

## I. Introduction.

In this book I describe the nature of creative development of individuals engaged in creative endeavors. I define creative development to be the process of development and creative activities of an individual engaged in a creative endeavor, extending over a period of time, usually several years or longer. Creative development encompasses both processes, experiences, and structures that lay the foundation for creativity, as well as the generation of creativity in its myriad forms, including ideas, insights, and discoveries, and engagement in creative projects leading to creative contributions.

The organizing principle and central theme of this book is that the creative development of an individual engaged in creative endeavors, across a wide range of fields, has a basic conceptual structure, which centers on, is based in, and grows out of his creative interests. More specifically, as I describe it, an individual's creative development is based in, centers on, and grows out of his creative interests, his conceptions of his creative interests, and conceptual structures he builds up in the domains of his interests – which guide him in his development, are generative of his creativity, and are the basis for his creative projects, and thus are a fundamental source and basis of his creative contributions to society. In the book I describe this basic structure and processes through which it is created and is generative of creativity and creative projects that lead to creative contributions. I describe and characterize creative interests and conceptions of creative interests; describe the formation of creative interests and kinds of interests; describe fundamental processes through which individuals develop their creative interests creatively, including building up rich conceptual structures in the domains of their interests – processes through which their interests and the conceptual structures they build up in the domains of their interests are generative of their creativity and creative projects; describe ways in which individuals are guided in their development by their conceptions of their interests and manage their development; describe larger patterns of creative development, including the evolution of creative interests and conceptions of interests, multiple interests, and sequences of interests formed and pursued over time; and discuss the implications of my description of creative development for understanding and modeling cultural development. I aim to show the clear, deep resonances and connections between creative interests, often formed early in development, and later creative contributions, and to show that creative development has a clear, well-defined logic and coherence, more so than has commonly been recognized.

Woven through my description I present many examples describing the creative developments of individuals whose developments I have analyzed – indeed whose developments provided an important basis for my construction of the description – illustrating the description and providing evidence in support of it. These include individuals in several fields, mainly academic, whom I interviewed about their development, for whom I also obtained and have drawn upon published and archival materials, and individuals in an array of fields who are famous for their creative contributions whose creative development I have studied

and analyzed drawing upon biographical and archival materials, including Virginia Woolf, John Maynard Keynes, Charles Darwin, Alexander Calder, Albert Einstein, Thomas Edison, Hannah Arendt, Hans Krebs, Galileo, William Faulkner, Ray Kroc, Tim Berners-Lee, Piet Mondrian, Rachel Carson, and others. For these individuals I describe their creative interests and their conceptions of their interests, as they described them or I reconstruct them, and describe how their interests, conceptions of interests, and conceptual structures that they built up and that developed over time in their interest domains were, and in some cases continue to be, the bases for their creativity and creative contributions; I also describe their formation of their interests and their paths of development. I discuss the empirical basis for my description, including the set of individuals I interviewed and sources of information about their development, later in this chapter, and list the individuals I interviewed and provide details about archival materials and information I collected about their creative development in the Appendix.

In describing creativity as based in and growing out of a process of development I follow and build on the great tradition of biography, describing the life and work of individuals famous for their creative work and contributions to society. Indeed biographies are an essential source of information and basis for my description and many of the examples I present. I also follow and build on a smaller but important tradition in the literature on creativity describing and tracing individuals in their creative activity and work over time, describing creativity as rooted in and emerging out of a process of development. I list some of the works in these two literatures that have been most useful to me in later sections of this Introduction. What I add to both traditions is a conceptual framework for describing creative development – placing a theoretical structure on the process of development, thereby manifesting and describing its general features. In turn this enables the developments of different individuals, in different fields, to be described within a common framework.

Descriptions of creativity often focus on peak creative moments of insight, idea generation, and discovery, depicting creativity as a sudden flash of illumination or discovery, unexpected and often dramatic. This continues to be the common view of creativity and dominant focus in the literature on creativity. Although peak creative moments definitely do occur, and are important, they are just one element in a larger process. To focus only on them, and ignore the larger, rich process in which they are embedded and out of which they emerge, skews our understanding of the nature of creativity – specifically, its context and conceptual basis. The framework presented in this book delineates specific processes and structures of creative development that are the source and basis of generation of several principal forms of creativity leading to creative contributions. In particular, it delineates and thus shows how individuals' ideas, insights, and contributions are rooted in creative interests they form, explore, and strive to develop creatively, including projects they undertake based in their interests, and conceptual structures they build up in the domains of their interests. These roots and bases are by no means evident on the surface: the creative interests that are the basis of individuals' creativity and contributions are often scarcely visible in their

creative works and contributions – which emerge often through a long and winding process, so that the importance of the interests that underlie them is masked. I have as a principle aim to manifest these linkages, to show that creative interests are the basis for creativity generation and creative contributions, and more generally to make manifest the basis and source of creativity and creative contributions in processes of creative development.

In the conceptual framework presented in this book individuals, through defining their own interests and pursuing the exploration and creative development of their interests, define, at least to a degree, their own paths of creative development. An individual's creative development is thus, at least to a degree, an autonomous activity. Of course random events and experiences, such as chance encounters, have important roles, which I describe – but fitting within a larger self-defined, self-guided process. Further, the originality of individuals' contributions is rooted in their interests and the paths they define and follow pursuing their interests – thus rooted in their own self-defined process and structure of development. As I describe, individuals' creative interests are generally distinctive, even unique – even within a field and a cohort of individuals in a field each individual typically forms a different, distinctive interest; the creative interests I present and describe as examples illustrate this point. In defining a distinctive interest or set of interests, then defining and following a unique path of development pursuing the exploration and creative development of his interests, an individual has a unique set of experiences and encounters, and internalizes a distinctive set of elements, building up distinctive conceptual structures in the domains of his interests. These experiences and structures are the basis of his creativity, his ideas, insights, and discoveries, which in turn are the basis of his distinctive, original contributions. Thus an individual's creativity and the originality of his contributions is rooted in the distinctiveness of his interests and the path he follows pursuing their development.

The description of creative development in this book includes, as an important facet, channels through which individuals are influenced in their creative development by their culture and the world around them. These channels, specifically channels of cultural transmission and influence, are not recognized or described in standard accounts of cultural transmission, including theories of memes and of learning, at least not in the same way. The most distinctive channel of cultural transmission described in this book is that which occurs through individuals' formation of their creative interests. Creative interests originate in individuals' engagement with the world, sparked by specific experiences and elements they encounter – I sketch this process in the next section; cultural elements and experiences are the basis for many creative interests, making this a main pathway of cultural transmission and influence. Further, cultural elements and experiences that are the basis of an individual's interests influence his subsequent development in a deep and pervasive manner, their influence carried indirectly, by and through his interests, often extending to major projects he undertakes, ideas he has, and contributions he makes; I show this with examples in the body of the book. Because these cultural elements and experiences influence an individual at such an early stage in his development, and their influence is transmitted indirectly, by and

through his creative interests, their influence, important and pervasive as it is, is nonetheless often not readily apparent in his subsequent projects, ideas, and contributions, but hidden, like an underground root or spring. Thus to identify these cultural linkages we must trace an individual's development with care, beginning far before his main contributions, at the time when he forms his main creative interests. Additional channels of cultural transmission and influence arise during exploration and development of interests. Notably, elements and experiences spark ideas, and individuals build up rich conceptual structures in the domains of their interests out of elements they encounter that are generative of ideas and insights they have.

Beyond describing channels of cultural transmission, the description in this book provides a basis for describing cultural development. Cultural development – the progress of civilization – has its primary source, ultimately, in creative contributions made by people in all walks of life. A well-grounded description of cultural development must thus be based in a description of individual creativity. The description here describes individuals in their creative developments and channels through which they are influenced in their development by their social-cultural environment and the contributions and work of other people, thus points towards a model linking individuals in their developments, and a description of cultural development rooted in individual creative development and creative activity.

### **An Overview of the Description of Creative Development**

The core of creative development consists of three steps: the formation of a creative interest, including a conception of the interest; the process of exploring the interest and developing it creatively; and, in the continuation of this second step, the defining and execution of projects rooted in the interest and growing out of its development, leading to creative works and contributions. My description centers on the first two steps, describing main processes and structures integral to them. I describe the factors that are important in the formation of creative interests and conceptions of creative interests, the nature of creative interests, including their distinctiveness and breadth, and kinds of creative interests. Then I describe processes of creativity generation rooted in creative interests and the conceptual structures individuals form in the domains of their interests – describing how their ideas and projects are sparked by and based in their creative interests and conceptual structures encoding and centering on their interests. I describe processes through which individuals are guided in their development and decision-making by their conceptions of their interests and values and principles associated with their interests. And I demonstrate with many examples the fundamental connection that often exists between an individuals' main creative interests and his main ideas, discoveries, and creative works. After describing these core processes, structures, and features of development, I go on to extend my description. I describe creative project work, focusing on creativity generation in projects. Then I describe larger and more complex patterns of development, including the formation of multiple interests and creativ-

ity rooted in combining interests, patterns of projects rooted in interests, the evolution of interests, and sequences of interests. Finally, I describe difficulties of creative development, channels of cultural transmission and influence, and the development of models of cultural development rooted in creative development. In this section I sketch main features of my description, providing an overview of creative development as I describe it. At the end of the section I outline the organization of the book more fully.

Individuals form their creative interests in and through their engagement with the world around them. In the course of their lives individuals have many experiences and encounter myriad elements, of diverse kinds. They have many social interactions and personal experiences, witness and learn about many events, encounter and learn about a great variety of phenomena, are exposed to and learn a great multitude of concepts, facts, theories, experiments, methods, styles, and approaches, and are exposed to, learn about, and study the creative works and contributions of many people, both in their field and their culture. Out of the vast numbers of experiences they have and elements they encounter and learn about a small number of distinct elements or experiences or clusters of interrelated elements or experiences – or, in the case of complex experiences and elements, a particular aspect or a few component elements – catch their attention and stand out, spark their interest, and spark a response in them.<sup>1</sup> They form their creative interests based on, in response to, and growing around these experiences and elements. Individuals are most open to having their interest sparked and forming interests during periods of their development when they are most open to the world and their experiences. They often are especially open just after they enter their chosen field or a new field, when they are actively learning about the field and encounter many elements in it that are new to them, and they often form creative interests during such periods.

In forming their creative interests, especially in the initial stages of formation based in responding to experiences and elements they encounter and learn about, individuals generally respond intuitively and spontaneously to what excites and interests them. Their responses are not rationally planned out, and often they know only a little bit about a topic or set of elements, such as an area of application of a theory, a style or approach, or a group of phenomena, at the time they form an interest in the topic or elements or based on them. Interests are primarily rooted in and generated by intrinsic interest: individuals find their interests interesting, exciting, fascinating, challenging – that is why they form them as interests and wish to pursue them. There are a variety of sources of intrinsic interest that are the basis for the formation of creative interests. Two important sources are a sense of richness of a potential domain of interest, and curiosity about a topic, for example a cluster of questions or issues or models; I describe these and other sources in the body of the book.

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<sup>1</sup> Registers of meaning individuals have, based on previous life experiences, often contribute to the sparking of their interests. Thus, an element or experience or cluster or elements or experiences that resonate with a register of meaning an individual has may thus draw his attention and interest, contributing to his formation of an interest based in these elements or experiences. I discuss registers of meaning further and provide examples of their role in sparking interests in chapter three.

Extrinsic factors also have a role in the formation of interests, including individuals' decisions about which interests to pursue. The two main extrinsic factors are the sense of openness and creative potential of an interest, eg, the sense that it holds opportunities for fruitful creative development, and the sense that an interest is potentially important, eg, that contributions generated through pursuing it are at least somewhat likely to be significant and important for one's field and society.

Beginning from their initial interests, based in intuitive responses, individuals form more defined creative interests, which form the basis for their development going forward. A key step in the process of forming a more fully defined creative interest is forming a conception of one's interest. An individual may or may not form a conception of his interest at the time he forms an initial, incipient interest; if he does, it is likely to be rudimentary, though there are exceptions – in some cases, including some of the examples I present, an individual has a quite clear conception of his interest from early on. Over time, as he thinks about his interest, reflects upon it, makes connections among different concepts, ideas, images, works, phenomena, facts, and other elements that fit with it, and imagines it more fully, the individual develops his interest conceptually, so that it becomes clearer and more integrative and coherent; and, as a natural part of this process, and generative of it, he naturally forms a fuller conception of his interest. In general an individual's conception develops together with his interest, each developing in stages. There are different patterns of development of interests and conceptions of interests, which I describe in the body of the book. Thus, in many cases an individual's interest and conception begin as relatively simple and basic and become richer; in some cases his initial interest and conception are narrowly focused, centering on specific elements and experiences, then broaden out to define a broader, richer domain; in other cases his interest begins as more general, then he narrows his focus.

Individuals conceive of their creative interests as domains filled with creative possibilities, filled with promise. They desire to explore them and learn about them, and to develop them creatively. They believe or at least hope that through exploring their interests and striving to develop them creatively they will be able to define creative projects and pursue them, and ultimately – perhaps only after some time – make contributions to their field and society. However, individuals do not at the time they form a creative interest, and form a conception of their interest, have a clear sense for how they will go about developing their interest creatively, or what they will discover, what ideas they will generate, and what contributions they will ultimately come to make through pursuing it and striving to develop it – there are many possibilities, many possible paths of development they may follow, their interest is defined in an open way. Their conceptions reflect this, conveying, as they describe them, a sense of openness.<sup>2</sup>

Creative interests have a striking combination of characteristics. They are highly distinctive, even unique. Yet they are also broad, broader than individual projects or ideas

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<sup>2</sup> For example, an idea can form the basis of a creative interest, but in that case the individual hopes to develop the idea further or use it as a basis for generating further ideas, discoveries, and projects. Thus in this context the idea opens up to further possibilities and is not limited to just the idea as it is.

or elements, defining domains that can be explored and developed in many different ways, as I have described above. These two characteristics, distinctiveness and breadth, are to some degree in tension with one another. The combination of the two is central to defining creative interests as a theoretical construct, in particular defining creative interests as intermediate level conceptual structures – I describe what I mean by this in the next chapter. Distinctiveness and breadth are powerful in combination, and jointly they are integral to the central roles creative interests have in creative development. The many examples of creative interests presented in the book, in particular individuals’ descriptions of their conceptions of their interests and my reconstructions of individuals’ interests, exhibit distinctiveness and breadth, demonstrating that creative interests possess these characteristics.

My description of creative interests to a degree follows and builds upon the commonplace idea of an interest; however it also challenges conventional ideas about interests and differs in significant respects from them. It is a commonplace that individuals engaged in creative endeavors have creative interests; indeed individuals engaged in creative endeavors frequently mention their creative interests in discussing their creative activities. The commonplace view of creative interests is valuable as a point of departure, in providing an intuitive sense of creative activity rooted in interests. However, it is also misleading and deficient in some important respects, and I believe as a result can hinder – and has done so – our understanding and appreciation of the true nature of creative interests and their role and significance in creative development. There are two fundamental ways in which my description is distinct from conventional notions and goes beyond them. One is in the idea of a conception of a creative interest. I do not believe it has been widely understood that individuals form conceptions of their creative interests. In fact individuals do form such conceptions: I present many examples of individuals’ descriptions of their conceptions of their interests. Further, their conceptions of their interests are central to their creative development: crucial in guiding them in their development; and conceptual cores around which they form conceptual structures in their interest domains which are vital in being the root of their creativity, generative of many of their ideas and insights. The other is in regards the nature of interests. Conventionally interests are often viewed as being simple, conventional subjects. This intuition is misleading in regards creative interests: I define creative interests somewhat differently, as distinctive topics that individuals define for themselves, thus inherently more creative. In turn, through this definition I show how important creative interests are in being the basis of original ideas, discoveries, insights, and projects, leading to creative works and contributions – appreciating the distinctiveness of interests is thus critical for appreciating their role in creative development.

Having formed a creative interest or set of creative interests – and conceptions of his interests – an individual sets out to explore his interests and develop them creatively. His interests are the focus of his attention, thinking, and creative activity, at the core of his creative development. Thus his focus narrows, one implication being that possibilities outside the scope of his interests tend to pass him by, often without him ever really being

aware of them.

Through exploring and learning about a creative interest he has formed an individual learns of and about many elements that fit in its domain or are connected with it – creative works, ideas, concepts, theories, facts, phenomena, images, et cetera. His attention is drawn by elements, aspects of his experiences, and events that fit and connect with it, thus he notices and focuses on them, and forms internal representations of them. Through these processes of learning, attention, and internalization the individual builds up a conceptual structure in the domain of his interest. The individual's conception of his interest sits at the center of this developing conceptual structure, guides his attention and learning, and is important in providing a core structure around which other elements coalesce, building associations and linkages, creating an integrative conceptual structure.

Individuals' creative interests, specifically the conceptual structures that encode their interests and that they build up in the domains of their interests, are a fundamental basis for their creativity generation. During periods when individuals are engaged in exploring their interests and seeking ways to develop them creatively these structures are indeed the principal basis for their creativity. A main process through which individuals generate ideas during these periods is through creative responses they make sparked by specific experiences and elements they encounter that connect with their interests, responses mediated by the conceptual structures in their minds that encode their interests and they have built up in their interest domains. Such creative responses are not common – only occasionally does an experience or element spark a response by an individual. But they are important, often crucial in sparking an important idea, project, or path of development an individual pursues. I give a series of examples of such responses, including by Alexander Calder, Tim Berners-Lee, John Maynard Keynes, and several of the individuals I interviewed about their development.

Conceptual structures of creative interests mediate and thus are the basis for the generation of creative responses through a combination of two processes. First, they guide individuals' attention, leading them to notice and focus on specific experiences and elements – or particular aspects of experiences and elements – that have in some way, perhaps not consciously recognized, a connection with one of their interests. Second, they are central for individuals' processing in the wake of the initial response, triggering associations and containing elements central in chains of thinking that lead to creative ideas and insights based in but going beyond the initial response. Individuals' creative interests, encoded in their mind, provide unique perspectives, enabling them to recognize and respond in distinctive ways to experiences and elements they encounter, to make creative connections with the experiences and elements that other fail to make, that are thus original. For example, an individual may recognize the importance of a particular aspect of a phenomenon that others have overlooked, because it connects with one of his interests in an interesting way. Or he may generate an original, creative connection with an element, for example an idea or image, that is part of his interest.

Individuals in some cases build up very rich conceptual structures in the domains

of their interests over time. I call the conceptual richness and knowledge such individuals possess, based in these rich conceptual structures, creative expertise. Such rich structures are generative of creative responses, for example Ray Kroc generated a creative response rooted in expertise he had built up over many years of work – I describe his interest, expertise, and response in the body of the book. They are also generative of creativity through other pathways. I describe two forms of creativity rooted in rich conceptual structures in interest domains. One is generalization, noticing and recognizing a general pattern, principle, or relationship among a set of elements. Such insights can be of great importance: Charles Darwin’s insight that the principle of transmutation of species was supported by and might be a basis for explaining and modeling patterns of characteristics of closely related species and varieties living in adjacent locales, and the changes in species through time in a given location or habitat, is an example – I describe in following chapters both his interest, based on his *Beagle* diary notes, and present and interpret his notes describing his initial insight. The other is making creative connections among specific elements: a classic example is Samuel Taylor Coleridge’s process of creation for his great poems, notably *The Rime of the Ancient Mariner*.

The third phase of creative development is engagement in creative projects. In general individuals develop their projects out of their creative interests. In many cases an individual develops an idea for a project through one of the processes described above. Thus for example one common pattern of development is for an individual to generate an idea for a project through a creative response – for example seeing a project or work of someone else sparks a connection with his interest, generating an idea for a project. In some cases an individual develops a project based on an opportunity he uncovers exploring his interest. In other cases an individual is offered a project, for example by a senior colleague or mentor, that he pursues. Finally, individuals develop projects in collaboration with one another, in the overlap of their interests; such collaborative projects are often rooted in creative ideas generated through a form of creative response – two individuals encountering one another, their engagement sparking an idea. Making the transition from exploration of interests to projects can be difficult both because of the difficulty in defining a project one wishes to pursue and because in choosing to pursue a project one narrows one’s focus and passes over many other possibilities.

Individuals who are actively engaged in a creative project or set of projects are generally quite inwardly focused, far more so than in periods when they are forming interests and exploring their interests and seeking ways to develop them, focused on tasks and task completion. Thus they are less open to their environment, except in so far as it is useful to them in helping them on their projects, for example providing the basis for a solution to a problem they confront. Individuals can be extremely creative in project work. I discuss a number of creative processes that are important in project work. One is the generation of creative connections rooted in the conceptual structure in the domain of an interest, the process described above: in working on a project based in a creative interest, for exam-

ple a composition or design, an individual draws on the conceptual structure he has in his mind that he has built up through exploring and learning about his interest, and generates ideas based in it. Other important processes fit with classical descriptions of creativity; these include creative problem solving, discovery, and imaginative and analogical thinking. I describe these processes, but only in brief. Projects are crucial to creative work: in the course of pursuing a project an individual is in many cases taken far beyond the interest which was the basis for the project, and beyond his original conception for their project, generating ideas and making discoveries he did not imagine, leading to important, original creative contributions. Yet regardless of how far beyond their interests individuals are lead in pursuing their projects, nevertheless their interests are the basis of their projects. Thus, to understand how an individual comes to pursue a given project we must go back further, and identify his creative interest or interests that lead him to come upon it or generate the idea for it.

In addition to their creative interests being generative of their creativity and the basis of their projects, individuals' conceptions of their interests are crucial in guiding them in their development. Their conceptions guide them in exploring their interests, and in their decision-making about which projects to undertake and, more broadly, which interests to pursue. Their conceptions also shape the way they conceive and define their projects and are important to their work on projects. Pierre Omidyar's values, connected with his interest in promoting and developing fair systems of exchange, were a vital factor in the way he developed his web-based auction site that became ebay. Piet Mondrian's abstract conception of a new art form, rooted in philosophical ideas, was crucial in guiding him in his artistic development. Conceptions of interests are also crucial in the process of revisioning, which is vital for many projects.

In engaging in a creative endeavor individuals undertake a process of development that is often long and fraught with uncertainty, following a path that has never been traveled before. To have the best chance of making contributions that fulfill their potential and the potential of their creative interests it is vital for them to manage their process of development, especially at certain junctures. Management includes decision-making about which interests to pursue and which projects to undertake, as noted above, as well as about when to abandon a line of development or a project. It also includes managing or at least being able to cope with one's emotions along what can be a rocky course. Of course creativity cannot be planned in advance – truly creative ideas and discoveries are unexpected, at least to a degree. Ideally, an individual's approach to managing his development should balance planning with spontaneity, flexibility, and openness.

In managing their development individuals are guided by their conceptions of their creative interests, and values and principles linked to their interests. Their conceptions and values and principles linked to them provide a context for individuals to think about their development. This larger context is important in motivating them, giving them a sense of purpose – a sense that through their work they may contribute to solving or understand-

ing larger, significant issues or problems, which will give them a sense of fulfillment and of having contributed to society. It is also important in evaluating the course of their development, which is crucial for guidance. A notable feature of creative development is the way individuals, at certain critical junctures, step back and reflect upon their course of development, for example their interests or the outcomes of a series of projects they have engaged in, from a broader, meta-level perspective. Such meta-level thinking is sometimes important: for example, an individual may in reflecting upon his development conclude that he has wandered too far from his initial conception of his interest, and decide to engage in a mid-course correction, to steer himself back towards topics that fit with it or reflect it; or he may recognize a larger pattern that triggers an idea for a new approach. I provide examples of such thinking, showing its importance for some individuals. In general I argue, and show through examples, that individuals engaged in creative development think about their development and manage it from a broader, more over-arching perspective than has previously been described – specifically, form a conception of their creative interest, use this conception for guidance, and, at certain junctures, reflect upon their development from the perspective of their interest and associated principles and values.<sup>3</sup>

Every individual who engages in a creative endeavor follows his or her own unique path of creative development. This path may be described most basically by the interests he forms, the projects he undertakes, the ideas he has and discoveries he makes, and the contributions he makes. More widely, it includes his experiences and encounters, events, the assessments he makes about his development, his decisions, and his emotions along his path of development, as well as his creative activities, such as exploration, problem solving, and composition, and the presentation of his ideas and works to others in his field and society. I focus in this book on describing basic patterns of development, that is, sequences of and inter-relationships among the basic elements of development I focus on – interests, including conceptions of interests, ideas, discoveries, and projects, as well as decision-making and management of creative development.

Patterns of creative development have a variety of forms. For many individuals, over medium spans of time their pattern of development resembles the branching structure of a tree – their core creative interests are like the trunk and their projects are like branches coming off of this trunk. Individuals whose development fits this pattern develop the ideas for their projects in the course of exploring their interests. During the time when they are focused on a project they temporarily set their interests aside; but as their project ends their attention returns to their interests, they resume exploration of them, and their new project generally develops out of their interests, not the project they have just ended. In other cases individuals projects lead from one to the next, forming a chain. Over longer time-spans

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<sup>3</sup> Individuals also have the ability to shift from a narrower to a broader perspective. Thus, an individual may at one moment be focusing on the details of a project he is working on, then shift to a broader perspective, seeing a connection with a creative interest he has, or evaluating a technical difficulty or problem he faces from the perspective of a creative interest and associated values and principles, helping him evaluate alternative approaches or possibilities in terms of how they fit with his broader goals and interests. Likewise, the ability to shift to a broader perspective can enable an individual to recognize the broader significance of a problem or solution that he encounters in a narrow context, for example working on a project.

individuals interests often change, as they learn and mature; also, their conceptions of their interests often become more sophisticated. These processes of change and maturation create further complex, rich patterns of development. I describe two main patterns of this kind: evolution of interests, often linked to projects and ideas and discoveries generating further development of an interest; and the formation of a sequence of linked interests over time. Two outstanding cases I present illustrating these patterns are the developments of Hannah Arendt and John Maynard Keynes. Their examples show how through evolution of interests and formation of sequences of linked interests individuals can go far beyond where they begin in their creative development, to make outstanding contributions much later, following a long process of development.

The description in this book naturally extends to developing a description of cultural development. Most strikingly, the description provides the basis for describing a core process of cultural development. I sketch this core process here; I discuss development of models of cultural development rooted in the description in this book in more depth in chapter seventeen.

As I describe in the opening section of this chapter elements and experiences that influence individuals in their formation of their creative interests have a deep and pervasive influence on their creative development. Acting by and through their interests, such elements and experiences influence individuals' whole course of development – the paths they follow, what they encounter and learn about, hence the basis for their creativity generation, and the topics, questions, and problems they become interested in and pursue in their projects – leading ultimately to their creative contributions. Among all the different kinds of elements and experiences that influence individuals in forming their creative interests, including all cultural elements and experiences, the contributions and work of other people, especially their predecessors in their field and neighboring fields, are especially important – the main source of their interests in many cases. Thus in many cases individuals' develop their interests out of their reactions to others' work – desiring to extend or apply the work of someone else, to challenge or refute it, or defining their interest in contrast to it, structuring it as a topic that is intentionally designed to be different. Even in cases in which an individual's interest develops around other elements the work of others is likely to have been crucial in exposing him to these elements and helping him recognize their significance; for example, when an individual develops an interest in a particular phenomenon in most cases he first learns about it through a description given by someone else. The adage that individuals “build on the work of their predecessors” is therefore true if it is understood to mean this: “individuals construct their interests and conceptions of interests in and out of their responses to the work of their predecessors.” This link between the contributions one generation makes and the creative interests formed by the next links the creative endeavors of successive generations in a two-step recursive process: the creative contributions made by the members of the preceding generation form the bases for the creative interests of the members of

the current generation, who develop their interests creatively producing their own creative contributions, which in turn become the bases for the creative interests of the members of the following generation. Thus creative interests and creative contributions form a pair of mutually dependent networks, each formed out of the other, a dynamic recursive system.<sup>4</sup>

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The chapters that follow present a systematic description of creative development following the outline presented here. I focus on each aspect of creative development in turn, and throughout present many examples, which collectively give broad empirical support to the description.

In the first part of the book I describe creative interests and their development. In chapter two I define and describe creative interests and conceptions of creative interests. In chapter three I describe the development of creative interests and conceptions of creative interests. In chapters four and five I describe sources of interests: in chapter four I describe intrinsic sources of interests, which are in general the primary source of interests; in chapter five I describe extrinsic and strategic factors in the development of creative interests. In chapter six I describe basic kinds of creative interests. In chapter seven I discuss the important characteristics of breadth and distinctiveness. Chapter eight is a bridge between the first and second parts of the book. In it I present a series of examples that illustrate that individuals' creative interests and conceptions of interests, as they describe them, in many cases carry through and are reflected in their creative contributions.

In the second part of the book I describe creativity and processes of creative development rooted in creative interests. I describe first fundamental processes of creativity generation rooted in creative interests. In chapter nine I describe creative responses. In chapter ten I describe individuals's processes of exploration building up conceptual structures in the domains of their interests, and creativity generation rooted in these conceptual structures. In chapter eleven I describe guidance, decision-making, and meta-level thinking about creative development, focusing on ways in which individuals' conceptions of their interests, and values and guiding principles that are part of or associated with their interests, are central to these processes. In the chapters following eleven I round out and extend my description. In chapter twelve I describe creative project work, focusing on processes of creativity generation. In chapter thirteen I describe multiple interests and the generation of creativity rooted in combining and linking elements based in different interests. In chapter fourteen I describe patterns of projects, focusing on patterns of projects rooted in a single core interest. In chapter fifteen I describe the evolution of creative interests and sequences of interests, thus richer patterns of development. In chapter sixteen I use the framework of description in the book to describe and analyze difficulties individuals may experience in their creative development. Diagnosing and describing difficulties is not my main focus in the

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<sup>4</sup> Other cultural elements and experiences enter into and influence individuals' development during later phases of their development, notably in sparking creative responses and solutions to problems and ideas in project work, and as elements in the conceptual structures they build up in the domains of our interests, as noted in the first section of the chapter.

book, but the description of creative development in the book provides insight about such difficulties, and this chapter is likely to be of interest for many readers interested in realizing their creative potential or helping others to do so. In chapter seventeen I describe channels of cultural transmission and influence, and discuss construction of models of cultural development based on individual creative development and creativity.

The book concludes with an Epilogue in which I set forth my further aim, to which this book points: the development of descriptions and models of social systems in which individuals are modeled as distinctive, and make contributions to their society rooted in their distinctiveness – an approach reflecting and thus supporting the fundamental principle of individualism and our cultural way of life.

### **Data and Sources**

The description of creative development in this book is supported throughout by examples of the processes and structures I describe that I have identified analyzing the creative developments of individuals engaged in creative endeavors. In part the description was developed inductively, based on analysis of the developments of these individuals; and in part it was developed deductively and has gained further support through clearly fitting, as a description, the developments of many individuals in a range of fields. The individuals whose developments I have analyzed are two distinct groups. One is individuals famous in history for their creative contributions, drawn from a wide range of fields and a range of time periods. The other is individuals I interviewed about their creative development who at the time I interviewed them were in an early to middle period in their creative careers. These individuals are not famous, and thus represent a very different sample; many have achieved some measure of success in their endeavors, in the sense of producing creative works, feeling a sense of accomplishment, and achieving a degree of recognition in their field. Here I present basic information about the individuals in the two groups and my data and sources of information about their creative development.

In developing my description I have studied the creative developments of many individuals famous for their creative contributions in a range of fields. In selecting these famous individuals to study I sought especially for breadth in terms of field, and also, to a more limited degree, in time period and nationality. I focused on individuals for whom I believed materials pertaining to their creative development existed and were accessible. In some cases these were obvious choices – Virginia Woolf, Charles Darwin, John Maynard Keynes, Thomas Edison. In other cases they were individuals for whom I came across descriptions of their development, and, in exploring further, found sufficient material to be useful. I have chosen also individuals for whom outstanding biographical scholarship exists describing their development. Biographical scholarly materials are a great and crucial resource for describing creative development. Also, they are a useful check on my description, for biographers do not have my description in mind or any intent to prove or disprove it in constructing their

accounts. In selecting individuals famous for their contributions to study I did not follow a systematic sampling process. However the breadth of the sample is considerable, and in combination with the sample of individuals I interviewed described below I believe it is compelling that the description of creative development I present, fitting with and providing insight about the developments of the individuals studied, who form a relatively broad sample of individuals engaged in a broad range of creative endeavors, holds the promise of having broad validity. I give here a list of many of the individuals whose creative development I have studied. The list gives a sense of the number and diversity of individuals. Some are very famous, others less well known; all have made outstanding creative contributions.

Hannah Arendt   Paul Barran   Tim Berners-Lee   Ingmar Bergman  
Alexander Calder   Rachel Carson   Paul Cezanne   Charles Darwin  
Samuel Taylor Coleridge   Charles Darwin   Walt Disney  
Fyodor Dostoevsky   Albert Einstein   Thomas Edison  
William Faulkner   Galileo   Robert Irwin   James Joyce  
John Maynard Keynes   Hans Krebs   Ray Kroc   Henri Matisse  
Piet Mondrian   Isaac Newton   John von Neumann  
Pierre Omidyar   Pablo Picasso   James Watson   Virginia Woolf  
Jef Raskin   William Wordsworth   Wilbur Wright

I have explored the development of many other individuals in a limited manner. Indeed the pool is essentially limitless, which is a challenge and an opportunity in developing a framework for describing creative development.

In researching and analyzing the creative development of these individuals I have drawn upon two fundamental kinds of sources. One source is materials that individuals themselves produce or create. Extremely valuable are statements individuals make, for example in a journal, at a relatively early stage in their development in which they describe creative interests, ideas, beliefs, plans, or designs that they pursue and develop creatively, and turn out to be important for their subsequent development and contributions. Such accounts avoid any issue of an individual reconstructing beliefs, ideas, interests, plans, or experiences to fit with later beliefs or ideas the individual has or contributions he makes, thus provide information demonstrating clearly and in a clean way the logic and validity of the description of creative development I present. Important sources containing statements of this kind that I have studied and draw upon include: Virginia Woolf's early notebooks and diary; Samuel Taylor Coleridge's letters and notebooks, in particular his early *Gutch Notebook*; Charles Darwin's *Beagle* diary and notes; Piet Mondrian's sketchbooks and theoretical writings on art collected and translated in *The New Art – The New Life*; Isaac Newton's mathematical papers, edited and annotated by Donald Whiteside, which include Newton's statements of problems and intimations of broader insights; Tim Berner-Lee's original documentation for his Enquire program and 1989 CERN proposal for an information management system, containing statements showing his interest and goal; a description of John von Neumann's specification for a computing machine; letters of Albert Einstein, Henri Matisse, Rachel

Carson, Wilbur Wright, and Coleridge; and the extensive papers of Thomas Edison and John Maynard Keynes, which contain many notes and comments they made stating and referring to interests, ideas, and work plans.

I have also drawn upon writings and other creative products produced by individuals relatively early in their development, that do not directly concern their interests, ideas, beliefs, and plans, but provide invaluable information about their path of development and in many cases contain strong indications of their interests and larger plans. Examples of such works I have utilized include: short stories of Virginia Woolf written as a young adult and in her thirties, prior to her creative break; early writings of Hannah Arendt, including *Love and Saint Augustine* and *Rahel Vernhagen* and articles she published in the 1940's; John Maynard Keynes's notes for presentations he made to the Apostles at Cambridge, notes for lectures at Cambridge prior to World War I, books *A Treatise on Probability* and *A Tract on Monetary Reform*, and other miscellaneous articles and notes he wrote, compiled in *The Collected Writings of John Maynard Keynes*; Alexander Calder's early sculptures; sequences of paintings and sketches by Henri Matisse, Pablo Picasso, and Piet Mondrian, especially from early in their creative development; Ingmar Bergman's early films; and Jef Raskin's Master's Thesis in computer science.

Famous individuals often describe their creative development retrospectively in autobiographies and memoirs. Such sources are not always reliable, both because individuals often write them late in life when their memory for events and ideas they had when they were younger may be poor, and also because they may shape their account to fit with their later famous contributions and ideas and public persona.<sup>5</sup> However, autobiographies differ markedly – some are candid and very valuable as a source of information. I have drawn upon a number that stand out for their lucidity and seem very likely to have a high degree of accuracy. These include: Alexander Calder's *Calder, An Autobiography with Pictures*; Ray Kroc's autobiography *Grinding It Out*; Albert Einstein's remarkably lucid "Autobiographical Notes" in *Albert Einstein: Philosopher-Scientist*; and James Watson's *The Double Helix*. Even these are imperfect; in particular, Watson's account is at times slanted stylistically – however there are other sources available to fill in and modify his account, including accounts of events by Francis Crick and Maurice Wilkins. Individuals also make statements describing their development soon after making important contributions, which thus describe relatively recent experiences and thoughts, and are less colored by their later fame, and, for both reasons, are likely in many cases to be reasonably accurate. I have drawn upon such statements made by a number of individuals whose development I describe, including, for William Faulkner, notes he made within a few years of his creative break about the genesis of his work on *Flags in the Dust*, as well as notes he made of the genesis of *The Sound and the Fury*, presented by Joseph Blotner in his biography (see below), and Matisse's "Notes of a Painter" and other writings of the same period. Interviews and lectures are a further source of autobiographical information. I have focused on interviews in which individuals speak

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<sup>5</sup> There is a large literature on autobiographical writing and the matter of its reliability or lack thereof. See the references later in this section.

specifically to their creative development. Interview sources I draw on include: an interview with Paul Barran in *Wired*; an interview with Jef Raskin, a principle individual in the development of the Macintosh computer, which is in repository at the Stanford University Library Making the Macintosh Project Archives; a set of interviews with Ingmar Bergman published in *Bergman on Bergman*; William Faulkner's University of Virginia lectures and various speeches; and Frederick Holmes's extensive interviews with Hans Krebs, incorporated in his biography (see just below).

The other fundamental source of information about individuals' creative development is biographies and other scholarship about their development. For many of the individuals I have studied there is an outstanding biography or body of scholarship that has been crucial for me in analyzing their development. Frederic Holmes' *Hans Krebs: A Scientific Life*, which is based on a combination of archival materials, notably lab records, and interviews, is an exemplar for biography of a person engaged in creative endeavors. For Samuel Taylor Coleridge, John Livingston Lowes gives a brilliant description in *The Road to Xanadu: A Study in the Ways of the Imagination* of Coleridge's process of creation for "The Rime of the Ancient Mariner" and "Kubla Kahn," Kathleen Coburn presents deep insights about Coleridge in published lectures based on her years of study of his notebooks, and Richard Holmes' first volume of his biography, *Coleridge: Early Visions*, is invaluable for its overall description and connections it draws between Coleridge's political activities and life and creative activities. There is a very extensive body of scholarship on Darwin; I have drawn in particular on the careful scholarship of Frank Sulloway tracing the development of Darwin's thought during the last leg of the voyage of the *Beagle* and his first months back in England, and Nora Barlow's annotations in *Charles Darwin and the voyage of the Beagle*; I cite many other scholarly articles I have drawn upon, mainly for confirmation, in later chapters. There are many outstanding biographies of great writers; I have drawn especially on Joseph Blotner's outstanding biography *Faulkner: A Biography*, and, to a more limited degree, Richard Ellmann's biography *James Joyce*; there are many others that have informed my development of my description, though I do not draw directly on them in this book, including Joseph Frank's multi-volume biography of Dostoevsky and Richard Sewall's *The Life of Emily Dickinson*. For Hannah Arendt I have drawn on Elisabeth Young-Bruehl's biography *For Love of the World*, her translations of Arendt's poetry, the letters between Arendt and Martin Heidegger, as well as theoretical analyses of her work by political theorists, especially of the growth and continuity in her thought. For Albert Einstein I draw especially on Arthur Miller's outstanding description of Einstein's development of the theory of special relativity, and of the views and scientific theories of his contemporaries, in *Albert Einstein's Special Theory of Relativity: Emergence (1905) and Early Interpretation (1905-1911)*. In addition Oliver Darrigol's *Electrodynamics from Ampere to Einstein* provides a valuable context for Einstein's thought and contribution; I make connections with and discuss a number of other interpretations of Einstein's process of development leading to his formulation of the theory of relativity in chapter ten. There is a voluminous scholarship on Pablo Picasso's

early career and work; I focus on his process of development leading up his pioneering *Les demoiselles d'Avignon*, drawing especially on the Picasso Museum *Les Demoiselles D'Avignon* compendium, which displays the development of his composition for the painting, as well as Mary Matthews Gedo, *Picasso: Art as Autobiography*, and Françoise Gilot's fascinating personal account *Life with Picasso* (with Carlton Lake). There is outstanding scholarship on Galileo I have drawn on – most especially William Wallace's careful demonstration of linkages from Galileo back to his teachers and contemporary thought in Italy at the time he was a young man, as well as Alexander Koyre's *Galileo Studies* and Stillman Drake's biography of Galileo's scientific career, *Galileo at Work*.

I draw on many other outstanding and detailed biographies throughout the course of this book, that provide the foundation for my own analysis: Linda Lear's *Rachel Carson: Witness for Nature*, Robert Skidelsky's biography of John Maynard Keynes, especially the first two volumes, *Hopes Betrayed* and *The Economist as Saviour*, Juliet Barker's *Wordsworth: A Life* and Stephen Gill's *William Wordsworth: A Life*, Tom Crouch's biography of the Wright Brothers, *The Bishop's Boys*, Hilary Spurling's *The Unknown Matisse*, Paul Israel's *Edison: A Life of Invention*, and many others.<sup>6</sup> I document my sources, and discuss differences between my interpretation and those in other accounts, in the footnotes to the main text throughout the book.

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The individuals I interviewed about their creative development are a group of gifted young people in a number of fields. Most are individuals in three academic fields: English and American literature; neuroscience; and mathematics. In each of these fields I contacted individuals who had recently graduated from the top-ranked doctoral programs in their field, as ranked by the National Research Council in their rankings of doctoral programs in *Research-Doctorate Programs in the United States; Continuity and Change* published in 1995.<sup>7</sup> I contacted individuals who had earned a doctorate from one of the top three programs in English and American literature in 1995, individuals who had earned a doctorate from one of the top four programs in neuroscience in 1996, and individuals who had received a doctorate from one of the top three programs in mathematics in 1997, contacting and interviewing individuals over a two year period.<sup>8</sup> In each field I contacted all individuals in the programs who had earned their doctorate in that year, with two exceptions: one English program was substantially larger than the others and I contacted one-half of its graduates; and not all the mathematics doctorates were contacted in order to keep that sample smaller

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<sup>6</sup> I have also drawn on cases about entrepreneurs. An excellent book on the background of entrepreneurs is Amar V. Bhide, *The Origin and Evolution of New Businesses* (New York: Oxford University Press, 2000). For cases, a personal favorite that I teach is "The Fisher Miller Skeleton: Design and Business Synergy," Design Management Institute (now part of the Harvard Business School case series), in which the creative development of Richard Miller is described. Another interesting case, also Harvard, is "Ken Hakuta: AllHerb.com, which recounts the development and series of ventures engaged in by Ken Hakuta.

<sup>7</sup> *Research-Doctorate Programs in the United States; Continuity and Change*, edited by Marvin L. Goldberger, Brendan A. Maher, and Pamela Ebert Flattau (Washington, DC: National Academy Press, 1995).

<sup>8</sup> These programs are: in English and American literature, Yale, UC-Berkeley, and Harvard; in neuroscience, Harvard, Yale, UC-San Francisco, and UC-San Diego; in mathematics, M.I.T., Princeton, and UC-Berkeley.

due to the technical difficultness of their work; in both cases those contacted were not selected based on any definite criterion and should be representative of the group as a whole. Nearly everyone I contacted agreed to participate in my study, with the overall participation rate 90%.<sup>9</sup> I interviewed 22 individuals with doctorates in English and American literature, 19 with doctorates in neuroscience, and 9 with doctorates in mathematics. Several of the literary scholars I interviewed also write fiction, and during our interview we discussed both their literary studies and their creative writing. Most of the people I interviewed grew up in the United States and are U.S. citizens. Approximately 10% are Canadian and 10% are European, one is Chinese, one is Indian, and one is Russian; also, one is deaf. Approximately 50% are women and women are well represented in all three fields.

There are two sampling issues to be noted in regards the group of individuals contacted and interviewed in these fields. I contacted individuals only at top-rated programs. It is possible that individuals attending lower rated programs may have systematically different patterns of development; in that case my analysis pertains only to gifted individuals engaged in training at the highest level.<sup>10</sup> Also, all the individuals I interviewed completed their programs successfully, earning a doctorate. Individuals who enter but do not complete these programs may be expected to have at least somewhat different patterns of development. Informal statistics I gathered speaking with program officers indicates that the great majority of individuals who matriculate in the programs I drew from earn degrees – at least 75%, and higher for most programs; thus this issue seems not to be a major concern for my sample.<sup>11</sup>

In addition to the individuals in the fields above I interviewed a small group of filmmakers and playwrights. I contacted three of six playwrights who graduated in 1997 from the Yale School of Drama, widely regarded as one of the leading drama programs in the country; all agreed to be interviewed and I interviewed two. I posted a flier at the NYU Tisch School of the Arts in the spring of 1997, asking filmmakers interested in participating in my study to respond. Two individuals responded and one was interviewed in depth. I interviewed one other person who is a playwright and a filmmaker, whom I gained access to through a contact. The set of playwrights and filmmakers is small and more haphazard in construction and cannot be taken to be representative of any well-defined pool of individuals in these fields. Nonetheless, the interviews I conducted with these individuals were valuable in providing further information about creative development in a pair of fields distinct from the academic fields.

Before conducting an interview with an individual I familiarized myself with the main creative products he or she had produced over the preceding few years. For the individuals who had earned doctorates I read their dissertations, which I obtained from the UMI Dis-

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<sup>9</sup> The percentages of individuals who agreed to participate and were interviewed is 85% in English and American literature, 90% in the neurosciences, and 100% in mathematics.

<sup>10</sup> One likely difference is that individuals at lower rated programs can be expected to take longer to complete their degrees, in part because of needing to work while attending school. Beyond this, there may well be differences in the nature of their interests and patterns of work for individuals who attend lower ranked programs, which deserves further study.

<sup>11</sup> I note that in my sample there are individuals who earned degrees in three or four years and others who took far longer – thus there is substantial variation in time to completion.

sertation Service, or, in a few cases, from their university, and, for some, I read published papers or abstracts. For the playwrights I read plays they had written and filed with Yale or sent me. For the filmmakers I viewed films they sent me or that were available on video. In addition, I familiarized myself with supporting materials that appeared to have been important for an individual in his work, such as articles and books he analyzed or drew upon in an important way in his work.<sup>12</sup> Having a high degree of familiarity with the work of individuals greatly facilitated our interview discussion, enabling us to discuss their work, work that for some is quite abstruse and highly specific, cogently. I believe my obvious familiarity with their work helped the individuals I interviewed feel comfortable speaking with me – in part by making it evident that I have respect for their work and for them – and open up to me more than they otherwise might have about their development.

A typical interview lasted somewhat more than two hours.<sup>13</sup> Interviews were conducted by telephone, with the exception of two conducted in person, and were recorded and transcribed. In the interviews I asked individuals to describe their creative development, broadly defined, typically beginning in childhood and college and moving forward to the present, with the main focus on the preceding several years, often beginning in the last year or two in college. I sent individuals a guideline for the interview a few days ahead of time so they would understand the nature of the interview, and many had assembled materials they referred to during our interview. I guided interviews with an open protocol, trying as much as possible to go in chronological sequence, dividing the interview into segments. Thus for example for individuals who attended graduate school, during the interview segment in which we discussed their graduate school experience we first discussed specific courses, papers, and projects that were important for them during their first year, then discussed their second year, proceeding in sequence. Often we revisited certain topics later in an interview, as the individual recalled further details or I had further questions of clarification. The interview transcripts average approximately 17,000 words in length, with variation from as little as 10,000 to more than 28,000 words; the typical length is 35 to 43 single-spaced pages.<sup>14</sup> The majority of words spoken in all interviews were spoken by the individual interviewed – at least 60% and on average, by rough count, close to 70%. I had email correspondence with many individuals after our interview, in which they clarified certain issues for me. In addition, I have re-interviewed several individuals, verifying information and earlier statements they made and obtaining information about their path of development since our interview.

In addition to the interviews I collected archival materials for the individuals I interviewed. For the vast majority of the literary scholars I obtained a copy of their dissertation prospectus. I also obtained additional materials for a number, including in particular several whose developments are described in some detail in this book. For several I obtained a copy

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<sup>12</sup> In some cases the individuals suggested these to me, but in most cases I selected what to read based on reading or viewing their work.

<sup>13</sup> No interviews were shorter than 80 minutes, but some were significantly longer than two hours – conducted over two sessions, and lasting as long as five hours in total.

<sup>14</sup> The great majority, approximately 90%, have length between 28 and 50 single-spaced pages; there are a handful shorter than 28 pages and a handful longer than 50.

of their college honor's thesis or senior thesis, for a few who wrote a master's thesis I have obtained a copy of their master's thesis, and a few have shared documents with me from early in graduate school, such as early papers, orals documents, and reading lists. For many of the neuroscientists I obtained copies of or read papers or abstracts they published either before entering their doctoral program or early on in their time in their program, for example abstracts published in the Society for Neuroscience *Abstracts* for the Society for Neuroscience annual meeting. For a few, in particular several whose development I describe in some detail in the book, I obtained oral proposals, college materials, such as an honor's thesis or class materials they shared with me, and miscellaneous other materials from their first years in graduate school. For the mathematicians I have located or obtained fewer source documents dating to years prior to our interview but still some: for one a master's thesis, for a second a pair of honor's theses, for a third a set of lecture notes she coauthored, and for a fourth a query he posted on a website. For the playwrights and filmmakers, as stated above, I either obtained directly or they sent me plays they wrote and films they made, including plays written and films made a number of years prior to our interview. In addition to these materials, pertaining to the period prior to the interviews, I have tracked and continue to follow the subsequent development and contributions of many of the individuals. I have sought out and identified papers and books they have published, films and plays they have created and that have been produced, and have obtained information about their development and current interests and projects from websites in which they describe their current interests, projects, and activities.

The appendix provides detailed information for my interview sample. It lists the names of all the individuals I interviewed in each group. For each individual, it lists the year of our initial interview and of any subsequent interview, the titles of the individual's main creative products produced over the time period covered by the interview and subsequently, and any further archival materials I have obtained copies of or examined relevant to my understanding of the individual's creative development and description in this book; it also lists any other individuals I spoke with about the individual's creative development, and other relevant materials I gathered and draw upon in the book, such as film reviews and websites.

In addition to the individuals in the fields described above, I have been able to gather information about the creative development of a number of individuals who are entrepreneurs and in business. These include an entrepreneur I was able to interview when he visited Yale, and several students in my classes who are entrepreneurs and engaged in business activities and wrote class essays describing their development. These individuals are also listed in the appendix.

An issue in regard the interviews is that they were retrospective in nature, with individuals describing their development over the preceding years. This raises concern, since individuals may not be able to recall their past circumstances or thoughts, or chronology of development, accurately, or may alter their vision of the past to fit their present concerns

and beliefs. Notwithstanding this, there are strengths in the interview and data collection process employed for this study. The interviews mainly focused on a period that was not the distant past, which is the case in many autobiographical accounts, for which memory is more likely to be poor, but rather the preceding several years, and were given by relatively young individuals whose memory was intact. Further, the interviews focused on topics that were, and in most cases continued to be, at the center of individuals' lives and activity. Individuals freely shared ideas and interests they had had, not feeling any need for secrecy, for example not to talk about an idea or interest they hoped to develop in the future; I believe their openness was enhanced by the fact that the interviews were focused on the past, not their current ideas.<sup>15</sup>

The greatest concern with the interviews being retrospective is that individuals may have stated they had interests at an earlier time that in fact they had not formed at that time. I have carefully analyzed the language individuals used to describe interests they formed at an earlier date. Overwhelmingly their descriptions, and the descriptions I rely on to support my description in this book, are stated in language in which they unequivocally state that they had the interest at the earlier time. Further, in a considerable number of cases an individual clearly stated that he or she had a conscious conception of his or her interest at the time, that is was actively thinking that this is what he or she was interested in. Thus for individuals to have reconstructed interests falsely they would have had to do so in direct opposition to the language they themselves use to describe their interests.<sup>16</sup> Creative interests as I describe them in this book are relatively stable constructs, thus are represented in memory as generic or fusion memories – recalling an interest one had is like remembering the walk to work one has taken many times – one remembers it as a single generalized event, not as separate instances, which is generally impossible. It is intuitive that such generic memories are likely to have high general reliability, though with fewer details, as compared with memories of specific events or emotions at a given time, which have detail but are not always reliable. Thus when individuals state interests they had it is likely they did have them, though they most likely will not remember precisely how they thought of their interest at different times.<sup>17</sup> Creative interests have two further characteristics associated

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<sup>15</sup> Individuals could speak openly about issues they may well have been hesitant to speak about while still in graduate school, such as ideas and interests they had thought of but not yet had the chance to pursue, projects that failed, and difficult relationships with advisors and fellow students.

<sup>16</sup> In a number of cases I asked individuals pointedly whether an interest they had described having formed at an earlier date was in fact an interest they had at that time, and in every case they affirmed that it was, and several also affirmed that they were consciously thinking about it as an interest at the time.

<sup>17</sup> Generic events are the most basic level of autobiographical memory. See for a fuller description Martin A. Conway and Debra A. Bekerian, "Organization in autobiographical memory," *Memory and Cognition* 15, (1987): 119-32, Lawrence W. Barsalou, "The content and organization of autobiographical memories," in *Remembering Reconsidered: Ecological and Traditional Approaches to the Study of Memory*, eds. Ulric Neisser and Eugene Winograd (Cambridge, UK: Cambridge University Press, 1988), 193-243, William F. Brewer, "Memory for randomly sampled autobiographical events," in *Remembering Reconsidered: Ecological and Traditional Approaches to the Study of Memory*, 21-90, Martin A. Conway, "A structural model of autobiographical memory," in *Theoretical perspectives on autobiographical memory*, eds. Martin A. Conway, David C. Rubin, Hans Spinnler, and Willem A. Wagenaar (Dordrecht: Kluwer Academic Publishers, 1992), 167-193, and Martin A. Conway and David C. Rubin, "The Structure of Autobiographical Memory," in *Theories of Memory*, eds. Alan F. Collins, Susan E. Gathercole, Martin A. Conway, and Peter E. Morris (Hove UK; Hillsdale, US: Lawrence Erlbaum Associates, 1993), 103-37. For a recent review of neuropsychological research on autobiographical memory see Daniel L. Greenberg and David C. Rubin, "The Neuropsychology of Autobiographical Memory," *Cortex* 39 (2003): 687-728. I am not aware of research showing

with high memory retention: they have high personal salience; and, as I describe them, have a high degree of rehearsal, being recalled to mind repeatedly.<sup>18</sup> I note finally that individuals' descriptions of their interests were self-generated – they did not need to mention interest in the interviews, but did so spontaneously. Further, there was little narrative pressure for them to construct interests – they could readily construct a narrative of development without doing so. Thus overall it seems likely that subjects' descriptions of their interests are real. I believe the greatest danger in the retrospective accounts individuals give describing their interests is that their interests become more solidified over time – an interest may begin as more fragmentary and fleeting, then, when an individual is actually able to develop it, for example has an idea and initiates a project, he may begin to think of it as more formed and definite, and in an interview which occurs later may describe it more this way. In fact I believe my description fits with this: thus, in chapter three I describe the formation of creative interests and emphasize that they are often quite fragmentary, often fleeting thoughts at first, then become more formed later; further, I describe individuals building up conceptual structures in the domains of their interests over time.

The archival materials I collected are very useful in confirming what individuals told me in interviews. These materials both confirm what individuals stated in our interview and in many cases show that an individual had formed his or her main creative interest, as stated in the interview, prior to entering graduate school or early in graduate school, before beginning work on his or her dissertation or at an early stage of work on it. Thus, for example, for literary scholars for whom I obtained a copy of their dissertation prospectus their prospectus generally shows that they had formed their main interest by the time they began work on their dissertation, and thus in most cases before they had the main ideas in their dissertation, which they developed after writing their prospectus. Likewise, for the neuroscientists' abstracts and papers they published either before entering their doctoral program or in their first year or two in their program show in many cases that they had formed a main creative interest, again as stated in our interview, prior to beginning directed work on their dissertation. For several individuals, including a number whose development is described in some detail in this book, additional materials, such as a college honor's thesis, or papers the individual shared with me, again confirm what the individual stated in our interview, and demonstrate in a number of cases that the individual had formed his or her main creative interest prior to entering his or her doctoral program or very early on during his or her time in the program. A number of individuals referred to written archival materials

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quantitatively how accurate generic memories are; but it appears to be the case that this is implicit in the literature – psychologists seem implicitly to acknowledge that they are, and in the search for inaccuracies in memory focus on specific events, for which memory is not always reliable. A generic memory is not tied to a specific event or time as closely and thus is not likely to be false in the same sense; it is also more difficult to demonstrate a generic memory to be false. Creative interests, in particular conceptions of interests, are thoughts or conceptual structures; Brewer in his study of episodic memory distinguishes memory of thoughts from memory of actions, and his results show that thoughts are remembered reasonably well, better than the time of event or emotions at the time.

<sup>18</sup> Ulric Neisser discusses the accuracy of generic memories, and rehearsal, in his study of the memory of John Dean, arguing that Dean's memory of generic facts, which are what was important to his story, was very good, though his memory for specific events was less accurate. See Ulric Neisser, "John Dean's Memory: A Case Study," in *Memory Observed: Remembering in natural contexts*, selection and commentary by Ulric Neisser (San Francisco: W.H. Freeman and Company, 1982), 139-59. Martin Conway argues for the importance of personal consequentiality for accurate memory in *Flashbulb Memories* (Hillsdale: Lawrence Erlbaum Associates, 1995).

during our interview, for example notes they had kept or an undergraduate thesis, providing a check on their own memory. Also, for a handful of individuals I interviewed a professor or advisor whom they mentioned as having direct knowledge about an important phase in their development; in each case this second individual confirmed my research subject's account and provided some additional details as well as a different perspective. I found few discrepancies between archival materials and statements made in interviews. The main area in which I have found individuals to make mistakes in memory was in dating, but usually fairly minor discrepancies, for example which term a class was taken in. But of course there are many statements individuals make that cannot be checked.<sup>19</sup> For many individuals, as stated above, I have followed their development and identified contributions they have made since our interview. In many cases these later contributions and work activities show that an individual's interest, as he or she described it in our interview, has been the root of his or her creative work and contributions made since that time, thus providing further, prospective, evidence in support of the description in this book.

Conducting interviews retrospectively as I did, within a year after individuals had passed through the end of the period of development we focused on, in fact had advantages. Individuals were able to reflect upon their development, placing experiences, activities, interests, and ideas in perspective. Their development was fresh in their mind, but they were not engrossed in the events they described to the point that it interfered with their ability to describe them clearly, as they might have been describing concerns of the present, for example if they were still striving to earn their degree or having interpersonal difficulties with an advisor or collaborator they were still working with.<sup>20</sup> They also were comfortable talking about interests they had had, which are inherently less sharply focused than ideas or projects. An interview focused on current activities might well lead, through a desire to show the present self in a positive light, to an excessive focus on elements viewed as demonstrating success, definite accomplishments like current ideas and projects, with it being more difficult to gain access to information about inherently more open-ended, less definite interests.

I discuss the creative development of many of the individuals I interviewed in the course of this book. For purposes of illustration I introduce here three whose development I discuss – Azad Bonni, Enid Zentilis, and Robert Kaufman. Azad is a neurobiologist who has done important work on signaling pathways for neurotrophins and is now head of his own

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<sup>19</sup> As noted above, I am mainly concerned with accuracy of generic memories, which the interviews were more focused on, and for which I have better checks. I am less concerned with memories of specific events, though these also enter into my description, for which I have few checks. Minor dating mistakes are not a major issue for my description; thus, exactly when someone first formed a creative interest is not crucial. However, if an individual actually formed an interest after other important events that he describes as occurring after forming the interest, such as having ideas or beginning projects that I take as based in the interest, that runs against the description I present. But the descriptions themselves, as presented in the following chapters, and the archival materials, do not support the view that this was common.

<sup>20</sup> This view is supported by Joy Amulya, who also studied the dissertation experience of several individuals, for her doctoral work. Joy interviewed her subjects at several points over the course of their work, and told me the time when I interviewed them, within a year or so of completion, was a good time to conduct an interview with them about their graduate experience and development, because for most they were no longer so involved emotionally in some of the temporary ups and downs and stresses of the process, but still have the experience fresh in their minds. Joy's work is in her doctoral thesis, *Passionate Curiosity: A Study of Research Process Experience in Doctoral Researchers* (Graduate School of Education, Harvard University, 1998). Her focus was different from mine, but the descriptions she gives of the developments of the individuals she interviewed are consistent, in many ways and I think overall, with my description.

laboratory at the Harvard Medical School. Enid is a talented filmmaker who was awarded the Grand Marnier Award from the Film Society of Lincoln Center, in association with the New York Film Festival, in 1997 for her film *Dog Race*; her first full-length feature film, *Evergreen*, came out in 2004. Robert is a literature scholar, currently a professor at Stanford University, who has developed original theories about the relationship between the literature and thought of the Romantic period and modern left critical thought; he has published numerous articles in journals and is, at the time I write this, at work completing several books.

Throughout the book I describe and discuss the creative development of individuals I interviewed side-by-side with the development of individuals famous for their creative contributions. This style reflects my belief that my description is general, that it describes the development of both those who achieve great success in creative endeavors and those who do not, and that we all have creative potential that can be realized through a process of development of the kind I describe. In a few places I compare and contrast structures, processes, and patterns of development of highly successful and less successful individuals.

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I close this section with comments on the use of retrospective descriptions individuals give of their creative development. Retrospective accounts have potential flaws that it is well to be aware of.<sup>21</sup> My purpose here is to note these and discuss their relevance for my use of retrospective material and overall description of creative development. I emphasize that I draw on a mixture of archival records, longitudinal prospective sources of information, and retrospective accounts; the archival materials, in particular for the interview subjects, serve as a useful check on individuals' retrospective accounts. Notwithstanding this, retrospective accounts are an important source of information, thus their use deserves discussion.

Retrospective descriptions individuals give of their creative development are inevitably highly selective. Individuals describe main interests, experiences, ideas, and projects they had, especially those that were fruitful or influenced their subsequent development, and are likely to pass over many other experiences and elements in their development that were more minor or they chose not to pursue or were unable to develop, and thus faded in importance. Obviously an individual cannot possibly describe the rich stream of his daily experience in an interview. The lack of daily material is not in itself a crucial problem, as my description focuses on creative development over longer periods of time, on more enduring interests, main ideas, events, and projects, and processes extending through time. Individuals recall and describe all of these, including interests, elements and experiences that sparked interests,

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<sup>21</sup> Useful references on self-narratives in general, of which narratives of creative development are a particular kind, include *The remembering self: construction and accuracy in the self-narrative*, eds. Ulric Neisser and Robyn Fivush, (Cambridge: Cambridge University Press, 1994), *Remembering Reconsidered: Ecological and Traditional Approaches to the Study of Memory*, eds. Ulric Neisser and Eugene Winograd, Daniel L. Schacter, *The Seven Sins of Memory: How the Mind Forgets and Remembers* (Boston: Houghton Mifflin, 2001), and Michael Ross and Anne E. Wilson, "Constructing and Appraising Past Selves," in *Memory, Brain, and Belief*, eds. Daniel L. Schacter and Elaine Scarry (Cambridge: Harvard University Press, 2000), 231-58. Further references are given in footnote 24 below.

creative responses, important ideas, project work, and pivotal decisions. However the record is clearly quite incomplete.<sup>22</sup> In fact I believe far more detail can be incorporated within the basic framework I present without fundamentally changing its nature. It can in particular incorporate more detail about development of interests over time and incipient interests, greater complexity and stagewise development of ideas, more details about engagement in activities, for example exploration of interests and project work, more decision points and greater elaboration of decision-making processes.

Psychological studies of memory raise the concern that individuals falsely remember and reconstruct past events or thoughts in some cases. For my description, and as an example of the problem, a concern is that individuals may state that they had an interest at an earlier time that fits with their later work but that in fact they did not have at the earlier time. While this is a serious concern to be born in mind, the fact is that the context of recollection in this book and kinds of memories that are its focus are different than the kinds of memories that seem susceptible of false memory described in the literature, and less likely to be subject to gross falsification. In particular, false memories have been studied for highly emotional and traumatic events, such as child abuse, for experiences and aspects of experiential memories that do not have high personal relevancy or importance, and, in an experimental context, individuals ‘filling in’ remembered short narratives they have been told to recall with elements that are not present in the original story, for example remembering a false detail, or falsely recalling an element that has a close association with an element that is part of a memory, for example falsely recalling hearing a word with a close association with words one has heard in a word list. None of these cases fits closely with recollection of interests. Interests have high personal relevance, they are not highly emotional or traumatic, nor are they tied to public events or a person’s public image for the most part. Further, while they form part of a larger autobiographical narrative, they do not fit in a tight narrative structure, but on the contrary are more open-ended and occur during relatively open periods of development. Finally, as noted above recollections of interests are mainly generic, not tied to specific experiences, and thus should be more robust against falsification than the kinds of memories studied in the literature on false memories.<sup>23</sup> For more on forms of false memories studied in the literature and ways recollections of interests are different see the footnote.<sup>24</sup>

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<sup>22</sup> In interviews I probed individuals to describe sources, such as books they read, people they spoke, their state and growth of knowledge. I also probed for areas of work they did not pursue, and many described interests they chose not to pursue and failed projects.

<sup>23</sup> I do use more specific memories of interests in places, especially specific language individuals use to describe interests they had, and their descriptions of how their interests were sparked. As for the specific language, it is not essential to the main description. The memories individuals have of their interests being sparked are highly memorable personally important, thus likely to be reliable, though some details, not of great consequence for my purposes, may be falsely remembered.

<sup>24</sup> Four basic kinds of false memories or conditions prone to falsification of memory have been studied. One, experimentally studied, is filling in a remembered narrative with an element that fits in it but in fact was not a part of the original narrative, or falsely recalling an element that has a close association with a true element in the memory, for example falsely recalling hearing a word with a close association to words one has heard in a word list. See Marcia K. Johnson, Shahin Hashtroudi, and D. Stephen Lindsay, “Source Monitoring,” *Psychological Bulletin* 114 (1993): 3-28. The context for this kind of false memory does not correspond closely with the role of interests in development or the context in which individuals describe their interests. Interests do not naturally fit and are not described in such tight narrative contexts as these false memory experiments, but are more open-ended and occur during relatively open periods of development. Also, interests are broader than single elements; a false association is not a whole interest, but an element – it is hard to see how the construct of an interest would arise as a false memory as described

The literature on the self suggests that individuals construct autobiographical narratives in light of their present self, their present needs, desire, and attitudes, and self-management.<sup>25</sup> Individuals may project attitudes and beliefs they now have back in time, to create a sense of self-coherence; also, they may portray their past self as less effective or accomplished, in order to generate an aura of self-improvement. In the context of descriptions of creative development such processes seem likely to have two main effects: to reduce the richness of descriptions, through individuals blocking out and not describing interests, ideas, and projects not related to the main line of their development and current work; and to lead individuals to denigrate their past ideas or works. I have discussed the first of these above. I have not found much evidence for the second, especially among the interview subjects, who freely describe past ideas and contributions; it may be more of an issue for famous individuals concerned to describe their development in a way fitting their public persona.<sup>26</sup>

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in this literature. Interests do have links to the generation of subsequent ideas that I describe; but the links are not so tight or close in time as in the false memory narratives studied, thus do not naturally serve as proximal causes for individuals in describing ideas they had. In other work Marcia and her colleagues interpret results to suggest that subjects tend to have less remembered detail and feelings for words they had not heard, 'lure' words, than for words they had heard, evidence consistent with general evidence in psychology that richer processing at encoding tends to reduce false memory formation. See Mara Mather, Linda A. Henkel, and Marcia K. Johnson, "Evaluating characteristics of false memories: Remember/Know judgments and memory characteristics questionnaire compared," *Memory & Cognition* 25 (1997): 826-837. A second form of false memory that has been studied is memory of a dramatic public event. Research suggests that memory for such an event may be vulnerable to becoming distorted through a combination of shared social memory and lack of personal relevancy, such that an individual remembers the event, for example how he heard about it or what happened, in a way that fits the general social view and does not accurately reflect his own experience of it. These kinds of memories have been called flashbulb memories, originally by Roger Brown and James Kulik in their pioneering study "Flashbulb Memories," *Cognition* 5 (1977): 73-99; and there is has been much research on individuals' accuracy of memory for them. In an important study Ulric Neisser and Nicole Harsch present results from studying memory of students for how they heard about the Challenger disaster – from whom, under what circumstances; Ulrich Neisser and Nicole Harsch, "Phantom flashbulbs: False recollections of hearing the news about *Challenger*, in *Affect and accuracy in recall; studies of "flashbulb" memories*, edited by Eugene Winograd and Ulric Neisser (Cambridge UK: Cambridge University Press, 1992), 9-31. The students filled out questionnaires within a day after the disaster describing how they heard about it, then again about three years later. Many students give substantially different accounts three years later than they gave at the time – overall accuracy being something like 50 to 60%. Many in particular stated that they had first heard about the disaster watching TV than had stated this at the time. The Challenger disaster in fact become lodged as a social memory centering on the fact that it actually was shown as it occurred on TV – for example it is well known that school children saw it happen – thus this social memory corrupted individual's memory. As opposed to these kinds of memories, interests are inherently private, not public, thus not vulnerable to the corruption of a wider social memory interfering with an individual's own memory; and they are personally significant in a way many public events that have been studied are not. It is noteworthy in this regard that public events that are significant, such as direct personal experience of an event, are remembered far better. Thus, Ulric Neisser, Eugene Winograd, and Weldon (1991), "Remembering the Earthquake: 'What I Experienced' vs. 'How I Heard the News'," reported in Martin Conway, *Flashbulb Memories* (Hillsdale, N.J.: Lawrence Erlbaum Associates, 1995), in a paper presented to the psychonomic society, San Francisco, report data on subjects memory for the context in which they experienced or first learned about the 1989 earthquake in Northern California. They report that individuals who personally experienced the earthquake had very accurate recollection of their experience of it eighteen months later, whereas individuals who did not personally experience it but learned about it were significantly less accurate. See Martin Conway, *Flashbulb Memories* (Hillsdale: Lawrence Erlbaum Associates, 1995), 49-52, 133. Conway in general emphasizes that personal consequentiality is crucial for good memory. A third area in which false memories have been found is individuals not correctly recalling events or elements in their environment that were not the focus of their attention (for example Daniel L. Shacter, *The Seven Sins of Memory: How the Mind Forgets and Remembers*). Again, this does not apply to individuals' memories of interests: their interests are at the center of their developments, thus a focus of their attention, so they should remember them. Lastly, a main focus of research on false autobiographical memories is falsely constructed memories of highly emotional, traumatic events, like child sexual abuse, or repression of such memories that are true. The kinds of ideations and experiences that are the focus in the present work, especially creative interests, are very different and not subject to the same emotional pressures as apply in these contexts, and the main factors that have been described as generating such false memories or repression of memories do not apply.

<sup>25</sup> For a useful review see Michael Ross and Anne E. Wilson, "Constructing and Appraising Past Selves," cited above.

<sup>26</sup> One further issue in the construction of false memories is the idea, rooted in psychology of the self as well, that individuals may be driven to create a sense of coherence in self-narratives of their development, contributing to their sense of a coherent self-identity through time. One way conceivably individuals might do this is through constructing creative interests retrospectively that fit with their later work, or extending interests back further in time beyond when they actually formed them. In fact individuals may construct a sense of self-coherence through time in

I believe that the evidence, both linguistic and supporting archival materials, makes it implausible that the many individuals whose development I studied who described creative interests all or mainly constructed interests they did not have. In the preceding section I have made this argument for the individuals I interviewed, based on both their statements in our interviews and the supporting archival materials. For a number of the individuals famous for their contributions whose development I describe there are extensive materials available that validates their having formed important interests well before their main contributions which, as I describe them, are rooted in and grow out of their interests.<sup>27</sup>

This leads on to one further issue to note in regards the description in this book, causality. I present the model in this book as a causal structure, using language in which creative interests and conceptual structures in interest domains are described as generative of creativity and guiding individuals in their development. Causality is always an inference. Here the inference is complicated further in cases in which the data is retrospectively based. Also, it is to be noted that the causal mechanisms I describe are not proximal, but extend over longer time periods. However, set against these concerns, the mechanisms are intuitive. I put them forward as hypotheses, as mechanisms that rationalize and generate a coherent description of creative development.

Ultimately, the approach in this book relies on convincing the reader with the weight of the evidence. The reader who approaches the description and cases presented in the following chapters with an open mind, taking note of the many different individuals whose development is described, and the many different forms of evidence and quantity of material presented, will I believe be convinced by the description. There remain significant gaps and many flaws, as I am only too well aware, and future work, with different data, may well modify the description significantly. But I present it in the belief that it will stand, in its fundamentals.

## Related Literatures

There are a number of literatures in the field of creativity studies in which aspects of creative development are discussed, in general from perspectives that are somewhat different but complementary to mine in this book. There are also related, relevant literatures on the social environment of creativity and cultural development. In this section I introduce these literatures in brief; they are discussed further where appropriate in the body of the book. I

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narrative constructions of their creative activity than through constructing interests, for example by linking chains of ideas, experiences, places, and people they worked with. Interestingly, turning the argument around, the description in this book is supported by self-psychology arguments. In their drive for coherence individuals will naturally tend to strive to define what their creative interests are, as a way to form a clearer sense of their 'creative identity' or self – and thus will form conceptions of their interests, as I describe.

<sup>27</sup> It is possible that individuals in some cases extend interests somewhat further back in time than when they actually formed them; and, as noted in the previous section, they may imagine their interests, looking back, to have been more fully formed at a time when they were more fragmentary or inchoate. In general the evidence is consistent with individuals having formed interests as far back in time as they describe, but the evidence is not strong on this point in most cases. In emphasizing interests that lead on to later projects and contributions individuals may well fail to describe other interests they might have pursued but did not or that did not prove fruitful, thus provide less of a sense of coherence.

do not provide a general review of the field of creativity studies. Different approaches to the study of creativity and reviews of subfields of the larger field are presented in the *Handbook of Creativity* of 1999 edited by Robert Sternberg and *The Creativity Research Handbook* edited by Mark Runco (1997) (there is also interesting commentary and review in the earlier 1989 *Handbook of Creativity*).<sup>28</sup>

The fundamental approach in this book is to study creativity as a process of development, unfolding over relatively long periods of time. This approach stands in contrast to most approaches, which focus on creativity as a short-term process, like a sudden flash of insight or illumination. I believe such sudden moments of creativity are important – indeed they are a part of my description – but that to understand the basis of creativity, including the relationship between creativity and cultural development, we must place these moments in context and understand how they emerge out of a process of development rooted in creative interests. My description is thus most closely linked with literatures in which creativity is also viewed as based in a process of development. The largest and most diverse literature in which our creativity is viewed in this way is the biographical literature about the lives and creative work of individuals recognized for their creative accomplishments. This literature includes many biographies and scholarly biographical work, described in the previous section as sources I use. A second literature in which our creativity is viewed as a process of development is the evolving systems approach to creativity, associated with Howard Gruber and exemplified by his biography *Darwin on Man* and the volume *Creative People at Work*.<sup>29</sup> The evolving systems approach shares with my approach an emphasis on the distinctiveness of each individual in his process of development, and a careful attention to the rich details of development unfolding over time. Howard Gardner also views creativity as a life developmental process, for example in his *Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi*,

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<sup>28</sup> Robert J. Sternberg, ed., *The Handbook of Creativity* (New York; Cambridge UK: Cambridge University Press, 1999); Mark A. Runco, *Creativity Research Handbook* (Cresskill, N.J.: Hampton Press, 1997); *Handbook of Creativity*, ed. by John Glover, Royce Ronning, and Cecil Reynolds (New York: Plenum Press, 1989). The field of creativity is vast and it is not possible to list all relevant major works or even reviews. In academic psychology the literature is often described as receiving an important impetus from Guilford 1950 statement and subsequent work – see J.R. Guilford, “Creativity,” *American Psychologist* 5 (1950): 444-54, and J.R. Guilford, *The Nature of human intelligence* (New York: McGraw-Hill, 1967).

<sup>29</sup> Howard E. Gruber, *Darwin on Man* (Chicago: University of Chicago Press, second edition, 1981); *Creative People at Work*, eds. Doris B. Wallace and Howard E. Gruber (New York: Oxford University Press, 1989); I note especially the chapter in this book by Margery B. Franklin, “A Convergence of Streams: Dramatic Change in the Artistic Work of Melissa Zink.” Franklin sketches Zink’s development as a sequence of stages; her terminology is different than mine, and her description is less structured, but it is reminiscent of my description. There was a festschrift and special issue of the *Creativity Research Journal* devoted to Gruber, with a number of articles reflecting his approach, in 2003; see Mark A. Runco, “Where Will We Hang All of the Paintings? An Introduction to the Festschrift for Howard E. Gruber,” *Creativity Research Journal*, 15 (2003):1-2, and, as articles I found interesting, Jacques Vonèche, “The Changing Structure of Piaget’s Thinking: Invariance and Transformations,” 3-9, Maria F. Ippolito and Ryan D. Tweney, “The Journey to *Jacob’s Room*: The Network of Enterprise of Virginia Woolf’s First Experimental Novel,” 25-43, Richard Brower, “Constructive Repetition, Time, and the Evolving Systems Approach,” 61-72, and Fernando Vidal, “Contextual Biography and the Evolving Systems Approach to Creativity,” 73-82. I discuss Howard Gruber’s interesting notion of “networks of enterprise in chapter fifteen. Though not exactly in this tradition, the work of Robert Sternberg and Todd Lubart on creativity as investment also focuses on a view of creativity as emerging out of a process over time: see their “An investment theory of creativity and its development,” in *Human Development* 34 (1991):1-31. Frederic Holmes was a biographer of scientists, but in his last work, *Investigative pathways: patterns and stages in the careers of experimental scientists* (New Haven: Yale University Press, 2004), he presents a general description, based on his life’s work, of the process of experimental scientific work, unfolding over long periods of time; his view fits with mine in general outline, but his language is somewhat different and he does not describe a structured process as I do.

and has an interesting focus on personal qualities, links from childhood to adult work, and patterns of work and relationships. In his work, and especially Mihalyi Csikszentmihalyi in his *Creativity: Flow and the Psychology of Discovery and Invention*, there is a focus on the experiential nature of creative work; in their work, and the evolving systems literature, there is a focus on motivational and affective as well as cognitive processes.<sup>30</sup> What I add to the evolving systems approach and other descriptions of creativity as a developmental process is a more structured description rooted in creative interests, conceptions of interests, the formation and growth of conceptual structures centering on and based in domains of creative interests, and explicit descriptions of forms of creativity and patterns of development rooted in these structures. A third literature consists of statistical analyses of patterns and trajectories of creative development, including especially analyses of rates of production of creative products over the course of creative careers.<sup>31</sup> Work in this tradition is important, and certainly fits with my description, but is less closely related to my approach. A fourth literature is the psychoanalytically-based and more general approaches viewing creativity as rooted in a process whereby individuals transmute their personal experiences, such as deep childhood feelings and experiences, into creative products, with the process of transmutation based primarily in the unconscious.<sup>32</sup> Such a process is quite different – or at least is described differently – than the processes I describe, such as the formation of creative interests and conceptions of creative interests, my focus being on different and somewhat wider ranging experiences and encounters and sources of interests, and in general more on cultural and conceptual bases of interests. I discuss the relationship between my description, in particular of the formation of interests, and theories of transmutation in more detail in chapter three; I also refer to these theories in a few places in later chapters.

Beyond the literatures discussed above, in which creativity is viewed as an extended process of development, there are also literatures focusing on creative processes over shorter time periods, on the order of days and weeks. The most relevant of these for my description is the literature on problems and problem finding. The importance of problems in motivating creative activity is discussed in many accounts of creativity. For example, obstacles that engineers and inventors encounter in the course of their work are frequently described as important factors spurring them on to greater creative accomplishments. Problem recogni-

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<sup>30</sup> Howard Gardner, *Creating minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi* (New York: BasicBooks, 1993); see also his *Extraordinary minds* (New York: BasicBooks, 1997). The recent volume *Creativity and Development*, eds. R. Keith Sawyer, Vera John-Steiner, Seana Moran, Robert J. Sternberg, David Henry Feldman, Jeanne Nakamura, and Mihaly Csikszentmihalyi (New York; Oxford: Oxford University Press, 2003), also contains discussion of creativity as a developmental process. Particularly of interest are Gardner's comments in Chapter Six, "Key Issues in Creativity and Development," 233, and R. Keith Sawyer's comments in his "Introduction," 3-11, and Chapter 1, "Emergence in Creativity and Development," 12-60, which point to the importance of the richness and distinctiveness of individual experience and development for creativity.

<sup>31</sup> Dean Simonton has published the best known work of this kind in modern times, including *Scientific Genius: A Psychology of Science* (Cambridge: Cambridge University Press, 1988), and *Origins of Genius* (New York: Oxford University Press, 1999). Further citations to his work are presented in chapter seventeen.

<sup>32</sup> Many descriptions of transmutation are based on psychoanalytic theory. An important book in which transmutation and other psychoanalytic theories of artistic creativity are set forth and described is *Psychoanalytic Explorations in Art* by Ernst Kris (New York: International Universities Press, 1952). Donald Winnicott's classic work describes creativity as growing out of the transitional space that is formed in the interaction of the infant and its caretaker and within which play emerges. See his *Playing and Reality* (London: Tavistock Publications, 1971).

tion has been linked with need perception and dissatisfaction with existing conditions (for example Subrata Dasgupta, *Technology and Creativity*, chapter 3).<sup>33</sup> Problem finding is a more exploratory and constructive process than problem recognition. Useful references are the classic work of Getzels and Csikszentmihalyi and the volume *Problem Finding, Problem Solving, and Creativity*, edited by Mark Runco.<sup>34</sup> In some respects questions and problems have a similar role in creative development as creative interests, in defining a creative direction. But there are important differences between the two constructs. Many problems and questions are relatively briefly defined, and many, especially many problems, are quite specific and involve narrow, precisely defined goals. In contrast, creative interests and conceptions of interests are broader, distinctive, and often more richly conceived. They are also inherently open-ended – viewed as potentially able to be developed creatively in many different ways, defining rich domains for exploration, and involving goals that are more open-ended. In this book individuals may seek to define problems rooted in their interest domains; conversely, beginning from a defined problem they may form a broader interest centering and growing around it. Thus creative interests often center on and involve questions and problems, especially ones that have a degree of breadth and are relatively open-ended. Narrower questions and problems in isolation enter into development separately, for example in defining projects. I compare and contrast relatively narrow problems and questions with creative interests in more detail in chapter seven.

The most widely described form of creativity is making a connection between or combining two elements that have not previously been connected or combined.<sup>35</sup> A basic theory of creativity that builds on this principle is the Darwinian model of random variation and

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<sup>33</sup> Subrata Dasgupta, *Technology and Creativity* (New York: Oxford University Press, 1996), chapter 3, “The Birth of Technological Problems,” 20-28. This view is echoed in many accounts, including in classic gestalt psychology.

<sup>34</sup> Jacob W. Getzels and Mihalyi Csikszentmihalyi, “Discovery-Oriented Behavior and the Originality of Creative Products: A Study with Artists,” *Journal of Personality and Social Psychology* 19, no. 1 (1971), 47-52, and *The Creative Vision: A Longitudinal Study of Problem Finding in Art* (New York: J. Wiley and Sons, 1976). Mark A. Runco, editor, *Problem Finding, Problem Solving, and Creativity* (Norwood, N.J.: Ablex, 1994). Many students of creativity and many individuals who have been successful in their creative careers have remarked that they consider skill in problem finding, for example asking the right question, to be crucial for achieving success in creative endeavors. See for example Robert Sternberg and Janet Davidson, “Cognitive development in the gifted and talented,” in *The gifted and talented: Developmental perspectives*, eds. F.D. Horowitz and M. O’Brien (Washington: American Psychological Association, 1986), 37-74. Albert Einstein and many others have emphasized the importance in scientific research of asking the right question or a good question. Gestalt psychologists in particular focus on problem finding in a more naturalistic setting – see M. Henle, “The cognitive approach: The snail beneath the shell,” in *Essays in creativity*, eds. S. Rosner and L.E. Abt (Croton-on-Hudson: North River Press 1974), 23-44, and, more generally, M. Wertheimer, *Productive Thinking* (New York: Harper & Brothers, 1959). For cognitive science approaches see Margaret Boden, *The Creative Mind: Myths and Mechanisms* (London: Routledge, 2004); *Creativity, Cognition, and Knowledge: An Interaction*, ed. Terry Dartnall (Westport: Praeger, 2002). An interesting model of problem finding as search is presented by David Klahr and Keith Dunbar in “Dual space search during scientific reasoning,” *Cognitive Science* 12 (1988):1-48. An interesting creative conceptual process more recently introduced in the cognitive science literature is blending – see Gilles Fauconnier and Mark Turner, “Conceptual Integration Networks,” *Cognitive Science* 22 (1998): 133-187. There is an interesting literature concerning interpersonal differences in aptitude for finding interesting problems and defining interesting projects, stretching back at least as far as Catherine Patrick’s research published in the 1930’s. Very well known is the work by Jacob W. Getzels and Mihalyi Csikszentmihalyi cited above: “Discovery-oriented Behavior and the Originality of Creative Products: A Study with Artists,” *Journal of Personality and Social Psychology*, and *The creative vision: a longitudinal study of problem finding in art*.

<sup>35</sup> For creative connections see S.A. Mednick, “The associative basis of the creative process,” *Psychological Review* 69: 220-32; see also Arnold Koestler, *The Act of Creation* (New York: Macmillan, 1967) – he embeds the connection in larger matrices, thus fitting more closely with my own approach of creativity rooted in conceptual structures. Creativity as an associative process is also described in early work by Spearman – C. Spearman, *Creative Mind* (New York: Appleton Press, 1931). For some recent work on conceptual combinations see *Creative Thought*, eds. Thomas Ward, Steven Smith, and Jyotsna Vaid (Washington: American Psychological Association, 1997).

selection, associated with Donald Campbell, and the basis of many modern accounts of creativity, as well as the essence of main theories of cultural innovation.<sup>36</sup> As a theory of creative development this theory has a minimal structure: individuals randomly learn many elements, perhaps focused in a conventional subject domain; then they randomly make combinations among them, either in their unconscious or more consciously; if a combination they make is a ‘good’ one, that is original and potentially valuable, they retain it and may then develop it further. Thus creativity arises out of a rather general learning process followed by random combinations and selection. In this book I propose a theory in which individuals are significantly more directed in their development, and guide themselves by forming creative interests, distinctive to them, defining distinctive, individualized domains in which they focus their attention and exploration, which in turn leads them to build up distinctive conceptual structures in the domains of their interests, which are generative of their creativity; randomness has a role in my description, for example in random encounters sparking creative responses, but in the context of a more self-directed, developmental process. In my view this description fits the facts, biographical and others, better. My description forges a bridge to literatures on self-determination associated with Edward Deci and Richard Ryan, and, in a broader way, the extensive literature on the self as a self-organizing, constructed entity, as well as the philosophical concept of autonomy.<sup>37</sup>

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<sup>36</sup> Donald Campbell, “Blind variation and selective retention in creative thought as in other knowledge processes,” *Psychological Review* 67 (1960): 380-400. An earlier, fairly similar, prominent model, focused on chance configurations as a means of solving difficult problems arising in creative work, is the chance-configuration theory set forth by Henri Poincare famously in his discussion of creative problem solving in his essay “Mathematical Creation,” reprinted in *The Creative Process*, ed. Brewster Ghiselin (Berkeley: University of California Press, 1952), 33-42. But as I note in the main text the theory has been taken up by many individuals and research lines in recent years, for example by meme theorists, as it fits naturally with the Darwinian idea of evolution by natural selection. I discuss theories of creativity in cultural theories, especially based on memes, in Chapter seventeen.

<sup>37</sup> Edward Deci and Richard Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior* (New York: Plenum, 1985), and “The ‘what’ and ‘why’ of goal pursuits: Human needs and the self-determination of behavior,” *Psychological Inquiry*, 11 (2000): 227-268; Richard Ryan, “Agency and organization: Intrinsic motivation, autonomy and the self in psychological development,” *Nebraska Symposium on Motivation: Developmental perspectives on motivation* 40 (1993): 1-56. Heinz Kohut in his pioneering work describes the self-object in the context of psychoanalytic theory – see *The Analysis of the Self: A Systematic Approach to the Psychoanalytic Treatment of Narcissistic Personality Disorders* (Madison, CT: International Universities Press, 1971) and *The Restoration of the Self* (Madison, CT: International Universities Press, 1977). There is much work in academic psychology, especially social psychology, on the self – see for example Roy Baumeister, *The Self in Social Psychology* (Philadelphia, PA: Psychology Press (Taylor and Francis), 1999). There is also an interesting literature on the self as formed historically and culturally – see the classic sociological account by Peter L. Berger and Thomas Luckman, *The social construction of reality: A treatise in the sociology of knowledge* (Garden City: Doubleday, 1963). Of interest are Charles Taylor, *Sources of the Self: The Making of the Modern Identity* (Cambridge MA: Harvard University Press, 1989), and Roy F. Baumeister, “How the Self Became a Problem: A Psychological Review of Historical Research,” *Journal of Personality and Social Psychology* 52 (1987): 163-76. For self psychology see Baumeister (1999) cited above. A related literature in cultural psychology is on the values of individualism and collectivism and the variation across cultures in relative importance placed by individuals on individualism, as well as differences in meaning and interpretation of these basic value dimensions. For a recent overview and meta-analysis of studies of cross-cultural differences see Daphna Oyserman, Heather M. Coon, and Markus Kemmelmeier, “Rethinking Individualism and Collectivism: Evaluation of Theoretical Assumptions and Meta-Analyses,” *Psychological Bulletin* 128 (2002):3-72, as well as the following comments on their work and their response. Two classic contributors are: Geert Hofstede – see his *Culture’s Consequences*, (Thousand Oaks: Sage, 1980); and Harry Triandis – see his *Individualism and Collectivism* (Boulder: Westview Press, 1995). For an of autonomy blending philosophy and psychology see Lawrence Haworth, *Autonomy: An Essay in Philosophical Psychology and Ethics* (New Haven: Yale University Press, 1986). For a selection of philosophical essays see *The Inner Citadel*, ed. John Christman (New York: Oxford University Press, 1989). For an interesting account of the philosophical development of the concept of autonomy see Jerome B. Schneewind, *The Invention of Autonomy* (Cambridge: Cambridge University Press, 1998). Much of the focus in philosophy is on autonomy in regards choices, especially moral choices, a principle that in modern times has a root in Immanuel Kant’s famous principle of the basis of moral action set forth in *Critique of Practical Reason*, trans. Lewis White Beck (New York: Macmillan, 1989)

Another branch of literature within the field of creativity studies that my description is connected with is the literature concerning the influence of environment, especially the social environment and reward systems, on creativity.<sup>38</sup> A wide variety of environmental factors and conditions have been described that may in certain situations influence our creativity, including incentives, feedback, critical reception, mentoring, and organizational and institutional structure and environment. Teresa Amabile has made important contributions in this area in her study of the influence of external reward systems on intrinsic motivation and creativity – see her *Creativity in Context*.<sup>39</sup> There is also much ongoing work studying creativity in the context of organizations. This work is relevant for many of the individuals whose developments I describe in this book, but not my focus, though organizational issues and context do arise in places.<sup>40</sup> There is also interesting work on collaborative creativity, mentoring, and more generally, the interpersonal context of creativity. Mentoring and collaborative creativity in particular are relevant for many of the individuals whose developments I describe, especially my interview subjects, and enter into my description in places, but again are not my focus. For recent work on collaborative creativity and relationships in the context of creative work see the citations in *Social Creativity*, 1, edited by Alfonso Montuori and Ronald Purser, *Jamming: The Art and Discipline of Business Creativity* by John Kao, *Group Creativity: Music, Theater, Collaboration* by R. Keith Sawyer, *Creative Collaboration* by Vera John-Steiner, and, for close relationships as an aid for individuals in creative work, Howard Gardner, *Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi*.<sup>41</sup>

Most directly related to my approach is a growing body of work situating creativity in the field in which it is based and the broader social-cultural environment. Csikszentmihalyi and collaborators, including Rick Robinson, David Feldman, and Howard Gardner, have described what they call the domain-person-field interaction, situating individuals in their

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(originally published 1788). This is thus a rather different focus and area of application than mine in this book. In embedding randomness in a model of development I find some resonance with the work of James H. Austin, *Chase, Chance, and Creativity: The Lucky Art of Novelty* (New York: Columbia University Press, 1976). He describes different four forms of luck, that in combination generate creativity: one is completely random accident, but the others are linked to individuals' own behaviors: luck based in exploratory behavior; luck based in expert knowledge and perhaps personal openness and attention; and luck rooted in distinctiveness of action. The model of creative development I present may be interpreted to show individuals defining paths they follow creating conditions for these forms of chance to operate. To the extent I describe individuals managing their development my description also has resonance with the theory of self-regulation of Michael F. Sheier and Charles S. Carver, *On the self-regulation of behavior* (Cambridge: Cambridge University Press, 1998).

<sup>38</sup> For an excellent review see the introduction to *Social Creativity*, 1, ed. Alfonso Montuori and Ronald Purser (Cresskill, N.J.: Hampton Press, 1999).

<sup>39</sup> Teresa M. Amabile, *Creativity in context* (Boulder: Westview Press, 1996); see also her original study, "Effects of external evaluation on artistic creativity," *Journal of Personality and Social Psychology* 37 (1979): 221-233, and her review of the literature on motivation and creativity with Mary Ann Collins, Mary Ann Collins and Teresa M. Amabile, "Motivation and Creativity," in the *Handbook of Creativity*, ed. by Robert J. Sternberg, 297-312.

<sup>40</sup> For creativity in the organizational context see Greg R. Oldham and Anne Cummings, "Employee creativity: Personal and contextual factors at work," *Academy of Management Journal* 39 (1996): 607-34. There are many recent contributions; see for example P. Tierney and S.M. Farmer, "The pygmalion process and employee creativity," *Journal of Management* 30 (2004):413-32, Daniel Stokols, Chip Clitheroe, and Mary Zmuidzinas, "Qualities of work environments that promote perceived support for creativity," *Creativity Research Journal* 14 (2002): 137-147.

<sup>41</sup> For *Social Creativity* see the citation in footnote 38 above; John Kao, *Jamming: The art and discipline of business creativity* (New York: HarperBusiness, 1996); Vera John-Steiner, *Creative Collaboration* (New York: Oxford University Press, 2000); R. Keith Sawyer, *Group Creativity: Music, Theater, Collaboration* (Mahwah, N.J.: Lawrence Erlbaum Associates, 2003); Howard Gardner, *Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi*, especially 43-44.

creativity work in the context of the conceptual or symbolic domain in which they work as well as the interpersonal field of environment of their work; one particular focus is on the collective judgment made in evaluating the value and creativity of individuals' work.<sup>42</sup> Silvano Arieti adapts systems concepts, including the notion of feedback loops, to describe the relationship between individuals engaged in creative endeavors and the social-cultural systems in which they are embedded.<sup>43</sup> Robert Sternberg and collaborators have developed a propulsion theory of creativity focusing on how individuals make decisions and orient their creative activities in relation to their field and their view about how it should develop.<sup>44</sup> My description here has some resonance with these descriptions, but I describe cultural linkages through specific channels of cultural transmission and influence not described in them.<sup>45</sup>

Finally, also relevant for this book is the literature on cultural development. This literature is vast and is not reviewed in detail here, though some references are listed in the footnotes; I discuss the literature further in chapter seventeen. In fact the study of cultural development has developed almost entirely separately from the study of creativity. Thus, traditionally cultural development has been studied mainly from historical, social, and economic perspectives, and, with some exceptions, there has been little emphasis placed on describing the creative development of individuals who have contributed to this development (this is somewhat too sweeping as there is interesting recent work for example on design; but it is a small, though growing literature).<sup>46</sup> In one important approach cultural development is described as an evolutionary process. This literature dates back at least as far as the pioneering study by Augustus Henry Lane-Fox Pitt-Rivers, *The evolution of culture*, published in 1906.<sup>47</sup> A striking feature of this literature is that the fundamental focus of analysis is not

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<sup>42</sup> Mihaly Csikszentmihalyi, "Society, culture, and person: a systems view of creativity," in *The Nature of Creativity: Contemporary Psychological Perspectives*, ed. Robert J. Sternberg, (Cambridge: Cambridge University Press, 1988), 325-39, Mihaly Csikszentmihalyi and Rick E. Robinson, "Culture, time, and the development of talent," in *Conceptions of giftedness*, ed. Robert Sternberg and Janet Davidson, 264-84 (Cambridge: Cambridge University Press, 1986), David Henry Feldman, Mihaly Csikszentmihalyi, and Howard Gardner, *Changing the World: A framework for the study of creativity* (Westport: Praeger, 1994).

<sup>43</sup> Silvano Arieti, *The Magic Synthesis* (New York: BasicBooks, 1992). Frank Barron also seeks to root creativity in the field and broader social environment in his autobiographical account *No rootless flower: An ecology of creativity* (New York: Hampton Press, 1995).

<sup>44</sup> Robert J. Sternberg, "A propulsion model of types of creative contributions," *Review of General Psychology* 3 (1999): 83-100, Robert J. Sternberg, James C. Kaufman, and Jean E. Pretz, *The creativity conundrum* (New York: Psychology Press, 2002), and Robert J. Sternberg, "The Development of Creativity as a Decision-Making Process," in *Creativity and Development*, ed. R. Keith Sawyer, Sawyer, Vera John-Steiner, Seana Moran, Robert J. Sternberg, David Henry Feldman, Jeanne Nakamura, and Mihaly Csikszentmihalyi, 91-138. In general these descriptions focus more on individuals consciously directed in their development and work from early on by a definite sense of the kind of contribution they wish to make, whereas I focus more on individuals forming interests they are intrinsically interested in, with less immediate thought about the ultimate contributions they will make through pursuing them, then following long, often winding paths leading to contributions, often contributions which they did not and could not have anticipated at the time they first formed their interests. There is some overlap in my discussion of the role of extrinsic and strategic factors in the formation of interests in chapter five.

<sup>45</sup> I do not consider judgement of work or individuals conscious views of their field as a whole and do not view their creative development as rooted in the effort, in any direct sense, to alter their field, as for Csikszentmihalyi and Feldman, Csikszentmihalyi, and Gardner, and Sternberg and Sternberg, Kaufman, and Pretz do. Also I do not focus on political-cultural-social conditions of creativity, such as freedom, political repression, degree of cultural openness, and economic systems – Arieti makes some very interesting comments about these. I discuss some relevant work in sociology related to these issues in chapter seventeen.

<sup>46</sup> For an interesting recent paper see Claudia Eckert and Martin Stacey, "Adaptation of Sources of Inspiration in Knitwear Design," *Creativity Research Journal* 15 (2003): 355-84. They provide a nice review of other recent contributions in the literature on sources for innovation in design in various fields.

<sup>47</sup> Augustus Henry Lane-Fox Pitt-Rivers, *The evolution of culture, and other essays*, ed. J. L. Myres (Oxford: Clarendon Press, 1906). He describes the evolution of several different cultural forms, including weapons, tools, and

individuals, but cultural forms, such as lineages of weapons, crafts, and tools, and discrete cultural units, often called memes, first defined by Richard Dawkins in *The Selfish Gene*.<sup>48</sup> The evolution of these forms and units of meaning is described almost as if it happens spontaneously, with the role of individual creativity deemphasized. Sociologists have in some cases considered individuals in the process of cultural development, but not consistently, and have not developed a comprehensive model linking individual creativity with cultural development. In his brilliant work on scientific revolutions Thomas Kuhn scarcely mentions processes of individual creative development. Economists who have discussed technological development have typically focused on forces that transcend individuals, like market dynamics, demographics, and the evolution of institutions; and when they do discuss the role of individuals or present models of the generation of innovations, these are highly simplified, with little connection with the literature on creativity.<sup>49</sup> Even the branch of literature that focuses on the importance of individual freedom and action, which is one inspiration for my own work, associated with Friedrich Hayek and with roots extending back to John Stuart Mill and far further, does not model the individual creative process.<sup>50</sup> The description in this book, in common with a number of the studies listed in the paragraph above, situates individuals in their creative development in their cultural environment. An objective I have is to contribute, with these studies, to the development of a new approach for studying cultural development, integrating models of individual creativity, thus in which creative development and cultural development are studied and described together.

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coinage, among the Australian Aboriginal peoples and other peoples whose cultures were pre-modern at the time he lived. Since his work was published many further studies have been published. George Basalla discusses the literature and gives many references to studies of the evolution of specific technologies in his book *The Evolution of Technologies* (Cambridge: Cambridge University Press, 1988). Payton Usher provides synopses of the development of several dozen important inventions in his book *A History of Mechanical Inventions* (Cambridge: Harvard University Press, 1954).

<sup>48</sup> Richard Dawkins, *The Selfish Gene* (New York: Oxford University Press, 1976). There is a related literature on the coevolution of culture and genes and the relationship between cultural and biological evolution – see Charles J. Lumsden and Edward O. Wilson, *Genes, Mind, and Culture: the coevolutionary process* (Cambridge: Harvard University Press, 1981), and, for a more mathematical approach, *Culture and the Evolutionary Process*, by Robert Boyd and Peter J. Richerson (Chicago: University of Chicago Press, 1985).

<sup>49</sup> In a famous passage, Joseph A. Schumpeter described how capitalism unleashes a “gale of creative destruction” in which new innovations are continually being introduced into markets, disrupting the established order. See chapter seven of his book *Capitalism, Socialism, and Democracy* (New York: Harper & Row Publishers, 1942). But he does not discuss the sources of innovation in creative processes. Economists certainly recognize the importance of technologic change for economic development – see for example Daid S. Landes, *The Unbound Prometheus: technological change and industrial development in Western Europe from 1750 to the present* (Cambridge: Cambridge University Press, 1969), Joel Mokyr, *The Lever of Riches* (New York; Oxford: Oxford University Press, 1990). There is a large recent literature on technologic innovation, especially associated with endogenous growth theory, sparked in part by Paul Romer’s paper, “Endogenous Technological-Change,” *Journal of Political Economy* 98 (1990): S71-102, as well as various microeconomic models of the research and development process; but these models are not linked to the literature on creativity. See my discussion in Chapter seventeen. One exception is a paper Martin Weitzman has written that makes a connection – building on the basic idea of creativity as making combinations: “Recombinant growth,” *Quarterly Journal of Economics* 113 (1998): 331-60.

<sup>50</sup> Classic works are Friedrich A. Hayek, *The Constitution of Liberty* (Chicago: University of Chicago Press, 1960) (see also his *Individualism and Economic Order* (Chicago: University of Chicago Press, 1948)); and John Stuart Mill, *On Liberty* (Hackett Publishing, 1978) (originally published in 1859).