstanding research on scientific creativity—in particular for his study on the development of Darwin's theory of evolution (Gruber 1974). It is thus tempting to subordinate Gruber's work into one of academic psychology's compartments, i.e. creativity research. But as the broad scope of Gruber's writings reveals, his work resists assignment to a neatly delineated research field. Apart from his contribution to our understanding of scientific creativity, Gruber *inter alia* worked on visual perception, on science education and—as a temporary collaborator of Jean Piaget—on cognitive development. Furthermore, he spent a considerable part of his productive energies on political issues, and so, for example, delineated an agenda for psychological peace research.

H. E. Gruber and K. Bödeker (eds.), Creativity, Psychology and the History of Science, 1-18. © 2005 Springer.

Yet Gruber was not only an extraordinarily versatile man with wide-ranging scientific interests. As this volume aims to show, Gruber's multiple enterprises are integrated on the trajectory of an intellectual developmental course which, though surprising at first glance, is consistent and understandable. Standing at the crossroads of several disciplines, Gruber's detailed analyzes of the growth of thought as well as his way of approaching the question of how new ideas come into being make apparent the shortcomings that the disciplinary splitting of the topic of growth of knowledge entails.

At first sight, Gruber's work seems to fall into psychology's young field of creativity research. Considering the role, though, that social and cultural surroundings play in his cognitive case studies, psychologists might be tempted to push off Gruber's work into history of science. However, as Gruber's case studies address the development of thought, its structural make-up, the anatomy of conceptual changes as well as their preconditions, the questions that Gruber pursues are psychological. Following the borderlines of academia, they would fall within the range of developmental psychology. Moreover, if psychology took the challenge of situating the growth of ideas or thoughts culturally and historically, Gruber's work would form part of its disciplinary core.

In the following some of the fundamental lines of Gruber's approach will be presented by situating it within the field of creativity research. His perspective on creative work will be contrasted with two psychological approaches to creativity: the psychometric approach and the creative cognition approach. Secondly, it will be pointed out how Gruber's work can contribute to our understanding of the growth of knowledge.

ROOTS AND PRINCIPLES OF PSYCHOMETRIC RESEARCH ON CREATIVITY

Creation is a phenomenon that has attracted philosophers and scientists for centuries. Scientific discoveries or original works of art are surrounded by an aura of mystery as their production seems to surmount ordinary human capacities. The notion of *genius*, so prominent in European intellectual movements of the eighteenth and nineteenth century, mirrors this enigma of scientific or artistic invention and turns it into a particular quality of the creator. In its production, the *genius* doesn't imitate, it creates, it doesn't follow rules, but establishes them. To nature, the *genius* entertains an intimate relation: The comparison between natural generation and the productive forces of the *genius* was widespread in the eighteenth century. Moreover, *genius* was regarded as appertaining to nature. As "don de la nature," it could not be acquired through scholarly diligence. In his *Critique of Judgement* (1790), Kant defined genius as "the innate mental aptitude (ingenium) through which nature gives the rule to art."

Inaugurating the disenchantment of *genius*, Francis Galton can be regarded as the originator of the psychometric approach to creativity. His famous *Hereditary Genius* (Galton 1869) displays some of the basic assumptions of modern differential psychology (assumptions that Gruber repudiates): The person is conceived as composed

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of fixed situation-independent attributes, mental excellence being one of them. For the assessment of mental excellence, Galton isolated individual performance or even reputation—a feature whose dependence on social processes can hardly be overlooked—from their social embeddings and took them as expressions of the individual's stable characteristics.

In order to show statistically that intellectual excellence, as any physical attribute, is inherited, Galton adopted statistical tools from Quetelet, the most prominent one being the "law of deviation from an average," which later became known as the normal distribution. Measurement thus demanded its tribute: instead of describing the ways in which the creative person is extraordinary in its true sense, i.e. incomparable to others, "mental excellence" was reduced to a single dimension on which individuals are arranged according to their outcome in a series of comparisons. The set of interindividual differences thus determined the degree of mental excellence ascribed to the individual.

Comparing the distribution of the examination marks obtained by seventy-two applicants for the Royal Military College with the numbers predicted by Quetelet's law, Galton reported a good fit: Mental abilities showed the same pattern of variation as heritable physical attributes such as body measures. In order to provide even stronger evidence for the heritability of mental excellence, Galton analyzed the pedigrees of "eminent" English men such as judges or statesmen. If intellectual ability was inherited, his argument went, the number of eminent cases in the family of an eminent man should decrease with hereditary distance: Galton's results seemed to corroborate this hypothesis.

In his book on genius, however, Galton had to rely on examination grades in order to measure mental excellence quantitatively. Though a couple of practices assessing individual differences were common at that time, no scientific technique was available which would allow the researcher to derive assessment data suitable for statistical analysis. In his laboratory in London, Galton himself worked on the development of techniques which promised to measure mental "faculties." In the end, his mostly sensory tasks did not prepare the ground for the kind of investigation of creative abilities that was to come. The psychometric approach to creativity took over the methodology of the mental testing approach whose application in intelligence research had become paradigmatic for research on personality in general.

It is mentioned in most historical surveys on creativity research that it was only after World War II that psychologists realized the social demand for tools assessing creative potential. Both academic achievement as well as scores in ordinary intelligence tests turned out to be insufficient in identifying the ability to invent or to find solutions in new situations. But psychology had nothing much to offer: Research on creativity was scarce at that time. The few studies that existed were mostly in-depth examinations of insightful problem solving (Wertheimer 1945) or historiometric studies (Cox 1926), neither of which addressed the public need for selection tools.

Representing an accepted research tradition, both in academia and among the public, the mental testing tradition could serve as a model, providing methodological guidelines that helped to close this gap. Its fundamental presuppositions were taken over rapidly by creativity researchers: Creativity became an attribute that was stable across situations and domains. Instead of being ascribed exclusively to the few great creators, creativity was taken as a continuous trait that everybody had to a certain degree. These assumptions guaranteed that the measurement of creativity could take place in the standard fashion, i.e. by paper-and-pencil tests that were administered to a great number of people. Historically, the trait orientation of the psychometric approach to creativity may be explained by the diagnostic impetus backing its earliest steps. Creativity research at that time aimed at the identification and selection of people with high creative potential rather than describing creative activities in depth.

As will become clear in this book, Gruber's approach to creativity diverges from the psychometric tradition in several respects. In the psychometric approach, creativity is a domain-independent general-purpose ability that can be distilled from possible content. A person is creative to a certain degree, and his degree of creativity should show up in cooking in the same manner as in the elaboration of a scientific theory. Gruber repeatedly points to one of the general problems of the psychometric approach: The creativity measures that have been developed in this tradition show only poor correspondence to real-world creative achievement and suffer from a lack of validity. A further point of Gruber's critique is the questionable fruitfulness of the explanatory strategy launched by the psychometric approach to creativity. What can be learned about creative accomplishments such as scientific discovery or artistic invention—their possible origins as well as their genesis—if one just ascribes them to the high creativity of the creator?

A further problem is raised by the requirements of statistical data processing. As the creativity measures have to yield results that are amenable to statistical analysis, psychometric techniques require large samples and the researcher must lower selection criteria. Instead of confining his examination to the few prominent creators of the domain in question—as Gruber does in his case studies—, the researcher must increase the range of study in order to validate statements statistically: Thus individuals are included who may have been quite successful in their respective professions, but, as Gruber points out, most are far from revolutionizing their domain.

Psychometric analyses typically provide moderate correlations between the trait named creativity and intelligence, the number of siblings or the "openness to experience" scores on the "Big Five." Unquestionably, correlations like these can serve as clues to remote conditions of creative achievement. They may indicate that some sort of relationship exists between creativity and the features in question, but, as they do not aim at the creative process directly, correlations won't address Gruber's main interest: how creative work is actually done.

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THE CREATIVE COGNITION APPROACH TO CREATIVITY

A further tradition of research on creativity which should be mentioned in order to highlight Gruber's perspective on this notion is the *creative cognition approach* (for more recent publications see Smith,Ward and Finke 1995; Sternberg and Davidson 1995), in fact, Gruber refers to this line of creativity research in several of the papers in this volume. The creative cognition approach has its roots in *Gestalt psychology*. Köhler's description of insight (Köhler 1976), Duncker's study of problem solving (Duncker 1945), and especially Wertheimer's *Productive Thinking* (Wertheimer 1945) still form its groundwork. The approach has more recently been bolstered by methodological and theoretical tools adopted from the Cognitive Sciences. In contrast to psychometric research on creativity, work on creative thinking addresses the creative process itself. Studies in this tradition analyze thought processes leading to original ideas, to sudden insights or to representational reorganizations. Instead of taking creativity as a trait coming in grades or as a virtue pertaining to the very few, creativity is regarded here as an essential property of human thinking in general: The human mind is generative and so are its products.

The main purpose of the creative cognition approach is to analyze the structural underpinnings of creative thought processes. Here, creative thinking was shown to take place as conceptual combination, grouping, generalization, analogical reasoning etc. In order to lay bare the essential features of creative thought as neatly as possible, researchers often rely on experimental methods. In the standard setting, the subjects have to work on a task that requires some sort of creative invention—they have to solve classical insight problems, design new furniture, or construct a practical device out of given geometrical forms. Based on the results thus obtained, the cognitive operations applied by the subjects are then carefully examined.

In this kind of investigation, a similarity between creative cognition studies and the psychometric approach becomes apparent. In both traditions, the creative process is cut off from its possible content. The measures commonly used in the psychometric tradition assess "pure" creativity, and claim to disentangle creative potential from mere expertise or knowledge. In the studies of the creative cognition approach on the other hand, the anatomy of creative thinking is examined in the laboratory, i.e. in a sphere that is detached from the challenges of a real-life creative endeavor. A second point of similarity between the creative cognition and the psychometric approach is their generalist view of creativity. Creativity is either conceptualized as a universal characteristic of human cognition in general, or it is taken as a dimensional feature of different levels but in principle pertaining to everybody. Both the generalist grasp of creativity as well as the abstraction from the content of creative achievement diverge from Gruber's perspective on creative work.

Gruber studies the work of extraordinary individuals, unambiguous cases of creative accomplishment—"humanity at its best" (p. 272). Limiting the range of study to exceptional scientific creators and their work, Gruber's approach avoids the problem that afflicts ordinary psychological research on creativity, i.e. that of establishing