Chapter II – the creative work processes of economists

Author:
Lauchlan Mackinnon
PhD Student
Departments of Economics and Philosophy
The University of Queensland
St. Lucia Campus, Brisbane, Queensland, Australia

Contact
Email: lmackinnon@ozemail.com.au
Phone: 0402 141 131

This is a DRAFT of a chapter that is proposed for inclusion in my doctoral thesis.

All constructive comments and feedback very much appreciated

Please do not cite, excerpt from or use without prior written permission

Copyright © Lauchlan Mackinnon 2005
Chapter IV – the creative work process of economists

Introduction

Dominant models of the creative process

The Wallas stage model

An overview of the Wallas stage model

Further aspects of the stage model of the creative process

Clarification of the creative goals during 'preparation'

Rational and intuitive creative work

Creative rhythm

Overlapping stages

Critiques of the stage model

The stage model and the creative work processes of economic theorists

The Wertheimer productive thinking model

An overview of the Wertheimer productive thinking model

Critical reflections on the Wertheimer productive thinking model

The Wertheimer productive thinking model and economists: a case study of Léon Walras

Conclusions

References
Introduction

The purpose of the present chapter is to investigate the genesis and development of economic ideas from the point of view of the creative work processes of economists.

The starting point for the present considerations is the distinction between the ‘context of discovery’ and the ‘context of justification.’ Karl Popper was perhaps the first to distinguish between the intellectual genesis of a theory or proposition and its justification. Popper (1934/1965) wrote in his 1934 Logik der Forschung that:

... the work of the scientist consists in putting forward and testing theories. The initial stage, the act of conceiving or inventing a theory, seems to me to neither to call for logical analysis nor be susceptible of it. The question of how it happens that a new idea occurs to a man – whether it be a musical theme, a dramatic conflict, or a scientific theory – may be of great interest to empirical psychology; but it is irrelevant to the logical analysis of scientific knowledge ... Accordingly, I shall distinguish sharply between the process of conceiving a new idea, and the methods and results of examining it logically. (Popper 1934/1965: 31)

Hans Reichenbach (1938) further articulated this distinction, distinguishing between a “context of discovery” and a “context of justification”. While it would appear that Popper was the first to introduce the actual analytical distinction, the terminology of ‘context of discovery’ and ‘context of justification’ seems to have originated with Reichenbach.

Popper chose to focus on the context of justification, suggesting that in the context of discovery that indeed ‘anything goes’: there are no rules, and there is no necessary logic, to the process of discovery of ideas and hypothesis generation. Milton Friedman (1953) took a similar position in economics:

Progress in positive economics will require not only the testing and elaboration of existing hypotheses but also the construction of new hypotheses. On this problem there is little to say on a formal level. The construction of hypotheses is a creative act of inspiration, intuition, invention; its essence is the vision of something new in familiar material. The process must be discussed in psychological, not logical, categories; studied in autobiographies and biographies, not treatises on scientific method; and promoted by maxim and example, not syllogism or theorem. (Friedman 1953: 42-43)

It is suggested that by and large, following Popper and Friedman, methodological works in the economics literature have not closely examined the context of discovery. The present chapter will attempt to remedy that deficit by focusing on the context of discovery with reference to the psychology of creativity literature, in particular with reference to the classic creative process models of Wallas (1926) and Wertheimer (1945/1961). Attempts will be made to relate those models the creative work processes of

---

1 Feyerabend (1978) of course claimed that anything goes in both the contexts of discovery and justification. Popper agreed with Feyerabend in the context of discovery, but disagreed in he context of justification.
professional economists and thereby assess the relevance of those models of the creative process for professional economists.

**Dominant models of the creative process**

Within economics, there has been little discussion of the creative process, either of the economic agent or of economists themselves. Austrian economists have advocated a process view of the economic system with agents demonstrating a degree of creativity in playing the role of the entrepreneur. There have been sporadic attempts to introduce a notion of creative economic man into the economics literature, such as John Foster (1987: 137) for example introducing a *homo creativus* based on the behavioural view of economic man proposed by Tibor Scitovsky. There have however been few, if any, attempts by economists to take creative work processes, as understood in the psychology of creativity literature, seriously, or to relate them to an understanding of the economic agent.

The present chapter attempts this task. The chapter naturally begins, therefore, with a review of the creative process as articulated in the psychology of creativity literature.

The psychology of creativity literature, following Mooney (1963) and MacKinnon (1970), distinguishes between four aspects of the psychology of creativity: the *creative person*, the *creative product*, the *creative process*, and the *creative environment*. In other words, creativity may be viewed in terms of a particular creative person creating a particular creative product through some creative process in a particular creative environment, thereby giving rise to four related aspects to the study of creativity – the person, the product, the process and the environment.

The creative *process* subset of the psychology of creativity literature is dominated by two models: the Wallas ‘stage’ model published by Graham Wallas (1926) in his *Art of Thought*, and the Wertheimer ‘productive thinking’ model, published by Max Wertheimer (1945/1961) in his *Productive Thinking*. Although these models may appear to be rather dated, they are still central to the modern understanding of the creative process.

The psychology of creativity literature is of course a substantial literature, with many contributions from a variety of perspectives over a lengthy history. The categorization of the psychology of creativity literature into considerations of creative person, product, process and environment does not do justice to the diversity of viewpoints and contributions in the psychology of creativity literature. In particular, it should be noted that there are ‘confluence models’ straddling one or more of the categories proposed by Mooney and Mackinnon, such as the models proposed by Gruber (Gruber, Terrel et al. 1962; Gruber 1974/1981; Gruber and Davis 1988; Gruber and Wallace 1989) and Csikszentmihalyi (1988; 1990; 1999). It does however present a convenient metaphor or filtering device through which to approach the literature and allow a convenient and tractable focus for the present discussion. Since the present interest is primarily in the creative process, rather than in issues such as the psychometric attempts to measure...
creativity or identifying and studying cognitive mechanisms underlying creativity, much of the substantive work in the psychology of creativity literature is not of direct interest for the present purposes, and therefore beyond the scope of the present discussion. For a review of the psychology of creativity literature as a whole, the interested reader might however like to review the edited collections produced by Robert Sternberg (1988; 1999), for example the review article by Sternberg and Lubart (1999) reviewing the state of the psychology of creativity field circa 1999 and identifying ‘mystical,’ ‘pragmatic,’ ‘psychodynamic,’ ‘psychometric,’ ‘cognitive,’ ‘social-personality,’ and ‘confluence’ approaches to the study of creativity.

Given the interest in the creative process in the present chapter, the chapter begins with a review of the major historical models of the creative process – the Wallas and Wertheimer models - followed by a brief exploration of the models’ relevance to describing the creative work practices of professional economists.

The Wallas stage model

An overview of the Wallas stage model

Wallas’s stage model of the creative process was motivated by classic testimonial accounts of the creative process from eminent scientists Hermann Ludwig Ferdinand von Helmholtz and Jules Henri Poincaré, and attempts to explain illumination and insight experiences in scientific work.

Poincaré’s testimonial account is representative of the kind of insight and illumination described in stage model accounts of creative work processes:

For 15 days I strove to prove that there could not be any functions like those I have since called the Fuchsian functions. I was then very ignorant; every day I seated myself at my work table, stayed an hour or two, tried a great number of combinations and reached no results. One evening, contrary to my custom, I drank black coffee and could not sleep. Ideas arose in crowds; I felt them collide until pairs interlocked, so to speak, making a stable combination. By the next morning I had established a whole class of Fuschian functions, those which come from the hypergeometric series; I had only to write out the results, which took but a few hours. (Poincaré 1908/1952)

Poincaré’s productive work was marked therefore by an illumination experience which was preceded on the one hand by conscious preliminary work and succeeded by further conscious verification and elaboration. Wallas’s model attempted to explain the occurrence of such dramatic illuminations and insights in scientific or artistic work in terms of such preceding conscious work, followed by dramatic insight and further conscious veritification and articulation. Wallas proposed (like Poincaré himself) that the conscious preparatory work led to internalization of work on a problem into the subconscious, leading to some form or other of ‘subconscious’ processing of the problem, and eventually the subsequent (and potentially dramatic) return to consciousness of new
insights, connections and associations, ideas or illuminations to consciousness. The Wallas stage model therefore involves four stages\(^2\):

1. Preparation
2. Incubation
3. Illumination
4. Verification and elaboration

‘Preparation’ is conscious preparatory work on a problem, which involves attempts to engage with and (unsuccessfully) attempt to solve a problem or task. Preparation might involve initial engagement with and reformulation and restatement of a problem. Following this engagement, the problem becomes internalized. The problem is ‘incubating’ in the subconscious, leading to (by some mechanism) a useful insight forming subconsciously and emerging, possibly quite dramatically, from the subconscious into conscious awareness as an ‘illumination’ or ‘insight.’ The insight is then verified for correctness and followed by further work to articulate and develop the insight.

There is no shortage of testimonial evidence lending support to the Wallas stage model. Testimonial support is available from sources such as the original and eminent testimony from Poincaré (1908/1952) and Helmholtz (1896), from classic studies due to Platt and Baker (1931), Joseph Rossman (1931), Catherine Patrick (1935; 1937; 1938), and Eliot Dole Hutchinson (1949), and from more recent studies such as Mihalyi Csikszentmihalyi (1997). Platt and Baker and Rossman focused on providing testimonials from technical professionals: Platt and Baker focused on chemical engineers, while Rossman focused on individuals who had obtained large numbers of patents for technical inventions. Hutchinson surveyed a broad cross-sample of eminent scientists, artists and thinkers of the time. Csikszentmihalyi surveyed a number of eminent contemporary scientists and thinkers, including 14 Nobel Prize winners.

Although the creative process literature tends to focus on the Wallas stage model, it should be noted that a variety of authors including Henri Poincaré (1908/1952), Carl Jung (1928), Joseph-Marie Montmasson (1931), Platt and Baker (1931), Joseph Rossman (1931), John Dewey (1934/1958), Eliot Dole Hutchinson (1949), Alex Osborn (1952) and Mihalyi Csikszentmihalyi (1997) have proposed their own accounts of creative illuminations in the form of a stage model. Each of these stage models involves the same central idea: creative illuminations or insights are preceded by preparatory work, are followed by verification and elaboration, and involve some mechanism of non-conscious processing of the problem prior to the insight. The accounts differ however in their account of the non-conscious processing that occurs prior to illumination or insight.

---

\(^2\) Wallas also identified an additional stage between incubation and illumination, termed ‘intimation’. Wallas essentially suggested that the conscious mind could be ‘aware’ that there was a solution on the way, that something was clicking in to place and that an insight is liable to break into consciousness as an illumination shortly.
experiences. Rossman for example is opposed to an explanation of illumination in terms of subconscious processes, as

The assumption that the subconscious is responsible for the final solution is, however, no answer to the problem. It merely amounts to giving a name to a thing which mystifies and puzzles us. (Rossman 1931: 86)

Rossman fails however to offer any credible alternative to subconscious mental processing, and the testimonials he collected supported - often very explicitly and in direct contrast to Rossman’s own views - a direct role for subconscious incubation and processing in the incubation stages before insight experiences.

Similarly, Hutchinson’s stage model account of the creative process is psychodynamic in nature: for Hutchinson, the “intuitive thinker is often in a state of problem-generated ‘neurosis’ or its lesser equivalent ‘tension’ owing to the practical block set to the immediate fulfillment of his creative desires.” Hutchinson views the “happy thought” or illumination as a catalyst or trigger for dissolving the neurosis or tension, leading to a restorative integration much along the lines of a words uttered by a therapist in a psychoanalytic context. Hutchinson therefore replaces the stage of ‘incubation’ with a ‘frustration’ stage.

Osborn (1963) supported a similar concept of psychodynamic tension in the creative process:

A clearer psychological explanation was put forward by Doctor Elliott Dunlap Smith: “If the knowledge of the inventor and the clues which will bring the invention into being have been brought nearly into position to provide the inventive insight, his inner tension will be strong . . . As he nears his goal he will become increasingly excited . . . It is no wonder that the sudden release of such inner tension is often describes as a ‘flash.’” (Osborn 1963, pp. 317-318).

Despite their considerable interest, it is beyond the scope of the present work to review the stage model accounts of Poincaré, Jung, Montmasson, Platt and Baker, Rossman, Dewey, Hutchinson, Osborn or Csikszentmihalyi in any detail3. It is useful however to broaden the Wallas model by mentioning several themes introduced in the broader stage model literature.

**Further aspects of the stage model of the creative process**

**Clarification of the creative goals during ‘preparation’**

---

3. These stage model theories were however researched in some detail during the preparation for this thesis. The material has been written up in considerable detail, however space considerations preclude including it here. Since I have been unable to find any contemporary text reviewing the stage and productive thinking creative process models in any depth, and since the stage and productive thinking models still form the core of the creative process literature in the psychology of creativity literature, it is to be hoped that it might be useful to publish this material separately as part of an overview book on the creative process literature.
Hutchinson (1949) and Csikszentmihalyi (1997) have noted that there may be a considerable degree of variation in the initial degree of clarity of the creative goals, and that often the actual creative process may be preceded by a prior process of articulating the goals or problem situation. Hutchinson for example wrote that:

In many cases – more, I believe, in the arts than in science . . . the goal is defined only in general terms. So nebulous and unspecified are the means to that end, or the end itself, that the immediate task is not one of launching straightway into a period of efficient labor but rather of discovering some conception that can will serve as a starting point. Such a suggestive idea, keynote, or motif is merely a focal point for the work and is not yet fully representative of all the means of its attainment. (Hutchinson 1949, pp. 42-43)

This theme is also articulated in the creative process literature by J. W. Getzels (1964; 1976; 1977).

Rational and intuitive creative work

Creative process authors such as Poincaré (1908/1952), Platt and Baker (1931), Hutchinson (1949) and Jung (1928) have differentiated between two qualitatively different kinds of creative work process: one in which the work process is essentially a conscious and rational approach, involving application of existing knowledge and techniques in a more or less logical or systematic manner, and a second in which the work process becomes more deeply internalized and the subconscious engages with the problem tasks and contributes to the development of the work, leading to connections insights and illuminations beyond those the conscious mind might otherwise have made. In this latter case, insight experiences and intuitive jumps play a significant role.

Analytic psychologist Carl Jung (1928) was one of the earliest to deliberately contrast these two different forms of creative work (in the context of considering the creative process in producing poetry or verse). Jung presented the first form of creative work:

There are works, verse as well as prose writings, that proceed wholly from the author’s intention and resolve to produce this or that effect. In this case, the author submits his material to a definite treatment that is both directed and purposeful; he adds to it and subtracts from it, emphasizing one effect, modifying another, laying on the colour here, that there, with the most careful weighing of their possible effects, and with constant observance of the law of beautiful form and style. To this labour the author brings his keenest judgement, and selects his expressions with the most complete freedom. In his view the material is only material, and entirely subject to his artistic purpose; he wills to present this and nothing else. . . (Jung 1928: 234-235)

There is however another class of creative works, where the author is moved by a creative force to do something ‘larger’ and ‘greater’ to what he or she might otherwise have conceived:

Doubtless, also, I am saying nothing new when I speak of the other class of art-works, that flow more or less spontaneous and perfect from the author’s pen. They come as it were fully arrayed into the world, as Pallas Athene sprang from the head of Zeus. These works positively impose themselves upon the author; his hand is, as it were, seized, and his pen writes things that his mind perceives with amazement. The work brings with it its own form;
what he would add to it is declined, what he does not wish to admit is forced upon him . . . he is overwhelmed with a flood of thoughts and images which it was never his aim to beget and which his will would never have fashioned . . . He can only obey and follow the apparently foreign impulse, feeling that his work is greater than himself, and therefore has a power over him that he is unable to command. He is not identical with the process of creative formation; he is himself conscious of the fact that he stands as it were underneath his work, or at all events beside it, as thought he were another person who had fallen within the magical circle of an alien will. (Jung 1928: 235-236)

Hutchinson similarly contrasted these two forms of creative work, and gave specific examples related to technical invention. For example, on the one hand Hutchinson cited Thomas Edison’s work process as an example of a systematic, deliberate approach to productive creative work, in this case involving testing of a range of hypotheses:

... I want to tell you that all I have ever tackled and solved have been done by hard logical thinking . . . I speak without exaggeration when I say that I have constructed three thousand different theories in connection with electric light, each one of them reasonable and apparently likely to be true. Yet in two cases only did my experiments prove the truth of my theory. (Edison, quoted in Hutchinson 1949: 14)

By contrast, an associate of Edison employed and described quite a different creative process:

Then it came like a flash of lightning – not the Edison way (ie, by the progressive elimination of numerous hypotheses). On a Sunday evening I lay on my couch with a headache, smoking cigarettes. I tried to keep my mind a blank; but after a year or more of being held down to my problem by Edison, I could no longer shut out the waxes, even in my sleep. And suddenly, through headache and daze, I saw the solution! True, the balanced chemical make-up of the Aylsworth wax must not be disturbed. But by a physico-chemical process which instantly quickened in my mind, I could modify the intimate physical structure of the wax almost at pleasure, and thus bring about any desired change in hardness . . . a positive solution to my despicable problem!

I was restrained from rushing to the laboratory that evening. But the first thing next morning I was at my desk, and half an hour later I had a record in the softened wax cylinder . . . The acoustic production was correspondingly excellent . . . It was the solution! I had learned to think waxes, and the solution had come without effort, after a year of the Edisonian blind groping that had led nowhere. (M.A. Rosanoff, quoted in Hutchinson 1949: 23-24)

We have, therefore, a spectrum of creative work ranging from more or less rational, deliberate and systematic projects and explorations to processes where subconscious processing of creative material plays, to a greater or lesser extent, a more significant role in the creative process. The difference between these two classes of creative work process is the extent to which the creative agenda and the creative context and background information are internalized into and processed by the subconscious mind, leading to the results of subconscious processing becoming available as illumination or insight experiences, new connections and associations, new interpretations and understandings, and evolving intuitions about productive directions to take in the creative work.

It should not be imagined that any individual performs only rational, systematic work or only intuitive, inspired work. A given creative agent may produce both kinds of work at different times. Hutchinson for example quotes Sir James Irvine:
I can divide my ideas for scientific research into two groups. The best ideas are what I may call inspired. Then come ideas which are logically and mathematically evolved. These give rise to sound scholarly productions which cannot be compared in quality with those which are inspired. These latter appear at odd times and in unpredictable ways. (Sir James Irvine, quoted in Hutchinson 1949: 25)

Similarly, the creative process may involve conscious and deliberate work on a creative project and/or for the involvement of the subconscious in the creative project, leading to intuitions, insights and illuminations guiding and enhancing the creative process.

**Creative rhythm**

Wallas (1926) noted a kind of ‘rhythm’ or ‘stroke’ to the creative process: in some parts of the creative process, for example in the preparation stage, deliberate and conscious efforts are required, while in other stages of the process, for example during incubation, similar efforts may actually get in the way of and impede the process. Each individual creative agent, and different creative projects for an individual, may therefore have a different natural creative ‘rhythm’ or ‘stroke’ that is productive for that agent, and knowing when to push and when to relax or pursue other lines of activity is an important skill in creative work.

Alex Osborn, the inventor of brainstorming, suggested for example that “all along the way we must change pace. We push and then coast, and then push.” (Osborn 1963: 117)

**Overlapping stages**

Wallas has been criticized on the basis that he was supposed to have held that the proposed stages in the creative process were strictly linear and sequential. Eindhoven and Vinacke (1952) examined this issue experimentally in a study of the creative process in artists, and found it difficult to identify any clear breaks between the stages:

> . . . there was certainly no sharply defined break between preparation and incubation or illumination. (Eindhoven and Vinacke 1952: 161)

Eindhoven and Vinacke conclude that:

> . . .the “stages” are not stages at all, but processes which occur during creation. They blend together and go along concurrently . . . Thus, it is far more meaningful and in better agreement with the facts to regard these alleged “stages” of creativity as aspects, or processes, of the complete dynamic pattern into which they are interwoven. Further studies might do well to carry further the kind of approach made here, that of observing and analysing the activities which occur, rather than basing analysis upon a rigid conception of four stages. (Eindhoven and Vinacke 1952: 161-162)

---

4 In considering Eindhoven and Vinacke’s work it must be noted that they defined preparation, incubation, illumination and verification differently to Wallas, for convenience in identifying these stages operationally in experimental conditions. This does not however affect the point made here relating to the relationship between the stages.
This point however should not be taken as a forceful criticism of Wallas’s model, as it is difficult to find anything in Wallas’s work, or in the testimonial material that Wallas’s model is built on, that asserts that the stages must be followed in a strictly linear fashion. Wallas’s stage model is entirely consistent with the idea that for example during incubation of one creative problem one might be doing vigorous preparatory work on another, separate, problem.

**Critiques of the stage model**

The stage model of the creative process has been critiqued by suggesting that the incubation-illumination stage model explanation is not necessary: instead the *pure-chance hypothesis* (illumination experiences are the result of pure chance), the *rest hypothesis* (a refreshed mind after a break is more productive) and the *forgetting hypothesis* (after a rest, mental sets or predispositions acting as a barrier to success are dropped, facilitating creative success) may be proposed to explain creative progress after a period with a relaxed mind, away from the work.

Jacques Hadamard (1945) summarised these hypotheses before rejecting them on a number of grounds. Most notably Hadamard argued that illumination insights typically showed evidence of internal processing that surprised the creative agent, and that such insights occurred under conditions of mental and physical exhaustion equally as much as in a fresh mind, and that insights usually struck the creative agent with a profound sense of harmony or aesthetic sensibility in a manner that a purely chance idea would not tend to accomplish. Following Hadamard’s criticisms of these hypotheses, it is difficult to accept these hypotheses as complete alternative explanations for illumination phenomena, but one may however readily accept these hypotheses as *complementary* aspects to the creative process, *along with* incubation and illumination phenomena. That is, in a given creative process, a rested mind and set unblocking may play a significant role in the creative work, or an illumination or insight might play a significant role, or factors of rest, set-unblocking and illumination may all play a part, but do not preclude the possibility or actuality of preparation, incubation, illumination and verification taking place. The hypotheses are not forceful criticisms of the stage model of the creative process.

**The stage model and the creative work processes of economic theorists**

It is useful to locate specific support for the stage model of the creative process in testimonial material sourced explicitly from practicing economists.

There is however in general a paucity of testimonial material available from modern economists discussing their experiences in their creative work. Gerald Holton (1973/1988; 1978/1998) has suggested one explanation, in considering a similar reluctance in scientists. Holton distinguishes between ‘private’ and ‘public’ science and suggests that the motivations and metaphors that fuel the *private* passion of discovery are
often obscured in the final, formal and public presentation of the work to the scientific community. Holton suggested that

Unless specifically urged, each [scientist] is likely to adopt in discussions of science the vocabulary and attitude of [public science], dry-cleaned of the personal elements. (Holton 1973/1988: 9)

This situation seems to be somewhat similar for economic scientists: there seems to be generally little discussion of the psychological journey or process of discovery leading to polished, formal theories or models: the motivating metaphors, dispositions and inspiration, the steps and mis-steps along the way, the events and dynamics in the process. In general the development of ideas - the context of discovery - seems to be kept private. In addition to this general lack of testimonial material, there is an additional issue that, as noted by Hutchinson (1949) and Jung (1928) (considered above), creative work processes may vary on a spectrum between predominantly rational ‘Edisonian’ systematic creative work processes and more ‘intuitive’ processes involving incubation, guesses, and illumination. One should not expect therefore that every economic scientist experiences illumination experiences: some individuals’ work processes may tend towards more systematic approaches with less likelihood of and occurrence of illumination experiences. It is, therefore, not to be expected that every economist will regularly experience insight and illumination experiences, or that even if they do, that they would necessarily publicly write about their psychological creative process and experience of conceiving and developing their creative work. One might expect on the basis of Holton’s observations regarding public science and the likelihood that real illumination experiences presumably only occur for a fraction of the community of professional working economists that little may have been written on illumination experiences, as indeed appears to be not far from the case5.

Fortunately however, there is at least some useful testimonial material already readily available in the literature, giving a useful insight into the creative work processes of economists.

To the extent that modern economics is a mathematical science, a broad level of testimonial support for the stage model for economists may be readily found, as testimonial material demonstrating the applicability of the stage model to work in mathematics and the physical sciences has been ongoing since Helmholtz (1896) and Poincaré (1908/1952).

Perhaps the first explicitly economic support for the Wallas stage model comes from no less an eminent authority in economics than John Maynard Keynes, who apparently came.

---

5 It would be useful to perform a survey of professional economists along the lines of the surveys done by Platt and Baker (1931), Rossman (1931), Hutchinson (1949), and Csikszentmihalyi (1997), examining the extent to which the Wallas and Wertheimer models reflect economists’ creative work processes and identifying other elements or aspects of the creative work process that they might consider significant. Time constraints precluded including such a survey with this dissertation, but it would make an interesting project after completion of the dissertation.
to a similar formulation to the Wallas model independently of Poincaré, and certainly before Wallas. Keynes remarked in a 1906 article, entitled “Egoism,” that intuition is the result of an individual exercising their “mental muscles and by keeping his nose close to the stone” (O’Donnell 1989: 92). Keynes further articulates this in his 1909 paper “Science and art” where Keynes outlines a three-stage explanation of creative insight, similar to the Wallas stage model; the first step is to “perceive very clearly the details together clearly before his mind,” the second is then “with a sudden insight see through the obscurity of the argument or of the apparently unrelated data, and the details will quickly fall into a scheme or arrangement, between each part of which there is a real connection,” where intuitions “arrive in a flash” after years of study (O’Donnell 1989: 92, 101). The essential features of the Wallas stage model including stages of preparation and illumination are very clear in Keynes’s formulation. Other material suggests that Keynes quite clearly considered himself to experience incidents of illumination and insight consistent with his model and, by extension, the Wallas stage model.

A second source for creative process testimonial material, drawn on extensively in the present discussion, is the material collated in Michael Szenberg’s *Passion and Craft* (1999). Szenberg solicits discussion of their creative work process from a number of eminent economists, and it is immediately clear from this material that there is a considerable degree of support for the stage model of the creative process.

Avinash Dixit for example explicitly draws on the stage model of the creative process (albeit through the later, secondary source of Littlewood 1986 rather than directly through Wallas or Poincare) in advising how to proceed with creative work in economics:

> Having posed the question and worked on it for a while, give the subconscious a chance. Perhaps the best advice on this comes from the mathematician J. E. Littlewood, in his lovely article “The Mathematicians Art of Work.” He distinguishes four phases in creative work: preparation, incubation, illumination, and verification. “In preparation, [t]he essential problem has to be stripped of accidentals and brought clearly into view, all relevant knowledge surveyed; possible analogues pondered. It should be kept constantly before the mind during intervals of other work . . . Incubation is the work of the subconscious . . . Illumination, which can happen in a fraction of a second . . . almost always occurs when the mind is in a state of relaxation, and engaged lightly with ordinary matters.” (Dixit 1999: 76)

Indeed, Dixit suggested this insight into the creative process was a kind of competitive advantage:

> Littlewood recommends “the relaxed activity of shaving” as a fruitful time for illumination; I shudder to think how much more David Kreps, Paul Krugman, and Lars Svensson would have accomplished if they had known this. (Dixit 1999: 76)

Richard Schmalensee (1999) similarly identifies illumination experiences:

---

6 It is of course difficult to ascertain for certain the extent to which Poincaré’s thinking on creative work might have been known to Keynes. Keynes had a definite interest in mathematics and may well have read with great interest Poincaré’s more philosophical work as well. Further investigation of this point is beyond the scope of this thesis.
I have usually found that my subconscious mind is better than my conscious mind at solving problems that don’t yield to straightforward approaches. That is, on more than a few occasions the solution to a problem has come to me unbidden in the shower or in some other relaxed setting after I’ve ended a period of intense work on the problem. The solution to one problem (devising an index of competitive localization) that I had pursued intensively for several weeks came to me in the middle of a movie in the old Orson Welles theatre in Cambridge. If a moderate amount of intense effort doesn’t get me past an important intellectual barrier, I tend to take a break and work on something else – or nothing at all – for a while. (Schmalensee 1999: 252)

Schmalensee also suggests that it is often hard to differentiate preparation stages clearly from more substantive work on a project:

It is of course sometimes hard to separate project execution from topic winnowing. Figuring out whether a conjectured theoretical result is correct, for instance, may be both the logical first step after forming the conjecture and the hardest step in the whole project. (Schmalensee 1999: 251)

Like Carl Jung (1928), Schmalensee notes that this psychological process goes at its own pace and cannot be rushed:

I am often frustrated at how long it takes to go from what seems to be final results to a completed manuscript, but whenever I try to rush this part of the process I am unhappy with the final product. (Schmalensee 1999: 251)

Finally, Schmalensee notes a verification and elaboration stage:

After the conceptually difficult work on a research project is apparently done, a lot of less interesting work is often required to clarify exactly what has been learned. In empirical analysis, this involves anticipating criticisms of both data and method and either reacting to them (perhaps by refining the data or employing additional tests or estimators), rebutting those criticisms, showing empirically or theoretically that they do not effect the main results, or limiting what is claimed. In theoretical work, this involves seeing which assumptions can be relaxed and making a case for the class of models and/or set of real situations to which the results are intended to apply. In both cases, it is necessary to make clear to readers exactly how the final product contributes to the relevant literature, and attempting to do this may suggest more work. (Schmalensee 1999: 252)

Helpman (1999) focuses on describing long term research projects with significant end-goals. For such long term projects it goes without saying that there is a high degree of preparation: indeed, initial and ongoing work on the project is preparation in the sense of the term in the stage model of the creative process. Helpman specifically identified an incubation stage in such creative processes:

One has to get accustomed to the idea that months will pass with no visible progress. This does not necessarily mean that no progress has been made. Sometimes incubation periods for ideas are very long. Then, all we can write on our report cards is that we have been thinking but have no results to report. Nevertheless, these periods are not a waste of time; they are just part of the creative process. (Helpman 1999: 138)

Further testimonial material could be marshaled to indicate that the stage model of the creative process is broadly consistent with the experience and creative work processes of
at least some economists However, the present material is sufficient to indicate the viability of discussing the creative work of economists in terms of the stage model. Further progress may perhaps best be made by means of a series of interviews with practicing economists asking firstly open ended questions about how their creative process develops, and secondly to what extent they consider the Wallas and Wertheimer models to be representative of their processes - and if not, why not? However, such an extended interview is beyond the scope of the present project.

The Wertheimer productive thinking model

An overview of the Wertheimer productive thinking model

The second major model of the creative process is due to Max Wertheimer (1945/1961). Wertheimer’s general framework for understanding creative work is in terms of a problem situation $S_1$, “the situation in which the actual thought process starts” and a situation $S_2$, “in which the process ends, the problem is solved”. The “productive thought process” consists of the process or steps between $S_1$ and $S_2$ denoted as follows:

$$S_1 \ldots S_2$$

Wertheimer (1945/1961: 242) allowed for productive processes that have no definite goal, but merely improve a situation:

$$S_1 \ldots$$

Additionally (1945/1961: 242), there could be processes which do not start with a problem:

$$\ldots S_2$$

This is typical for example of creative work:

$$\ldots$$ there are processes in which $S_1$ plays little or no role. The process starts, as in some creative processes in art and music, by envisaging some features in an $S_2$ that is to be created. The artist is driven towards its crystallization, concretisation, or full realization. Characteristically, the more or less clearly conceived structural whole-qualities of the thing to be created are determining in the process. . . When ideas about the goal are somewhat vague, there may be two directions at work simultaneously – one working to get the central idea clearer, the other to get at the parts. (Wertheimer 1945/1961: 242)

In general therefore, there may be prior elaboration of the structure and situation before $S_1$, and further elaboration and development after $S_2$ so that generally stated, the productive work process becomes:

$$\ldots S_1 \ldots S_2 \ldots$$

Wertheimer summarises this process in general terms:
Productive processes are often of this nature: in the desire to get at real understanding, questioning and investigation start. A certain region in the field becomes crucial, is focused; but it does not become isolated. A new, deeper structural view of the situation develops, involving changes in the functional meaning, the grouping, etc. of the items. Directed by what is required of the structure of a situation for a crucial region, one is led to a reasonable prediction, which – like the other parts of the structure – calls for verification, direct or indirect.

Two directions are involved: getting a whole consistent picture, and seeing what the structure of the whole requires for the parts. (Wertheimer 1945/1961: 212)

Wertheimer introduces several more specific theses regarding the productive thinking process, including: (i) that the productive thinking process involves a restructuring of the problem situation, and, more generally the framework in which the problem situation is understood, (ii) that the structural constraints in a problem, task or situation impose almost inevitable lines of force or tension leading to restructuring of the problem or task situation, and (iii) that there is a ‘whole-part’ relationship where the demands of the parts shape the structure and evolution of the whole’ and the demands of the whole shape the restructuring of the parts.

Wertheimer suggested that the productive thought process involves a restructuring of the problem situation:

\[ S_1, \text{ as compared with } S_2, \text{ is structurally incomplete, involves a gap or structural trouble, whereas } S_2 \text{ is in these respects structurally better, the gap is filled adequately, the structural trouble has disappeared, it is sensibly complete as compared against } S_1. \text{ When the problem is realized, } S_1 \text{ contains structural strains and stresses that are resolved in } S_2. \] (Wertheimer 1945/1961: 238)

It is not, however, just the formulation of the problem that is reworked, it is also the mental framework of understanding – the ‘gestalt,’ so to speak, through which the problem situation is understood – that is also restructured and evolved:

In real thinking processes, items often do not remain rigidly identical; and as a matter of fact, precisely their change, their improvement, is required. If an item, concept or proposition, recurs in the process and appears from an atomistic point of view as identical, it very often is not really so. It’s functional and structural meaning has actually, and fortunately, changed. (Wertheimer 1945/1961: 259)

This transformation may be a form of ‘gestalt shift’ or ‘mental revolution’:

---

It may be digressing from the letter of Wertheier’s terminology, but the term ‘gestalt shift’ that Wertheimer used primarily to denote visual shifts in perception is used here to indicate shifts in the mental framework within and through which the problem situation is understood. The term gestalt shift is used here analogously to the term paradigm shift in Kuhn’s *Structure of Scientific Revolutions*. As noted above, it is quite clear that the concept of such a mental shift is present in Wertheimer’s writings, so this is not an issue of content, only of terminology. I am perhaps however taking some liberties by referring to this shift or of underlying mental framework through which the problem is viewed as a ‘gestalt shift,’ but on the other hand it highlights nicely the parallels between such shifts in Wertheimer’s model and paradigm shifts in Kuhn’s model. These parallels are further explored in chapter V.
when the initial situation is not grasped either because it is too complex, too confusing, or because it appears in a simple but cheap, superficial structure, a transition is required first. The situation must be structurally understood so that the problem is grasped in its structural role as part of the given situation. *Often this transformation actually explodes, revolutionizes the old view of S*$_1$. (Wertheimer 1945/1961: 239)

Wertheimer suggests that the problem situation $S_1$ in itself sets up dynamics leading towards productive work:

The thesis is that the very character of the steps, of the operations, of the changes between $S_1$ and $S_2$ springs from the nature of these vectors set up in these structural troubles in the direction of helping the situation, of straightening it out structurally. (Wertheimer 1945/1961: 238)

There is a whole-part relationship where the parts are determined by the whole and also participate in determining the evolution and nature of the whole:

$S_2$ is a state of affairs that is held together by inner forces as a good structure in which the parts are determined by the structure of the whole, as the whole is by the parts. (Wertheimer 1945/1961:239)

This whole-part relationship was corroborated in contemporary investigation of the creative process, such as for example by Patrick (1941):

The primacy of the whole over the parts is apparent in the last two stages. When the idea becomes definite for the first time . . . it is a general idea, and we can saw that the whole precedes the parts, for the details are added later in the final stages of revision. . . . the idea which is first written or sketched . . . is a general one. In the last stage of revision the attention is chiefly focused on details or parts. (Patrick 1941: 131)

Sometimes a part develops into a whole, which then leads to a focus on parts in revision:

In many cases the primacy of the whole over the part is apparent from the beginning of the task to write a poem or draw a picture. In other cases, however, the idea of the whole develops from a detail or part . . . which idea of the whole in turn precedes the parts or details brought out in revision. (Patrick 1941: 131)

Wertheimer does not hold that the productive thinking process he describes is the only process through which useful results can develop through. Wertheimer for example contrasts the productive thinking process with

. . . processes in which some steps, some operations coming from various sources and going in various directions, may lead to the solution in a fortuitous, zigzag way. (Wertheimer 1945/1961: 238)

Wertheimer explicitly lists a spectrum of productive thinking process: firstly alpha processes, which are the productive thinking processes involved in

. . . $S_1$ . . . $S_2$ . . .
described by Wertheimer. Secondly beta processes, which are essentially alpha productive thinking processes except that “some of the items needed for progress, or some of the operations, may drop in externally, by chance, by external analogy, by mere recall, or as a result of blind trying” (1945/1961: 245). At the other extreme are gamma processes, where “the solution, is brought about by sheer chance discovery or merely by a succession of blind trials, by sheer external recall, sheer reliance on blind repetition, by blind drill or by prompting” (1945/1961: 245).

**Critical reflections on the Wertheimer productive thinking model**

Among the many critical points of discussion that could be raised in relation to the Wertheimer productive thinking model, two points should be made that are particularly pertinent to the present thesis.

Firstly, Wertheimer’s account involved the structure of a problem setting up ‘vectors’ of force, almost inevitably pushing the researcher in certain lines. For Wertheimer, structural aspects become causes in the productive thinking process (1945/1961: 230) so that the nature of the process is that the steps in the process are structurally determined (1945/1961: 240). This raises questions of what degree of inevitability there is in the structural situation and of the role of the particular individual thinker in finding or determining these lines of force or ‘vectors’ of direction along which the problem situation is explored and restructured. Wertheimer did explicitly allow for the role of the individual personality in the creative work process:

> The forces in the situation may be of two kinds. In many instances it is the structural nature of the objective situation which essentially determines the vectors and the steps while the I, the ego, and his personal interests and tendencies play only a small role, or none at all . . .
> There are other cases in which personal needs are the source of the problem. Here the I plays an important role. But . . . in order to really solve a problem, a transformation is often needed first . . . [into] the objective structural requirements. (Wertheimer 1945/1961: 241)

While Wertheimer’s model allows for the individual personality, it does not however answer questions such as how different experience, disposition, personal styles, personal cognitive dispositions or tendencies, or other personal factors impact on and relate to the supposedly inevitable lines of force. Presumably, the lines of reaction to the structural problem depend not only on the problem, but also on the predisposition of the researcher to positively or negatively even consider lines of inquiry. Schroedinger or Einstein, presented with a problem situation in physics, might have initially be inclined to proceed in quite different directions in approaching the problem, indeed Gerald Holton (1973/1988; 1978/1998) has argued that indeed this is the case: different scientists have different ‘themata’ or paradigmatic commitments and orientational worldviews, which would lead the scientists to pursue different directions given the same problem situation. The ‘vector’ of productive work given a particular problem situation and a particular creative agent might therefore be viewed as being partially determined by the structure of the problem situation (as highlighted by Wertheimer), but, in initial attempts at least, also
partially determined by the dispositions, experience and orientational understandings of
the particular creative agent or agents doing the productive work.

Secondly, Wertheimer’s productive thinking process model allows for not only a
restructuring of the mental framework or ‘gestalt’ of the researcher, but also the needs or
normative goals of the thinker. That is, implicit or explicit goals or aspirations may be
included in the initial situation S₁, and the situation S₂ may meet that need or goal with
the situation S₂ regarded as being more structurally sound or complete with respect to that
need, so that the structural “gap” or tension generated by the need or goal in S₁ is
resolved in S₂. This raises an ambiguity in exactly by what criteria S₂ is regarded as more
complete and satisfactory than S₁. It may be for example that S₂ is a more logically
complete and objectively correct problem situation but fails to meet the personal needs
implicit or explicit in S₁ or, conversely, S₂ might meet those needs adequately but leave
the problem situation logically unimproved or in a worse situation. Such questions might
be answered in terms of the subjective priorities of the agent involved in the productive
thinking process or in more objective terms as the work is published and disseminated,
but might be seen from a number of different perspectives simultaneously as S₂ being
more or less satisfactory than S₁ according to quite different perspectives and criteria of
assessment.

The Wertheimer productive thinking model and economists: a case study
of Léon Walras

Having considered Wertheimer’s model as presented by Wertheimer, it is useful to
consider Wertheimer’s model in relation to testimonial material in relation to the work
processes of practicing economists.

As noted above in discussing the stage model of the creative process, there is a
considerable paucity of material involving economists discussing their creative work
processes. Additionally, to assess the relevance of the Wertheimer model, a significant
level of detail is needed regarding the actions and thoughts of the agent during the
process of creative work, the kind of material that really only becomes available through
a case study of specific works with access to notes and other resources or through access
to the scholar in an interview format, focusing on the development of one or more key
works and the intellectual development of the scholar. Consequently, it is difficult to
assess the applicability of the Wertheimer productive thinking model to the creative work
processes of economists from citing comments and testimonials from economists
themselves.

In order to proceed, it is necessary therefore to turn to the study of manuscripts and notes
made available from the work of at least one significant economist. One such suitable
collection of documents are the notes and papers of Léon Walras, collated and studied by
William Jaffé (1965). As Jaffé (1972) notes:

Fortunately, Léon Walras left to posterity a mass of documents, besides shedding additional
light on the genesis of the “marginal revolution,” constitute excellent material for a case
study of the process of scientific discovery. (Jaffé 1972: 387)
In addition, Jaffé makes it clear that an understanding of Walras’s creative process calls for some other explanation than a stage model account of flashes of illumination:

The story thus unfolded does not, alas, possess high dramatic qualities. We do not have a case here where a fundamentally novel theory occurred to the discoverer in a single illuminating flash nor one in which the discoverer appears congenitally endowed with serendipity in any measure. On the contrary, Léon Walras’s path towards his solution of the problem of exchange value was long and tedious. (Jaffé 1972: 388)

It would seem therefore that Walras’s process of discovery would potentially make a suitable case study for exploring the relevance of the Wertheimer productive thinking model to the creative work processes of an actual historically significant economist. Unfortunately, space will not allow consideration of further economists in the present discussion.

Jaffé (1972) has considered Walras’s process of discovery and development in some detail. It is sufficient for the present purposes to consider some of the major features, and then consider the extent to which the Wertheimer model provides an appropriate framework in which to locate and understand Walras’s work.

The first elements of the creative process to consider are the formative influences on Léon Walras. These include Léon Walras’s early engineering study at the École des Mines, the influence and prior work of Léon’s father Auguste Walras, and Auguste and Léon Walras’s combined reading of and assimilation of existing economic thought, including a number of specific influences, particularly the pioneering work of Augustin Cournot.

Walras himself acknowledges his debt to the influences of his father and of Cournot:

I am indebted to my father, Auguste Walras, for the fundamental principles of my economic doctrine; and to Augustin Cournot for the idea of using the calculus of functions in the elaboration of this doctrine. (Walras 1877/1954: 37)

Considering Léon Walras’s training at the École des Mines, Walras was exposed in the course of this study to teaching in statics and mechanics. Although Walras was not an exceptional student, Walras was deeply influenced by the mathematical beauty and power of the physical mechanics he was exposed to. Ingrao and Israel for example note that:

Walras’s early reading consolidated his boundless enthusiasm for Newtonian astronomy and the solid edifice of classical mechanics, which he regarded as unequalled models of scientific knowledge throughout his life . . . it was in those years that he read with great enthusiasm Poinsoit’s Elements of Statics (Ingrao and Israel 1987/1990: 88)

Jaffé (1960; 1965: vol 3 149-150, letter 1483, n. 7) has argued that Walras took the conception and framework of general equilibrium from the second chapter of Poinsoit’s book, and from a memoir entitled “General theory of equilibrium and motion of systems.” Concerning his Economique et Mécanique, Walras wrote to a student noting
“the perfect similarity 1. between our formula of maximum satisfaction with the formula of the equilibrium of the Roman balance and 2. between our equations of general equilibrium with the equations of universal gravity” (Ingroa and Israel 1987/1990: 90).

Following Jaffé, a substantial case may be made that Walras’s early training at the École des Mines exposed Walras to a mathematical and physical metaphor that was to guide his work throughout his life.

The influence of Léon Walras’s father Auguste Walras cannot be overstated. Auguste Walras bequeathed to Léon several convictions that were to guide Léon Walras’s work, in particular the notion that economic science can and should be a mathematical science, secondly the notion of rareté and the conviction that rareté must play a central role in the theory of exchange. Auguste Walras had also undertaken considerable exploratory work, considering the problem from a variety of points of view and in relation to existing economic theories.

Auguste Walras had attempted to make the common-sense notion of rareté as scarcity more precise by defining it as the ratio of a number of persons desiring a good (each person assumed to want no more than a single unit of a good) to the total quantity of the good. Auguste Walras however later discerned a commensurability problem in the first part of the ratio, and concluded that until this conceptual difficulty was surmounted, economics could not become a mathematical science. This was the state in which Léon Walras ‘inherited’ the problem from his father:

It was the challenge implicit in his father’s conclusion which incited Léon to long labors that eventuated in his marginal utility theory. As Léon was the first to acknowledge, he owed much to his father for having adumbrated the problem, but it is evident that he could not possibly have attained to any conception at all of marginal utility by following his father’s reasoning. (Jaffé 1972: 389)

There were a number of minor influences on the development of Walras’s thought, such as for example the work of Burlamaqui, Genovesi, Turgot, Condillac, and Nassau Senior (Jaffé 1972: 390-392). Auguste Walras had “consulted the principal economic treatises, both French and English” (Jaffé 1972: 388) and it would normally be reasonable to suppose that Léon Walras did likewise. Schumpeter (1954) however has suggested that while Léon Walras read and absorbed the French intellectual tradition including Condillac, Turgot, Quesnay, and Biosguilbert, primarily through the lens of reading Say and his influences, Walras was not much influenced by English political economy: Walras “paid conventional respect to A. Smith. The rest of the great Englishmen meant little to him” (Schumpeter 1954: 828). Walras of course (see Walras 1877/1954: 36) formally stated that he was not aware, while developing or his Eléments, of Jevons’s (1871/1888) publication of Jevons’s Theory of Political Economy.

Jaffé suggests that none of this reading was particularly influential in guiding Walras to the formulation of his marginal utility theory:

For all their penetrating insight into the bearing of scarcity on value and price, neither Burlamaqui, nor Genovesi, nor Turgot, nor Condillac, nor Nassau Senior, all authors whom
Walras had apparently read at an early stage, can be said to have offered a likely lead to anything like a rigorous formulation of the theory of marginal utility. They never sharpened their argument to a fine analytical point; their disquisitions on value were even more discursive than those of Auguste Walras. (Jaffé 1972: 392)

Jaffé concludes:

We are left, therefore, with no alternative but to search for suggestions in Léon Walras’s manuscripts and worksheets. (Jaffé 1972: 392)

Jaffé therefore starts with a manuscript denoted by Walras as the “1’ère Tentative.” Jaffé summarises:

The whole effort centered around a labored attempt to assign meaning to the proposition that “the price of things is in inverse ratio to the quantity offered and in direct ratio to the quantity demanded” where quantity offered was defined as the total existing quantity in the possession of the several individuals in the world considered and the quantity demanded as the sum total of their wants or needs . . . Auguste Walras’s quasi-mathematical definition of rareté upon which his argument was founded led him completely astray. (Jaffé 1972: 392-393)

The next manuscript, the “2’ème Tentative,” was

. . . quite different and shows that in the interval . . . he had made considerable progress in shaping the structural pattern of his general equilibrium model (Jaffé 1972: 393, italics added)

However,

This did not dampen his misconceived resolve . . . to prove Cournot wrong in dismissing as meaningless the ratio of the quantity demanded of a commodity to the quantity offered. Léon Walras still clung to his father’s idea of rareté, which he expressed as the ratio of the utility of a commodity for all consumers taken together to the total quantity of that commodity in existence – though now with a shade less confidence. (Jaffé 1972: 394)

Jaffé summarises the state of play at this point:

It was this mixed bag of bungled mathematical economics and fruitful insights that Léon Walras brought with him when he arrived at Lausanne in December 1870 to take up his post as professor of economics. There was certainly nothing in that bag which would point to his eventual role as a marginal revolutionist, except his dogged persistence in trying to make sense of his father’s rareté. (Jaffé 1972: 394)

By 1872, Walras had made progress in assembling the machinery of his mathematical general equilibrium model, but he had not yet succeeded in integrating rareté into his model. The turning point was reached in 1872 due to a question asked by Léon Walras to a colleague, Paul Piccard, who furnished Walras with “the simplest analytical tools required for establishing the condition of maximum satisfaction for a trader.” Jaffé observes:
Unquestionably, it was from Piccard’s mathematical demonstration that Léon Walras distilled his refined and analytically tractable conception of marginal utility. (Jaffé 1972: 398)

This insight was succeeded by an integration of Piccard’s insight – and of rareté – into Walras’s framework and an elaboration of the theory into a complete and presentable publishable whole.

We now have therefore a high level, broad overview of Walras’s process of creative discovery. Some useful observations can be immediately drawn from such a high level overview. If we represent the creative discovery process broadly as

\[ \ldots S_1 \ldots S_2 \ldots S_3 \ldots S_4 \]

where \( S_1 \) is the problem situation as left by Auguste Walras and taken up by Léon Walras, and \( S_2 \) is the final restructured problem situation published by Léon Walras in his *Elements*, then

\[ \ldots S_1 \]

represents the initial creative work process of Auguste Walras in formulating and restructuring the problem, and

\[ \ldots S_2 \]

represents the further work on and restructuring of the problem situation by Léon Walras up and until he reached Laussane.

\[ \ldots S_3 \ldots \]

represents the work Walras continued to put into the project in Laussane up to and until Piccard’s contribution, which triggered a significant restructuring of the work and Walras’s integration of the concept of rareté into his essentially Newtonian equilibrium framework. Finally,

\[ \ldots S_4 \]

represents the final integration and structuring of this insight into the work and the restructuring and shaping of the completed work for publication.

It may then be noted that the final situation \( S_4 \) involves a reformulation of not only the intellectual product into the eventual form published in Walras’s *Elements*, but also the way rareté is conceptualised and integrated into the general framework. We can therefore identify following the contribution of Paul Piccard a ‘gestalt shift,’ a transformation and restructuring in both Walras’s formulation of the intellectual product and in the way that the problem situation is conceptualised.
Two additional themes are immediately evident in reviewing Walras’s process of creative work. Firstly, as noted above, physical mechanics clearly played a significant role in providing a conscious metaphor for elaborating a mathematical model of economic exchange. The application of such a guiding metaphor seems to have been both consciously deliberate and extensive. Secondly, there seemed to have been certain ‘hard core’ paradigmatic presuppositions that guided Walras’s work, most particularly the notion that economics can be usefully developed as a mathematical science and a conviction of the central role of \textit{rareté}. It was only with a restructuring of the central concept of \textit{rareté}, a ‘gestalt switch’ or ‘paradigm shift,’ that Walras was able to integrate \textit{rareté} or marginal utility with his mathematical framework.

It would of course be highly relevant and interesting for assessing the relevance of the Wertheimer model to return to Walras’s notes and closely study the evolution of specific elements of Walras’s theory over time in much greater detail noting the dynamics and logic of this restructuring and evolution, and consider this evolution in terms of logical necessity and vectors of change as described in Werthemer’s theory. Such a study is however beyond the scope of the present work, for reasons of both time and space.

In concluding the case study therefore, it appears that Walras’s creative work is broadly compatible with a Wertheimer account of the creative process, and indeed at least one ‘gestalt switch’ or restructuring of both the conceptual framework the problem situation is understood in and the problem situation itself can be identified. This gestalt switch or restructuring was triggered by an external contribution, seemingly acting as a catalyst for a transformation of existing psychic material and intellectual content, in a manner reminiscent of Hutchinson’s (1949) stage model theory. It appears likely that further and more detailed study would reveal more of the kind of dynamics of discovery posited by Wertheimer, and in addition the case study strongly reveals a significant role for metaphor or analogy, in this case with the physical sciences, and of orientational ‘thematic’ or ‘paradigmatic’ convictions or viewpoints.

\textbf{Conclusions}

The two dominant classical models of the creative process, the Wallas stage model and the Wertheimer productive thing model, have been reviewed and related to the creative work practices of professional economists. From readily available testimonial material and manuscripts, it appears that there is a good fit between both of the Wallas and Wertheimer models and the creative work processes of professional economists.

However, further work in the form of interviews with and surveys of professional economists would be useful to further explore the creative work processes used by economists, in particular the extent to which professional economists hold the Wallas and Wertheimer models to be useful and relevant accounts of their own creative processes and describing other aspects of their creative processes that they might consider to be important. Similarly, there is scope for further work examining the manuscripts and working notes of economists such as Léon Walras to examine on a finer level of detail.
the extent to which the Wertheimer model is a useful account of the processes involved in such creative work.

The present chapter has made an original and useful contribution to the literature in not only summarizing the dominant creative process models in the psychology of creativity literature but also relating those models to the work practices of actual professional economists - thereby making this literature accessible to economists.
References


Gruber, H. E., G. Terrel, et al. (1962), Contemporary Approaches to Creative Thinking, Atherton Press.


Helmholtz, H. v. (1896), Vortrage und reden (5th Auffl.), 1, Friederich Vieweg und Sohn, Brunswick, Germany.


Hutchinson, E. D. (1949), How to Think Creatively, Abingdon-Cokesbury, NY.


Jung, C. G. (1928). 'On the relations of analytic psychology to poetic art' in Contributions to Analytic Psychology, Harcourt, Brace, NY.


