**Late Polymathy Emergence**

J. Salzman

Technion – The Israel Institute of Technology

# Abstract

This article provides a descriptive account of late polymathy emergenceamong scientists and other highly specialized professionals. We expect this to lead to detailed studies that will produce theoretical models of life span decision patterns among creative individuals with a broad range of interests. Inspired by the Four C Model of Creativity, we contemplate multidisciplinary experiences and propose categorizing individuals with expertise and interest in several diverse fields as “small-p polymaths” and “Big-P polymaths” (p-polymaths and P-polymaths). We show paradigmatic examples of how personal and situational determinants may induce specialized professional individuals (mainly p-polymaths) to postpone expression of their diversified avocations until late in their professional life. In many cases, late polymathy is expressed approaching retirement. We consider the plausibility of the contention that polymath professional researchers gravitate toward active engagement in the arts.

# Late Polymathy Emergence

Works made by *Homo sapiens* since the Upper Paleolithic times, such as the cave art found in Lascaux and Chauvet caves in France, have an uncontested status as art (Davies, 2015). It seems that even 40,000 years ago there already were, among our human ancestors, artists (Curtis, 2007). Nobody cares whether these artists were professional or amateur, educated or self-taught, or if their artifacts or images were the result of a serious or casual leisure activity. In fact, we tend to believe that art-making is, and has been throughout time, one of the defining characteristics of the human species (Morris-Kay, 2010).

Can such a contention lead one to infer that, in our time, wherever a human community exists there is somebody making art? Surely not. What is more compelling is the question of significance: Was art-making, in prehistoric times with very short life expectancy and demographic instability, really essential for survival? In what sense? Survivability in the context of human species’ evolutionary history is understood today with reference to the fact that engagement with *creativity*,and particularly with the arts, was (and is) an integral and necessary adaptive component of a common human nature (Dissanayake, 2008).

Generating new ideas or concepts, implementing novel artifacts, formulating original and unknown processes, discovering rules and mechanisms in the dynamic evolution of nature, transforming objects, decorating, and inventing stories are just a few examples of human activities that are regarded as creative achievements. The three main fields in which such activities developed are art, science, and technology. To be considered creative, the idea, artifact, process, or theory must be original (novel), appropriate, and (except in the arts) useful (Sawyer, 2003).

A large number of studies have been devoted to creativity during the last century, in particular after a seminal talk presented by Guilford at the American Psychological Association in 1950 (Guilford, 1950). Early psychological studies focused on the mental processes (including subconscious and unconscious experiences) of creative individuals. The social context of the creativity processwas later incorporated into the modeling thereof (Feldman, 1974).

More recently, creativity has been conceptualized as a *system,*in which the process is the result not of a single creator but of an *interaction* between three elements: a domain of knowledge, an individual, and a field. The individual creator draws from experiences, codes, traditions, and emotions related to the cultural context (the domain), and may use imaginative skills to implement some novelty to be appreciated, judged, or rejected by the social environment (the field) (Csikszentmihalyi, 1999).

From the psychological perspective, creativity, innovation, and invention processes, when resulting from the integration of diversified pieces of knowledge, appear to be closely related to *polymathy*. A polymath is a person with expertise and capabilities spanning a wide range of subject areas or disciplines. In modern times, their characteristics and behaviors are regarded as an antithesis of *expertise* in a hyper-specialized system of knowledge. Many cultural historians state that the interdisciplinary approach of the polymath may be an important advantage for solving the most difficult and complex problems of the contemporary world. Biographies have described certain outstanding individuals, such as Herman von Helmholtz or Thomas Young, as “the last polymath,” indicating that there will be no more people like that and that they constitute an endangered species. But in reality, are they?

# Demystifying Prominence

Since the early decades of the last century, polymaths have been discussed in relation to the controversy around the relative advantages of *generalists* versus *specialists* (see, e.g., Root-Bernstein, 1989, 2004, and references therein; see also Ahmed, 2018; Araki, 2018; Burke, 2020). In most of these scholarly publications, polymaths have been described as *cultural heroes*: Nobel prize laureates, great eminences, universal men, game changers, celebrity performers, extraordinary achievers, monsters of knowledge, inimitable humans. One may get the (wrong) impression that “normal people” are excluded from this trait.

Cultural heroes are needed in every human community. Every small town may have its local hero; every academic institution admires and venerates some of its greatest past members. Such individuals provide inspiration, horizons to the aspirations of newcomers, and identification. Heroic narratives talk about doing something far beyond the normal scope of common people and becoming immortal. However, heroes fall short of representing the whole. The claim that human knowledge rides on the shoulders of heroes, and only on them, is difficult to defend.

On the contrary, the production of new knowledge entails a multilayered complex system in which millions of people are continuously actively pursuing the validation, improvement, modification, development, and advancement of the many fields of human knowledge (Ilkka, 2019; Mesoudi & Thornton, 2018). These people include artists, engineers, mathematicians, medical doctors, scientists, and other professionals and nonprofessionals. Some of them are highly creative, and nobody has ever established how many of them are polymaths. Most are not celebrities, extraordinary achievers, or famous heroes. The cumulative evolution of knowledge could not have been developed by a single individual or by a handful of “prominent ones” (Dean et al., 2014).

The conclusion arising from the above is that if somebody intends to study the social behavior and psychological attributes of polymaths, they have to look for them among regular community members, not among heroes. An important step in this direction was the model of “little-c” and “Big-C” creativity (Csikzentmihalyi, 1996), later enlarged to the Four C Model of Creativity (Kaufman & Beghetto, 2009). The main implication of this approach is that there is a continuum of creativity levels, and the legendary achievers (Big-C) are not the only ones that deserve recognition as being creative individuals.

Inspired by the little-c and Big-C creativity model, we propose categorizing polymathy into little-p and Big-P (p-polymaths and P-polymaths). Therein, members of the little-p class are creative, polymathic individuals who, although at a professional level, have not achieved legendary status (paralleling the Pro-C creativity level in the Four C Model). Big-P polymathy corresponds to the exceptional, legendary Big-C creativity case. Kaufman and Beghetto (2009) explained that conducting studies of living people with Big-C creativity is nearly impossible. Thus, in the rest of this paper we deal with p-polymaths.

A phenomenological field study of p-polymaths aimed at understanding the motivations for certain people to choose the generalist path, and their personal experiences, was recently conducted by Cotellesa (2018). This included personal interviews focusing on personal life history and meaning-making motivations. The participants’ narratives provided insights regarding their experiences as polymaths.

Participants in Cotellesa’s (2018) study are labelled here little-p since they had achieved a recognized level of professional status, but not (yet) the legendary level of a cultural hero. A main precondition for participation in the study was the individual’s active involvement in divergent fields, such as business, science, and the arts. Typical examples include someone with a PhD in neuroscience also being an accomplished photographer; a financial analyst with a Bachelor of Arts degree in theater; a mathematician who is an accomplished pianist; a physics professor who is also a professional magician. The conclusions of the field study include the existence of identity issues (not fitting in the typical box), efficiency (ability to juggle many interests through effective time management), dedication (willingness to improve oneself through self-directed learning), and extracurricular determinants (family and financial resources impacting the emergence of polymathy).

We may bring another paradigmatic example of p-polymaths engaged in the advancement of human knowledge. My personal experience draws from 30 years of working in scientific–technological research at the Micro-nanoelectronics Research Center at the Technion, The Israel Institute of Technology. The center is the hub for about 15 faculty members and more than 50 associated researchers, graduate students, postdocs, and engineers devoted to the study of micro- and nano-devices. As a prerequisite for the scientific characterization of these micro- or nano-devices, one has to proceed in the process of nano-fabrication, which is plagued with many unknowns. Problem-solving in such daily work relates regularly to chemistry, material science, optics, vacuum engineering, microlithography, and more. Daily problem-solving in the laboratories requires, more often than not, a multidisciplinary approach. Without a systematic study, I recall that many individuals have shown creative problem-solving using multidisciplinary knowledge (without having reached eminent status). Nanotechnology and nanoscience laboratories like the one described here exist in most developed countries around the world, hosting thousands of researchers and engineering staff.

We must note that even in such interdisciplinary research centers, not everyone attempts to solve their problems polymathically. Some prefer to consult or collaborate with the expert sitting in the neighboring office. Others, in a polymathic way, try to figure out possible solutions based on their experience in a distant discipline.

Pursuing an active exploratory search for the optimal solution in practical situations independently is a clear sign that polymathy is an *attitude*, not necessarily a *trait*. This means that polymathic problem-solving involves an *affective* component (enjoyment in confronting the challenge), a *behavioral* component (allocating personal resources to understanding the problem), and a *cognitive* component (utilization of previous interdisciplinary knowledge) (Rosenberg & Hovland, 1960).

I may extrapolate, claiming that among many professionals (architects, high school teachers, large-company engineers, medical doctors, nurses, start-up members, and many others), p-polymaths are to be found. They enjoy life, contribute, and flourish “under the radar.” Unfortunately, their traits have not been studied using a social-psychologic approach.

# Professional Life Cycle in a Specialized High Technology Society

Career patterns in present-day Western society have gone through drastic changes since they were conceptualized by Donald Super (1980) more than 40 years ago. One important trend in the present-day labor market is the increase in job mobility (Tikhonov & Novikov 2020). As an example of this trend, according to the US Department of Labor, the average number of jobs held by baby boomers in the United States between the ages of 18 and 38 exceeds 10. This may reflect an active negotiation of young employees for a better match between personal vocation (or expectations) and actual job requirements, or the continuous seeking of a higher reward.

In individuals’ early professional career, job changes are often perceived as a normal process of finding the right match in the labor market (Oreopoulos et al., 2012). Mobility rate peaks around the age of 26 and decreases continuously during the working life cycle (Forsythe, 2018). This decrease with age may be interpreted as a combination of vocational satisfaction and situational and personal determinants, such as marriage, early parenthood, and social status.

Let us focus, under this perspective, on the professional (newly graduated) individual with a broad range of interests and capabilities. In the early stages of employment, they are mostly devoted to activating their expertise within their main (narrow) specialization. The tension between expectations and job opportunities (or job requirements) motivates them to invest their greatest resources to succeed in their present role or in shopping for an alternative one. They are not in a position to risk or compromise their project with diversified thinking or with an unconventional approach. In addition, after-work time may be committed to family (parenthood), which imposes limitations on leisure time priorities.

For the creative professional with a broad range of interests and a tendency to use an interdisciplinary problem-solving approach, there is also an opportunity for sequential changes in job assignment within the same company. Mid-career professionals are likely to accumulate in their working history a large variety of specific specialized projects. However, it may take many years until the process of securing job stability, recognition, and success within the narrow specializationunfolds the interdisciplinary potential.

A similar process is often found in academic careers. The young researcher may not be inclined to move to another research institute or department, but they may be continuously negotiating their position, visibility, creativity, and competitive achievements, expecting tenure, promotion, and international recognition. The specific themes being addressed and exposed as part of their research personality are likely to be successfully solved (or exhausted) and replaced by other ones (similar to the case of lateral job mobility within the company in the industrial employment case). It may take two or three decades until their body of public achievements becomes widely recognized. In this way, the individual accumulates interdisciplinarity,

According to the “traditional” view of career stages proposed by Ronald Super (1957) , the lifelong working evolution is likely to include: (a) an exploration stage (age 15–24), (b) an establishment stage (age 26–44), and (c) a maintenance stage (age 45–65).

In all cases, we often find professionals working in the hyper-specialized society accumulating various themes, subjects, or even disciplines within their expertise. They become interdisciplinary experts.

After-work opportunities for serious leisure projects, hobbies, and social engagement become more accessible when individuals become established at work and more relaxed in their multiple duties. It is not uncommon to see engineers, medical doctors, scientists, and other professionals returning to musical instruments they had previously set aside, become deeply engaged in certain competitive sporting activities, or enroll in evening courses in the arts as they age.

Recent views and models of lifelong careers are more dynamic, complex, and multifaceted due to the rapid changes in technology, political influences, fluctuating markets, and emerging opportunities. However, the evolutionary principles of individual career patterns remain valid.

Job mobility or shifts in a specific role within an organization are perceived by the individual as *career decision points*.These points reflect encounters with a variety of situational determinants, such as geographic, social, economic, and family conditions. The outcome may be an increase in wage, a new technological challenge, a change in working environment, increased vocational satisfaction, or the need to add components to the existing professional toolbox. These shifts are sometimes denoted *learning cycles* that contribute to broadening the spectrum of expertise. New tools and concepts borrowed from remote disciplines need to be mastered and applied to the new problem at hand. Thus, shifts from one job to another, or between assignments, may contribute to the late formation of a multidisciplinary expert.

One may summarize this rather general description of career patterns as follows:

1. Every shift in a specific activity is a decision point. Decision points are critical for identity formation.
2. Movement to a new specific activity contributes to becoming multidisciplinary.
3. Job security and other situational determinants may evolve into the potential to adopt a polymathic attitude.

The schematic (and perhaps oversimplified) description presented here of a lifelong career pattern in a hyper-specialized society may lead to an opportunity for a polymathic attitude. However, this is only an opportunity. The individual who is attracted to *divergent thinking* (unusual association of concepts, attempting different perspectives and approaches to problems) (Guilford, 1967) may find joy and satisfaction in implementing this attitude. We do not embrace the vision of “polymathy as a life project” (Araki, 2018). Neither do we regard this as a “management issue” (benefits versus costs). Instead, we consider it as an evolutionary process embedded in the working dynamics of a high technology society.

This opportunity is what we denote *late polymathy emergence*. It probably comes to the fore late in the working trajectory after confronting diverse problems to be solved, novelties to be invented, concepts to be manipulated, secrets to be uncovered, and challenges to be met. The system composed of the domain, the individual, and the field may have to be concerted to turn this opportunity into a creativity greenhouse.

One outstanding exception to the lifelong career pattern described here is the case of young, creative, and bright professionals joining a highly aggressive start-up company. This is a working environment that combines specialization with openness to “crazy” ideas, inventiveness, and high-risk moves. The employee here may have enough self-confidence to attempt a polymathic attitude from the beginning. We will address the social behavioral patterns of this group of people in a different publication.

# Late Polymathy Emergence and Retirement

Our description of mobility patterns of professionals uncovers a possibility that specialists in our technological society can be driven in a natural way to a broader, more interdisciplinary approach. The individual, finally armed with many experiences, having tasted several disciplines, and probably having become more self-confident, is also capable of returning to some of their old hobbies, sporting activities, or artistic avocations that were postponed or neglected during their career journey. This broadening of specialization focuses and activation of avocations is what we denote late polymathy emergence. At this stage one may start thinking about retirement. The retirement process starts at that point (Wang et al., 2018).

Decision points, learning cycles, and transient events during a career may have affected the individual’s identity, and sometimes been associated with some degree of stress, but none of them was as profound and significant as the retirement process. Unlike the earlier decision points, the move into retirement implies learning to live with a new identity. This identity transition process necessarily entails a search for meaning (Wang et al., 2018).

The retiring professional, having acquired some degree of polymathy (Salzman, 2022), is likely to invest a significant amount of cognitive effort in planning and designing their retirement lifestyle to find worthwhile actions, projects, commitments, social connections, and values that will provide meaning to the years to come. In other words, the question being asked is “What do I really want to do to make post-retirement life worth living?” It has been suggested that the past history of engagement in a creative network encourages the retiree to adopt one of three possible options: (a) a continued activity in (and commitment to) their previous domain, (b) a change to a new domain, or (c) a broadening of focus within or beyond domains (Nakamura & Csikszentmihalyi, 2003).

The second and third options represent a more explicit avenue for adopting the polymathic attitude. By that we refer, as examples, to the retiring chemist shifting into painting, the mechanical engineer into music composition, the mathematician starting to write poetry, or the physicist engaging in sculpture.

# Retiring Professional Researchers and the Arts

In some cases, when individuals have spent most of their adult years engaged in science, technology, engineering, or mathematical disciplines (STEM), they may reach the conclusion that, although the domain is still important, they no longer experience profound personal engagement in these activities. Moving into a new domain is perceived in these cases as the best way to prevent the natural decay in creative productivity (Simonton, 1988). Changing domain has a social cost: the belonging to the previous community is weakened or eventually broken. On the other hand, an individual who changes domain may adopt in later life the identity of an *explorer*.

In many Western countries, academic and government-related employment is subject to mandatory retirement at a certain age (typically between 65 and 70). With present-day life expectancy, one may expect, in these cases, two to three decades of post-retirement activities. Thus, it is not uncommon for STEM-related individuals to start negotiating with themselves and planning their meaningful aging several years prior to their formal retirement date. For these individuals, with a certain degree of manual skill, willingness to embrace a humanistic approach, and confidence in their adaptability, active engagement with the arts is a viable option.

Transition from the STEM disciplines into the arts is perceived as a fresh revival of creativity. It provides a widening of the “universe of discourse.” While producing visual artifacts (paintings, sculptures), writing poetry, or composing musical pieces, one may attempt communicating expressively any theme of interest. A theme may comprise animals, emotions, gender issues, historical events, humans, landscapes, objects, racial discrimination, scenes, social criticism, technological threats, and more. For some, there is no need of a theme. The aged artist affords the opportunity to shift from the rigorous study of a definite domain separated from the whole reality into a fuzzy mixture of fiction and reality; the subjective and the universal; affective and cognitive; normative and defiant. The artwork may try to confer an aesthetic value, a message, an innovative form, or a combination of these. It may express a clear, sharp message or offer an open reading with multiple interpretations (Ecco, 1989).

These choices do not specifically concern the aged newcomer to the art field. They are inherent to the very definition of the arts, intensively investigated in the past (see, e.g., Adorno, 1970; Carroll, 1999; Hegel, 1975; Jimenez, 2002), and continuously debated to the present day (e.g., Adajian, 2018; Danto, 1981, 1989; Forsey, 2001). However, for the aged polymath, they may become a wonderful, authentic, meaning-making endeavor. They are thus likely to provide a source of joy, well-being, and usefulness while they acquire their new identity.

However, as much as this may look like a promising paradise, it is not free from obstacles, barriers, and challenges. The first such challenge is learning a new symbolic language in which a visual or aural signifier may have multiple significations. Art symbols are likely to refer to other artworks, thus forming a complex associative network. Second, there is a need to master a set of techniques (a toolbox) for creating artifacts. Third, one has to approach a diverse set of codes, cultural narratives, iconographic and immersed messages, traditions of works, genres, theories, and conventions. We may denote all the above the *language of art*. Mastering proficiency in the language of art could be challenging for retiring individuals. At their entry level, they may try enrolling in university-type, degree-seeking art studies, or in (less structured) community art education centers (e.g., Wallace Foundation Knowledge Center, 2007). Needless to say, these courses can only partially fulfil this expectation.

However, there is a more compelling challenge: the social constraints or ambivalent response of the field. The field is the third component in the system model of human creativity (Csikszentmihalyi, 1999). It is the validating response to a piece of artwork, its approval and social recognition agent. This field may be naively considered the audience, the beholders of the art piece, but it is not. The judgment and approval of the artistic activity of an aged nonprofessional artist is mostly performed by *cultural mediators and gatekeepers*.These cultural mediators may be the art critics, art dealers, curators, or gallery owners in the visual arts, or cultural brokers, editors, or publishers in the literary publishing field. The term “gatekeepers” stems from the frequent role of these agents in evaluating, judging, and selecting the cultural works, and the corresponding creators, that deserve to be supported and distributed. Cultural mediators contribute to the formation of cultural tastes and consumption patterns.

The influence of mediators is decisive in fields characterized by a lack of objective quality standards. However, art critics too, in certain cases, do not have a reliable instrument to assess aesthetic qualities in an unequivocal way, and no objective agency can prove their evaluations to be true or false (Van Rees, 1989; Yogev, 2010). In such cases, gatekeepers rely on reputation, or on previous critical assessment of an artist’s work; on genre, technique, materials choices, etc. All the above may be of disadvantage to the aged STEM professional; by becoming nonprofessional artists, they are frequently marginalized or regarded as outsiders.

One last obstacle for scientists becoming artists that is frequently mentioned is the commitment to rigorousness. Such commitment is expressed in logical inference, attention to facts, unbiased recording of experimental results, certainty (true versusfalse), and detailed planning. This way of thinking about and relating to the world may result in some rigidity, imposing limits on “wild creativity.” We may quote in this respect Susan Langer (1953):

There are things which do not fit the grammatical scheme of expression, but they are not necessarily blind, inconceivable, mystical affairs; they are simply matters which require to be conceived through some symbolistic schema other than discursive language.

We denote these things “beyond certain knowledge,” which are difficult for people committed to rigorousness to comprehend.

Obstacles, barriers, and challenges for the aged newcomer to the art world are plentiful. Nevertheless, long-term commitment to this field may be, as pointed out by Jeanne Nakamura and Mihaly Csikszentmihalyi, a source of meaningfulness and vital engagement.

# A Kind of Summary

* Artistic creativity in Paleolithic times has been interpreted as being rooted in survival needs. In modern times, art-making is a viable option for the aged (retired) polymath as a source of meaningfulness. We suggest that these two motivations are closely related.
* Polymaths have been identified by many scholars as an extraordinary class of cultural heroes.We propose the existence of two groups: the P-polymaths and the p-polymaths. The latter comprise versatile, interdisciplinary, modest, creative individuals. Their behavioral traits could be of great interest for research in social psychology and cultural sociology.
* The role of heroes and others in advancing cumulative culture has been briefly touched upon: Who rides on the shoulders of whom?
* In a hyper-specialized society, polymaths are not necessarily the opposite of specialists. We have seen that in certain scenarios (job mobility, sequential research themes), the specialist may gravitate toward being a multidisciplinary expert. Eventually, this can be the source of late polymathy emergence.
* Late polymaths from the STEM disciplines in retirement may rejuvenate their creativity through engagement in the arts. This could become an interesting, enjoyable, valuable, and difficult time for them.

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