



**Michael Espindola Araki**

**Polymathic Leadership: Theoretical Foundation and  
Construct Development**

**Dissertação de Mestrado**

Dissertation presented to the Programa de Pós-graduação em Administração de Empresas of the Departamento de Administração, PUC-Rio as partial fulfillment of the requirements for the degree of Mestre em Administração de Empresas.

Advisor: Prof. Flávia de Souza Costa Neves Cavazotte

Rio de Janeiro

April 2015



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## Abstract

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The objective of this work is to propose a novel theoretical approach to leadership called polymathic leadership. “Polymathic” originates from the noun “polymath”, which means “a person of wide-ranging knowledge or learning” (OXFORD, 2015). Polymathic leadership is here presented as a pattern of leader behaviors that encourages and inspires followers to advance to higher levels of depth, breadth and connectedness of ideas, knowledge and competence. It is theorized this kind of leader behaviors and the kind of collective behavior it inspires are especially positive in dealing with problems and situations that are characterized by being difficult, complex, volatile, uncertain and ambiguous. Due to the obscurity of the term polymathy, the work first explores and reviews the meanings and definitions of the term, then articulates it with other, well-defined, constructs of the literature. After that, the definition and description of polymathic leadership is presented, along with its differentiation from other types of leadership. Moreover, the work introduces a model of polymathic leadership with examples of its relevance and usage in work groups. It concludes by highlighting the possibilities of further studies unfolded by this novel approach.

## Keywords

Polymathy; Leadership; Polymathic leadership; Groups; Teams; Theory; Theoretical framework.

## Resumo

Araki, Michael Espindola; Cavazotte, Flávia de Souza Costa Neves. **Liderança polímata: fundamentação teórica e desenvolvimento do construto**. Rio de Janeiro, 2015. 203p. Dissertação de Mestrado – Departamento de Administração – Pontifícia Universidade Católica do Rio de Janeiro.

O objetivo deste trabalho é lançar as bases teóricas para o desenvolvimento de um novo construto no campo de liderança chamado “liderança polímata”. “Polímata” pode se referir tanto a um substantivo (a pessoa polímata) como a um adjetivo (a liderança polímata). O termo tem origem no grego clássico e significa “amplo conhecimento ou aprendizagem” (OXFORD, 2015). A liderança polímata é aqui apresentada como um padrão de comportamentos de um líder que incentiva e inspira seguidores a avançar para níveis mais elevados de profundidade, amplitude e conectividade de ideias, conhecimentos e competências. Teoriza-se que tais comportamentos do líder assim como os comportamentos coletivos que essa abordagem defende são especialmente positivos para lidar com problemas e situações que se caracterizam por serem difíceis, complexas, voláteis, incertas e ambíguas. Devido à obscuridade do termo polimatia, o trabalho primeiro explora e analisa os significados e definições do termo para depois articular a polimatia com outros construtos bem definidos da literatura. Em seguida, é apresentada a definição e descrição da liderança polímata, além da análise de suas diferenças e similaridades com outras abordagens de liderança. Além disso, o trabalho apresenta exemplos de como essa abordagem de liderança pode ser utilizada em grupos de trabalho. O trabalho conclui destacando as possibilidades de novos estudos a partir desta nova abordagem.

## Palavras-chave

Polimatia; Liderança; Liderança polímata; Grupos; Equipes; Teoria; Quadro teórico.

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## Preface

“Particularly today, when so many difficult and complex problems face the human species, the development of broad and powerful thinking is desperately needed”

(SAGAN, 2012, p.133)

The words above were written by the American astronomer Carl Sagan, in his book *Dragons of Eden* of 1977. In this extract, Sagan was specifically referring to the polymaths, as he described, “remarkably gifted multidisciplinary scientists and scholars” (SAGAN, 2012, p.133). The meaning of this term (polymath) has undergone some changes along the years, but since times long past it has remained a symbol of “higher status”, which just a select group of people could aspire to achieve. Polymathy, then, has fallen into obscurity.

This work critically revisits the traditional ideas of polymathy and advances towards a new and more structured conceptualization of the construct. It is seen that the development of polymathy bears consequences on the several interchanges that an individual is expected to engage in. One of these dynamics is the very special process of influence, which occurs in groups and involves the coordination of actions for the pursuit of shared goals, called leadership.

# 1. INTRODUCTION

## 1.1. CONTEXTUALIZATION

“Problem: *noun*

a: an intricate unsettled question.

b: a source of perplexity, distress, or vexation.

c: difficulty in understanding or accepting.”

(MERRIAM-WEBSTER, 2015)

Problems can have many definitions, such as those presented by the Merriam-Webster dictionary. Throughout history, humankind has been accustomed to face a multiplicity of challenges, however, we had never experienced a world in which technology develops and propagates so fast (DRUCKER and DRUCKER, 1993; SENNETT, 2007). The world today is much more complex than any time in the past. Our time is characterized by a new degree of globalization and technological development, by connectedness of economies, by intricate systems and machines that govern our lives. Being so, the problems we face are also expected to be different.

There is an acronym called VUCA, coined by the Armed Forces, that expresses situations involving high degrees of volatility, uncertainty, complexity and ambiguity (JOHANSEN and JOHANSEN, 2007; BENNETT and LEMOINE, 2014). This acronym is good to describe many situations in the world today. We are living, more than ever, in a world with VUCA problems. Often, while dealing with situations of these kinds, proven, traditional methods might not be sufficient, thus, new possibilities or solutions must arise. These new solutions, however, may also provoke unforeseen and unintended consequences, which add to the initial problem.

Solving problems without the possibility to rely on pre-existing “best practices” or procedures that have been proven successful in the past is a daunting challenge. We are, more than ever, facing this kind of challenge. Furthermore, some problems we face today carry a new and different sense of urgency. Due to the great power (productive or destructive) that we can harness and the impact that we can inflict upon large environments, it is easier for us today to inadvertently provoke

or cause social and environmental catastrophes than any time in the past (DIAMOND, 2006; EHRLICH and EHRLICH, 2013).

This new global situation has effects in the most diverse spheres. In the political sphere, former General Secretary of the United Nations, Kofi Annan, has voiced concerns that our current systems are not dealing with these new world challenges accordingly: “the scale and speed of economic, demographic and technological changes are upending the political status quo” (ANNAN, 2014). In the economic and business sphere, the scurrying changes mentioned before are affecting the landscape of entire economies. While economic changes, yielding benefits in one side but generating new challenges on the other, have always happened, many common people today feel vexed by the new state of complexity that the world economy has reached.

The graphs and the related discussion below are an effort to illustrate the size and the depth of the changes mentioned previously. The graphs show the percentage of employment in the sector of manufacturing in the U.S.A, Japan and Germany from 1970 to 2010.

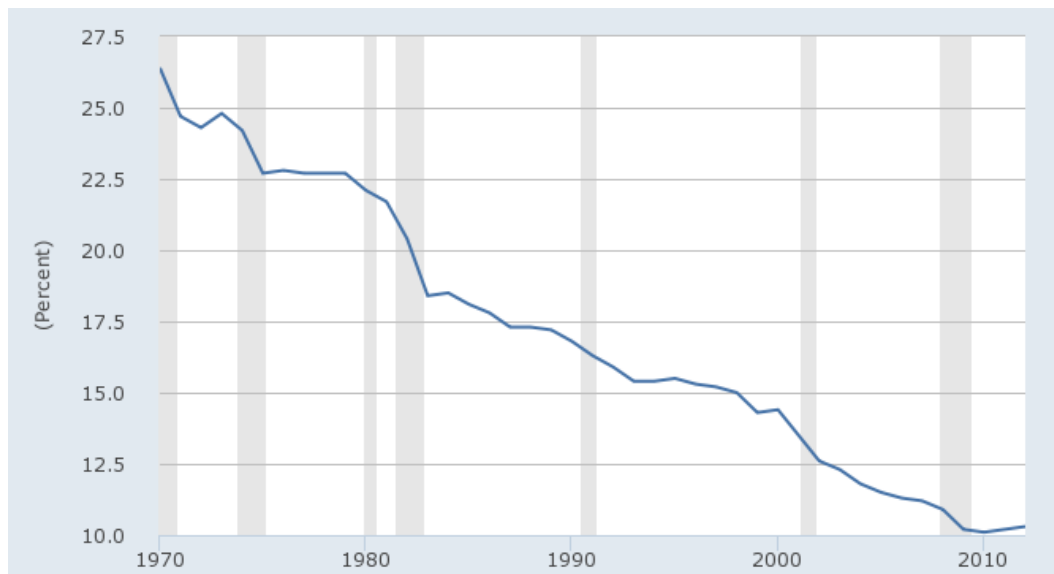


Figure 1. Percent of employment in Manufacturing in the U.S.A.<sup>1</sup>

<sup>1</sup>Shaded areas indicate US recessions. Source: US Bureau of labor statistics at <https://research.stlouisfed.org>. Accessed June 22<sup>nd</sup>, 2015.

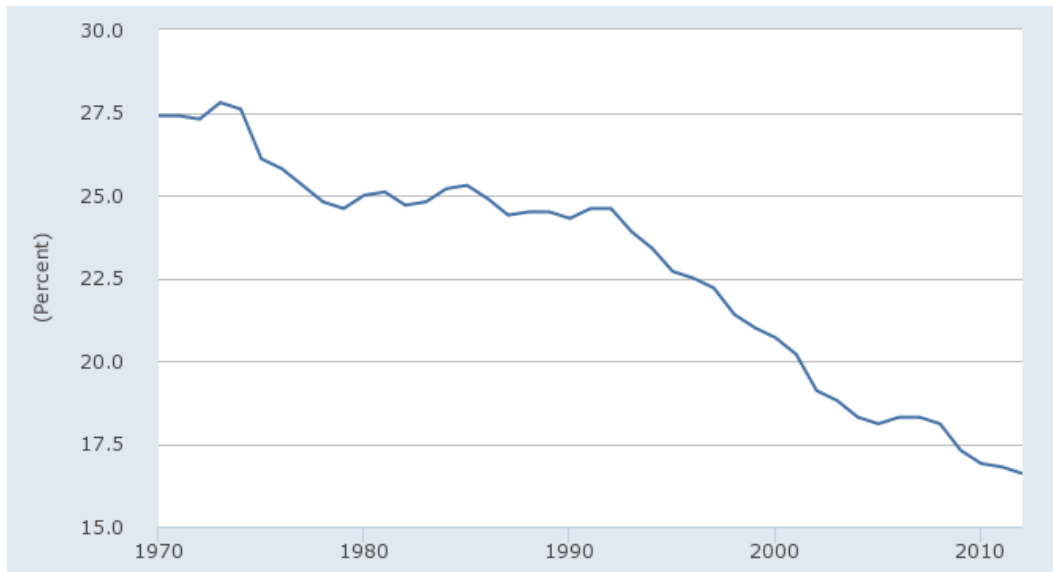


Figure 2. Percent of employment in Manufacturing in Japan.<sup>2</sup>

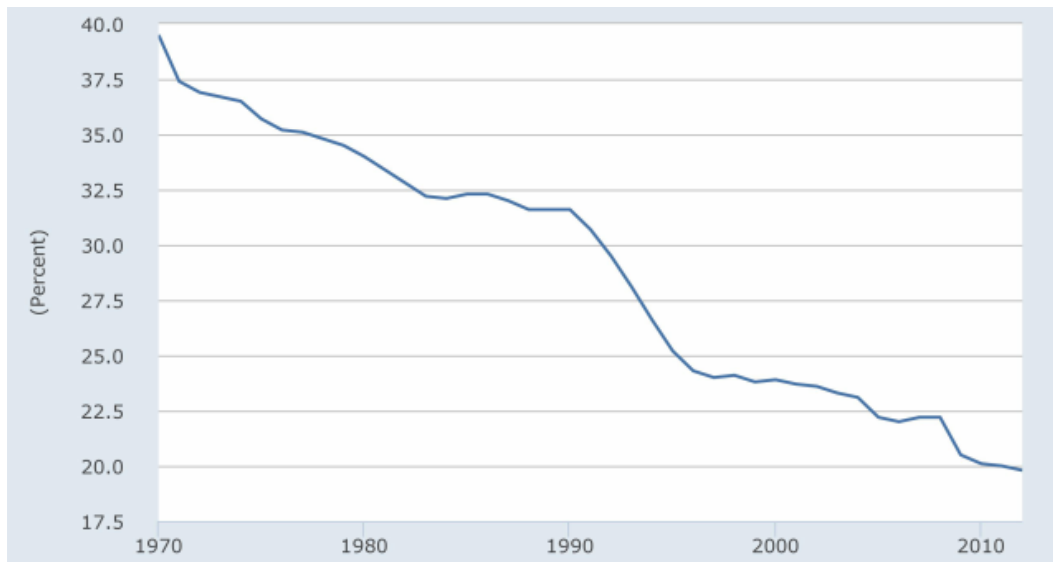


Figure 3. Percent of employment in Manufacturing in Germany.<sup>3</sup>

All the three countries show a sharp decline in manufacturing jobs, and this pattern is not exclusivity of those countries, it is the same for other industrialized countries like France, Italy, England, Canada, Netherlands, Australia and Sweden. It means that - in a rather short time span - several countries had their economy radically transformed, thousands of companies either reinvented themselves or disappeared, and millions of people had their lives directly or

<sup>2</sup>Source: US Bureau of labor statistics at <https://research.stlouisfed.org>. Accessed June 22<sup>nd</sup>, 2015.

<sup>3</sup>Source: US Bureau of labor statistics at <https://research.stlouisfed.org>. Accessed June 22<sup>nd</sup>, 2015.

indirectly affected by these changes. Investigating the phenomenon further, it is possible to see that the very manufacturing sector has undergone a tremendous revolution. Take for instance the value added of several manufacturing sub-sectors to the American GDP in the period of 2000 to 2010:

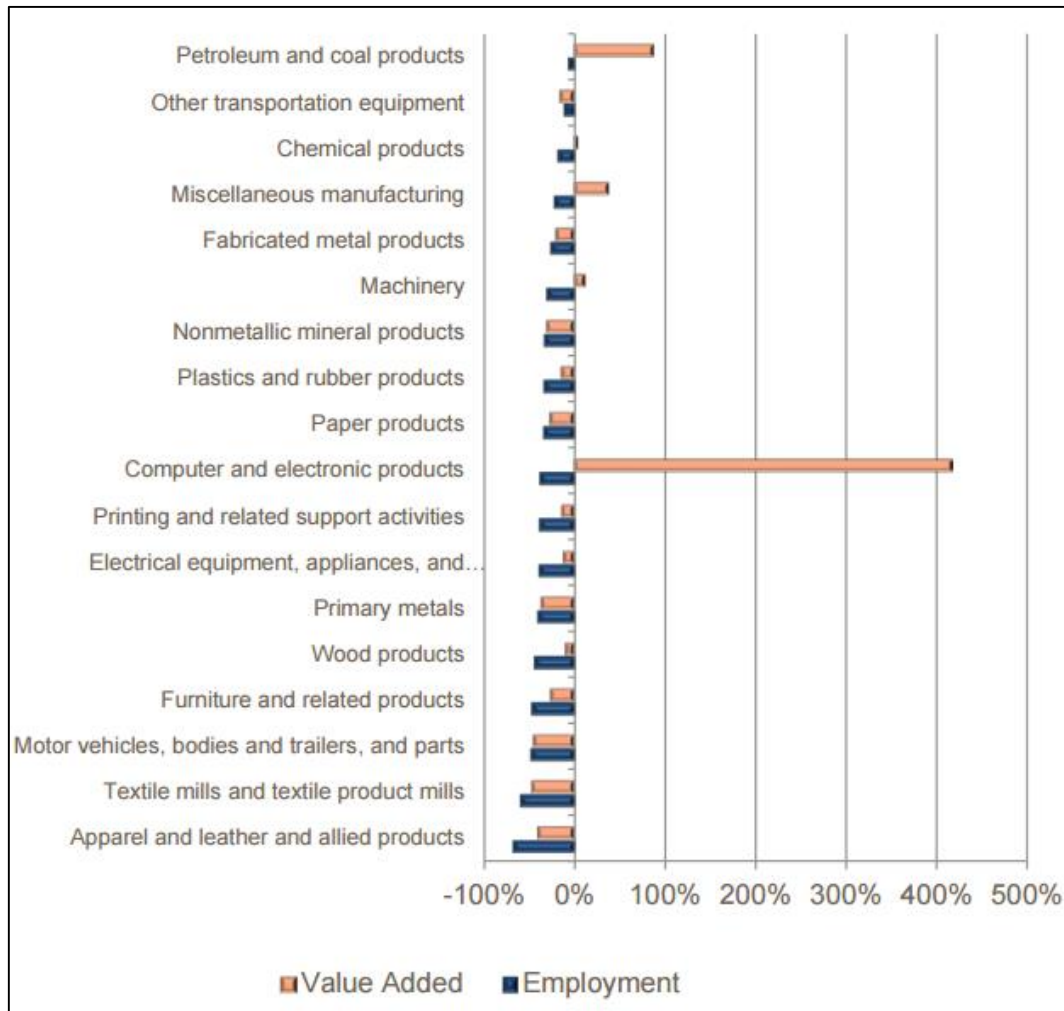


Figure 4. Value added and employment from 2000 to 2010 in the U.S.A.<sup>4</sup>

Even though it is discussed that some values are overstated (petroleum and coal products, and computer and electronic products) and the effects of Intermediate Goods Imports was not considered correctly (ATKINSON *et al.*, 2012), the transformation of American manufacturing in a period of just ten years was substantial, possibly not many companies were able to sustain old methods of doing business. If we look via the perspective of employment, in overall, every industry lost jobs.

<sup>4</sup>Source: The Information Technology & Innovation Foundation, 2012.



It can be argued that these rapid changes are not necessarily a problem. Indeed, the economy and the productivity are growing in most countries, the market has more and better products to offer than ever, and in the case of the United States, unemployment rose from 2008 to 2010 but then began to fall and it is now at rates similar to 1950. It could be argued that, overall, this is not a problem; it could be the case that countries, companies and workers should adapt to the “new times”.

Nevertheless, not all institutions, organizations and people deal equally well with some changes. Even if the overall situation might be better, perceptions of failures in the system and the dissatisfaction of representative groups may lead to severe problems. Important social pacts, which sustain our way of making changes with each other, may be in jeopardy. Authors such as PIKETTY and GOLDHAMMER (2014) and REICH (2007) have published works that call the attention to the increase in income inequality and point out how this might be a great problem, with grave consequences to whole societies and even to transnational secular institutions such as democracy.

The problems faced by societies and organizations today tend, more than ever, to require a high degree of coordination, integration and the development of a deep collective knowledge in many areas in order to be properly addressed. Even problems that might have been trivial in the past are far from that today. The secular extractive activity of forestry is a good example of this point. In the past centuries, thousands of acres were devastated without much planning or concern for sustainability in order to supply companies and people with forestry goods such as wood. Today, a competitive forestry company must not only excel in extracting wood from the forest, but it must also be able to do many things that were unnecessary or inexistent in the past; it must utilize advanced technology to harvest, transport, process, manage and control the goods, it must also have the information systems to provide data on productivity, profitability, accountability, etc.; it needs to be extremely aware of the conditions of its workforce, it needs to have people to ensure that acceptable standards are being met and to negotiate with the workers; it needs to be in touch with conservational groups and be attentive to the needs and concerns of the local community; it must have a brand which consumers can identify with; it needs the community to perceive the extractive activity performed by the company as sustainable, and much more. It means that a successful forestry company, that aims to continually exercise its activity and engage in sustainable

exchanges with society, must possess an immense range of skills, knowledge and competencies within its workforce. Moreover, these skills, knowledge and competencies must be somehow interconnected. For instance, it is not viable for a marketing department to not deeply comprehend the value of the product; the difficulties in extracting it, getting the required licenses, developing the required technology, etc. On the other part of the continuum, the person in the production end must also understand that things such as the importance of maintaining best practices have an impact on how the product is marketed. This is but one example of how simple activities have become complex and challenging. otherwise

A more volatile, uncertain, complex and ambiguous world undoubtedly affects not only countries and organizations but also, and specially, the people. After all, economies, countries, organizations and institutions are abstractions supported, made or compound by people. These entities may sway, appear or disappear depending on things such as the feelings, aspirations, emotions and ideals of the people. An example of this was the institution of the tulip in the 17<sup>th</sup> century Netherlands: many people felt they could have their wealth multiplied by buying tulip bulbs, and they were paying relatively enormous prices for them, their irrational aspiration led to one of the earliest economic bubbles of modern history (MACKAY, 1932). A similar example happened in the 21<sup>st</sup> century United States: when many people started using their homes as security in order to raise funds, and many others felt that collections of obligations based on their debts were a very safe investment, all of them hoping that house prices would increase endlessly, it led to a great worldwide economic crisis (MIAN and SUFI, 2015). On the other hand, as a positive example, when some groups of people felt that many people would enjoy having personal computers, they pursued this idea and counted with favorable systems and institutions, companies such as Microsoft and Apple were created, transforming the whole world in a positive way (looking at it through a developmental perspective).

This is a work about polymathy and polymathic leadership. The part regarding polymathy involves a wider discussion in various levels of analysis. The part regarding polymathic leadership is more specific; it focuses on social interactions of people within workgroups in a business environment. This introductory larger-level debate was included for several reasons. First, the concept of polymathy – the comprehension of which is a necessary step for the development

of polymathic leadership – aims to be applicable at several levels of analysis: the individual, groups, organizations, societies, etc. Thus, the necessity of expressing the situation of the world in a large scale and the connections of it and what is happening in the realm of individuals, groups and organizations. Second, it prepares the ground for the defense of polymathic leadership as a solution that embraces and is well equipped to deal with constant change and complexity. It also hints that this solution must be consonant with the idea that different bodies of knowledge must be articulated with depth and different kinds of experiences and views must be taken into account. Lastly, it reminds us that solutions that worked well, and locally, in the past may not be the optimum solutions for the world today. Hence, a new solution ought to be flexible.

This work chooses to focus on leadership is due to the capacity of this process in assisting in solving big problems. It is arguable that the nature's "invention" of leadership is a great solution itself. Leadership may have evolved as a social strategy for solving coordination problems (VAN VUGT, 2006). It means that leadership might have emerged in order to make people work together to achieve an objective impossible for a single person alone. While in a distant past, some of our big problems might have been coordinating the hunt of a mastodon or keeping a small number of people alive and in relative harmony, today, our problems are naturally much more complex. Some of them include avoiding mass extinctions (including ours), avoiding the use of nuclear weapons, granting food and sanitation for billions of people, granting that our systems (such as the global finance system) have mechanisms to work in a connected and VUCA world, etc. Furthermore, in the near future we may have totally different and new kinds of problems, such as dealing with genetically modified (and possibly enhanced) babies, really intelligent machines and other unforeseen things that escape the imagination of the most ingenious science-fiction writers. We probably have a mismatch between what the ancestral solution (leadership) was "designed" to solve and the problems of today. If so, we cannot simply discard nature's solution and directly engineer another type of leadership. One way of dealing with this demand for a "new leadership" (BRYMAN, 1992) is, first, to deeply comprehend the process of leadership itself, its different aspects, and the different manners in which leadership can be expressed. After that, we can choose to support the leadership models that, in our understanding, are better suited to deal with the situations that

we are facing now that we will face in the future. That is, precisely, what many scholars are trying to do in the field of leadership today (DAY and ANTONAKIS, 2012, 2013). This work is one more effort in this direction.

## 1.2. OBJECTIVES

This work aims to present and structure scientifically the framework of polymathy while also utilizing this concept applied to the field of leadership studies, resulting in the approach called polymathic leadership. Thus, the first part of the work addresses topics about the explanation and development of the concept of polymathy and the second part of the work (from chapter 4 on) addresses topics related to the explanation and development of polymathic leadership.

The main objective of part one (chapter one to three):

- Develop polymathy as an operational construct in social sciences.

Intermediate and instrumental objectives in part one:

- Analyze, organize and systematize the existing literature on polymathy.
- Articulate the construct polymathy with other, well-defined, constructs of the literature
- Present a new definition and description of polymathy.

The main objective of part two (chapter four to five):

- Develop the construct of polymathic leadership.

Intermediate and instrumental objectives in part two:

- Present the construct of polymathic leadership, its definition, and description.

- Articulate polymathic leadership with the extant literature on leadership and other relevant constructs concerned.
- Demonstrate the relevance and value of polymathic leadership processes for some group processes in business settings.

In order to achieve the objectives concerning polymathic leadership, the work contains analogies and examples of polymathic leadership utilization aiming at demonstrating the value and relevance of polymathic leadership in business practices.

### **1.3. RELEVANCE**

Although polymathy is still not a very usual term, issues related to the concept of polymathy (which include pursuit of multiple interests, the development of various abilities, and the interconnectedness of different bodies of knowledge) permeate the public and scientific debate in many ways. I start by bringing newspaper articles and stories as examples of how such issues have been receiving attention by the popular media. Then, I proceed to expose how some of these questions have been approached by the scientific literature and posit some gaps that can be addressed by a better conceptualization and understanding of the constructs of polymathy and polymathic leadership.

In the first news article, the secretary of creative economy at the Brazilian Ministry of Culture criticizes the closed view and dogmatism of Brazilian universities curricula, in special post-graduation courses. She urges to us “sew together bodies of knowledge”, because the market is not after diplomas anymore; instead it seeks “what a person has aggregated that nobody else has had”. She uses herself as an example: she studied Law, Music and then had a Ph.D. in Sociology. This large array of skills and learnings is what the 21<sup>st</sup> century is demanding from professionals in her view. She concludes addressing the importance of professionalism, rather than amateurism, for successful entrepreneurship, with the construction of a strong set of competencies, especially by the small entrepreneur.



Figure 5. Interview with Cláudia Leitão in the newspaper “O GLOBO”<sup>5</sup>.

The second news article discusses how the choice of working in a specific area (such as Humanities, Biological sciences or STEM sciences) can shape the individual’s way of acting, thinking and feeling in the work environment. In the text, André Sih, a headhunter and coordinator of a post-graduation program in a Brazilian university, is interviewed. He defends that people who possess multiple abilities will stand out in this decade. He also highlights that areas linked to creativity and innovation are multidisciplinary by nature, and therefore more interesting in his point of view. Further inside, the article brings the examples of an artist who has multiple talents and conjugates his interests in his art career and a violinist of the Brazilian Symphonic Orchestra who had been a physician for thirty years. They all defend the importance of connecting different skills and bodies of knowledge.

<sup>5</sup>Interview published in the section BOA CHANCE, in O GLOBO, July 8, 2013.

O GLOBO

CLASSIFICADOS DO RIO

DOMÍNIO 23.8.2015

Boa Chance

Áreas da Ciência  
Pág. 3

AS DÚVIDAS NA HORA DE ESCOLHER A CARREIRA

Quem prioriza status e dinheiro tende a mudar de área

Concierge  
CONTRACAPA

PROFISSIONAIS CONQUISTAM NOVAS ÁREAS DE ATUAÇÃO

Missão principal é atender desejos e caprichos dos clientes

# Humanas, Biológicas ou Exatas? Eis a questão!

O modo de agir, pensar e sentir das pessoas no ambiente de trabalho muda de acordo com a área da ciência em que se faz carreira

Quem trabalha nos segmentos de engenharia e TI tem afinidade com números e é interessado em novidades tecnológicas. Aqueles que optam por direito, comunicação ou sociologia costumam dominar bem a língua escrita e falada e ter senso crítico para analisar os fatos sob pontos de vista histórico, cultural e social. Já os médicos e outros profissionais da área tendem a ter equilíbrio emocional e sensibilidade no dia a dia.

Os estereótipos não estão longe de ser verdade quando o assunto são gostos e comportamentos dos que atuam em uma das três áreas da ciência (exatas, humanas e biológicas). Mas essas diferenças vão além, segundo especialistas, e podem ser uma ferramenta útil para entender e determinar padrões de pensar, sentir e agir das pessoas no ambiente de trabalho.

Com base no depoimento espontâneo de mais de oito mil funcionários em todo o Brasil, uma pesquisa do site Love Mondays constatou diferenças de percepção entre profissionais de humanas (comercial, recursos humanos, educação e psicologia) e de exatas (finanças, engenharia e programação). A flexibilidade e a falta de reconhecimento estão entre os pontos mais elogiados e criticados, respectivamente, pelo primeiro grupo. Para o segundo, a competência técnica dos colegas de trabalho e a burocracia excessiva são, nesta ordem, os fatores mais valorizados e desprezados no ambiente corporativo.

O site também fez um levantamento que apontou diferenças no que diz respeito às relações interpessoais: os que atuam na área de humanas são os que mais admiram e gostam de seus colegas de trabalho. A maioria daqueles que pertencem a setores mais técnicos, como engenharia, construção e energia, disse que não considera o relacionamento com os colegas o fator mais positivo no trabalho.

**SIMILARIDADES**  
Na opinião da CEO do Love Mondays, Luciana Caletti, na área de humanas é frequente encontrar profissionais com maior capacidade de ponderar ideias e pessoas mais abertas a opiniões diferentes e aos diversos cami-

Figure 6. Cover of the newspaper article about multiple talents, in “O GLOBO”<sup>6</sup>.

<sup>6</sup>Article published in the section BOA CHANCE, in O GLOBO, August 23, 2015.



Domingo 23.8.2015 | Boa Chance

CONTINUAÇÃO DA PÁGINA 1

# Habilidades e talentos múltiplos

Mais importante do que gostar de uma ou outra disciplina é saber o estilo de vida que se pretende ter



**Muti Randolph.** "O mundo hoje exige multidisciplinaridade"

**Q**ualquer pessoa traz consigo diversas habilidades que podem ser utilizadas em pelo menos duas áreas da ciência, afirma Vera Lorenzo, diretora da empresa de treinamentos Foreign Affairs e autora do livro '50 coisas para fazer antes dos 50'. São os talentos multidisciplinares que levam jovens a ter dúvidas no momento de es-

trará conhecimentos que podem ser úteis para o trabalho com o qual a pessoa se identifica. Mais importante que pensar se gosta mais de matemática, história ou biologia é analisar o estilo de vida que se pretende ter e que carreiras podem proporcionar esse tipo de satisfação no futuro.

A decisão certa é uma combina-

zer vestibular para biologia antes de ingressar na faculdade de comunicação visual. Mas, ao contrário do que se pode imaginar, a base para suas ideias é mais pautada nos conhecimentos autodidatas em biologia do que na área de comunicação.

— Hoje leio mais livros sobre ciências biológicas do que aqueles relacionados

Figure 7. Inside part of the article about multiple talents, in "O GLOBO".

The last article, with the title "a single career is not satisfying anymore", starts with the topic of the anxiety to choose a profession for a lifetime when the person is sixteen and seventeen, stating that this decision is less and less determinant to the professional life of an individual, since, according to the article, people are changing careers more often. Again, the topic of multidisciplinary is addressed,



along with the testimonial of professionals who could successfully bridge different areas of knowledge.



Figure 8. “A single career is not satisfying anymore”, newspaper article in “O GLOBO”<sup>7</sup>.

These articles indicate that individuals and organizations are being caught by a change of paradigm regarding labor. Many see the necessity of more flexibility and connectedness for the part of organizations, and the development of the capacity to acquire multiple skills and integrate them for the part of the individuals as responses to this new situation.

In the scholarly literature, in the field of Organizations, a phenomenon that is receiving attention is the necessity for better communication between distinct areas, departments and sectors of the companies and their better interconnectivity can promote the performance of the company. The study of Karahanna (2013) point to the importance for the Chief Information Officer (CIO) - traditionally a professional with very hermetic and technical language and background - to develop shared cognition and shared language with other members of the Top Management Team - the CEO, CFO, CMO, COO, etc. - in order to improve the

<sup>7</sup>Article published in the section BOA CHANCE, in O GLOBO, July 20, 2014

Information Systems strategic alignment of the firm and thus achieve better financial performance. According to them, if a CIO can speak the “language of the finance”, he can better explicit the value of a very technical and important project to the CFO; if he understands more of the business itself, he can improve his communication with the CEO and better align the Information Systems’ strategy with the firm’s strategy. In other words, if the CIO can have more plurality of knowledge and learnings (characteristics of a polymath) he can be more instrumental to improve the company as a whole.

Polymathy related issues are also present in the discussions on leadership. The field of leadership studies is significantly broadening its scope; scholars from the field are rethinking the role of leadership and its relation to an increasingly complex world. They are searching for information that can help explain the phenomenon in different areas, thus gathering more pieces of the great puzzle in different places and trying to connect those pieces into more integrative and comprehensive approaches. One example of this movement is seen in this extract: “instead of conceptualizing and studying leaders and followers as distinct entities, better understanding the dynamic flows in leadership processes underscores a need for a broadened perspective on the role of a leader” (DAY and ANTONAKIS, 2013, p. 222).

This integrative effort for a better comprehension of the phenomenon of leadership is spanning disciplines as different as Biology and Evolution (VAN VUGT, 2006), Neuroscience (BOYATZIS *et al.*, 2014), Sociology (CONGER *et al.*, 2000), Ethics (CIULLA, 2004), Culture (SCHEIN, 1992; DEN HARTOG and DICKSON, 2004), Emotion and Empathy (GOLEMAN *et al.*, 2013), Gender studies (ROSENER, 1990) and Learning and Education (RAELIN, 2006). The following extract is very emphatic on the relevance of this movement:

Today leadership research is primarily conducted by psychologists, sociologists, historians, management theorists, political scientists, educators, ethicists, philosophers, and anthropologists. I have no doubt that over the next fifty years critical additions to the leadership research team will involve engineers, biologists, geneticists, and chemists. A more holistic approach to human development is on the horizon, and leadership development has traditionally trailed only a short distance behind the science of human development.

(AVOLIO, 2010, p. 747).

This movement means that, in order to deepen our understanding of the complex phenomenon of leadership, we are resorting to an increasingly number of fields and trying to articulate these different perspectives into a more comprehensive view.

This movement questions the rationale and value of the so-called *Grenzwachtturm*, or the intellectual regulators of the frontiers between disciplines (WARBURG apud BURKE, 2014). The manner in which the gateways between disciplines work today might have to be revisited in order to accommodate the necessity of more interconnectivity, but without threatening the necessary and vital depth residing in each discipline. This is a question of utmost importance for polymathy.

According to Northouse (2013, p.5), “leadership is a process whereby an individual influences a group of individuals to achieve a common goal”. It means that leadership entails interactive events - social exchanges - in which influence occurs. It also means that leadership means involving a group of people, working together, towards a common goal.

As with the world situation previously described, the way we lead and follow, as well as the manner we see the phenomenon of leadership are changing rapidly. Today, the main leadership approaches tend to be more inclusive and process-oriented rather than leader-oriented possibly a consequence of a more complex world, as posed by Day and Antonakis (2013), “challenges requiring leadership have become increasingly complex. Complex challenges are unlikely to be addressed by any one leader successfully; thus, leadership will likely require a more inclusive orientation”.

Today these issues are of utmost importance in the discussions in the field of leadership. Leadership can influence groups, organizations and societies towards new collective relations, norms, institutions, structures and systems. We can reach suitable systems for a great variety of challenges, which may work well for centuries. However, these very systems may be ill-suited to deal with new types of challenges. When such situations occur, leadership plays a key role, being the process of influencing others towards the construction of new and more suitable

systems. The system proposed in this work is polymathy as a worldview, and the pathway for individuals, groups and societies to be able to achieve the goals and exercise the behaviors related to this worldview is through polymathic leadership.

This work intends to contribute to the scientific debate by helping classifying and organizing the construct of polymathy, which has a very rich meaning and can help provide new insights about the questions outlined above; by offering models that can make sense of the varied sources of information about the phenomenon; by proposing the utilization of this construct in the context of leadership; by theorizing about its antecedents, components and possible effects; and by serving as a basis for action through the behaviors outlined by polymathic leadership.

#### **1.4. DELIMITATIONS OF THE STUDY**

This is a theoretical study that aims at developing the construct of polymathy and applying it to leadership, proposing the new construct of polymathic leadership. Due to the already large scope of these objectives, this work will not contain any empirical research. However, possible field approaches are outlined in this work, and some strategies for future empirical investigations are discussed in the last chapter.

## 2. LITERATURE REVIEW

Before discussing polymathy and polymathic leadership, this work reviews the standard literature on subjects relevant to the topic such as intelligence, creativity, culture, learning and education, and about the structuring of social exchanges that take place between the individuals, systems and structures. As seen further, these subjects (some of them closely interconnected with the construct) will influence directly or indirectly the discussion of polymathy. Another objective of this chapter is to clarify which of the different approaches of the above-mentioned concepts this work is utilizing.

### 2.1. INTELLIGENCE

Intelligence is a construct whose definition is still elusive today (HUNT, 2010). Depending on the context, a shortened, simplified definition of intelligence can be satisfying; for example, as a set of capacities that are measured via tests such as the IQ tests (AMABILE, 1996). Nonetheless, in this work, we need to dig deeper on the construction and definitions of intelligence. Linda Gottfredson (1997), concerned with the popularization of myths and misunderstandings regarding the concept of intelligence, published a statement to clarify what the scientific mainstream understands by the term “intelligence”:

Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings - “catching on,” “making sense” of things, or “figuring out” what to do.

(GOTTFREDSON, 1997, p. 13)

Intelligence, in this sense, is a broad and complex concept by nature. Such breadth, complexity and difficulty of definition and/or delimitation has led many authors to contribute to the study of the field with different, and sometimes, conflicting approaches.

Binet (2004) was a pioneer in the psychometrics of intelligence. First of all, he came to the conclusion that there was some kind of general intelligence and the field of psychology should be preoccupied first with its measurement. (VARON, 1936). It is important to note that Binet's definition of intelligence was probably inspired by another scholar from his time, Hippolyte Taine, who defined intelligence simply as "the faculty of knowing". (TAINÉ, 1870 apud VARON, 1936). When Binet tried to narrow the definition of intelligence, he came to a four-step process: (1) perceiving the external world; (2) retrieve these perceptions from the memorial state; (3) handling these perceptions and (4) meditating on them. Not satisfied with the definitions that he and his colleagues could achieve at that time, Binet concluded the following:

[. . .] we are obliged to be content with very vague notions, since, all things considered, they are worth more than false notions, and we do not hesitate to prefer them to physiological hypotheses, which while seeming more exact are really more hypothetical.

(BINET, 1872. p. 72 apud VARON, 1936. p. 36)

Naturally, neuroscience as we know it today was not available at the time when Binet and his colleagues approached the idea of intelligence. However, apart from the difficulties to define and delimitate intelligence, Binet's approach always advocated for a unified and general intelligence, an idea coherent with the general factor (or g factor) intelligence: an underlying general mental ability which could be utilized at different kinds of intelligence or mental capacity tests, involving either words, numbers, pictures or symbols (SPEARMAN, 1904).

At another point in history, the scholar Howard Gardner proposed a theory of multiple intelligences, in his theory rather than being a general ability, different intelligences would exist into different domains or types of intelligence, such as Visual-spatial, Verbal-linguistic, Logical-mathematical, Bodily-kinesthetic, Interpersonal and Intrapersonal intelligences (GARDNER, 1985). There are many criticisms to his approach, one of them on his utilization of the term intelligence when he could call those different modalities as abilities, rather than intelligences. However, a more fundamental criticism of this approach pointed by ROOT-BERNSTEIN and ROOT-BERNSTEIN (2013) is that the theory may have

confounded the tools which we use in order to produce things in the world with the actual processes of intelligence which happen within each individual mind. For instance, Albert Einstein is pictured as the quintessential Logical-mathematical thinker, however there is evidence that his ideas came from means which do not resemble Logical-mathematical skills in any way, they came from imagination, imagery, observation and even playing. Besides, there is evidence that Einstein needed help in order to translate his thoughts and ideas into signs and numbers that could be put in a formula for others to understand. In fact, what ROOT-BERNSTEIN and ROOT-BERNSTEIN (2013) propose is that the thoughts and ideas – products of an intelligent mind – happen at pre-verbal level; first they occur to the mind of the thinker via images, emotions, intuitions or bodily perceptions and after that they can be systematized and translated into some kind of formal language to be understood and communicated to others. This idea will prove vital to the following discussion of knowledge and to the conceptualization of polymathy as a cognitive process.

There are, naturally, many other schools of thought and other approaches on intelligence whose detailed study would surpass the scope of this work, albeit there are two concepts which regard cognitive abilities that will prove very useful for the understanding of polymathy and will also bridge the discussion from the concept of intelligence to knowledge.

The first of these concepts is the Cattell–Horn–Carroll theory of human cognitive abilities. In 1993, John Bissell Carroll presented his seminal treatise called *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*. This work was an effort to present in a single organized framework an empirically-based typology of the elements of human cognitive ability (MCGREW, 2009). This theory received this name because Carroll expanded on Cattell and Horn's theory of Fluid (Gf) and Crystallized Intelligence (Gc).

Carroll organized human cognitive abilities in three strata: the narrow, broad, and general cognitive abilities (CARROLL, 1993). The “very general mental capability” which Binet mentioned would be similar to Carroll's last stratum, the general intelligence. This umbrella general stratum is divided into eight broad strata, which are:

1. Fluid intelligence (Gf): a type of intelligence concerned with basic processes of reasoning and other mental activities that depend only minimally on learning and acculturation. It includes the broad ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures.
2. Crystallized intelligence (Gc): a type of intelligence concerned with mental processes that reflects not only the operation of fluid intelligence, but also the effects of experience, learning, and acculturation. It includes the *breadth* and *depth* of a person's acquired knowledge, the ability to communicate one's knowledge, and the ability to reason using previously learned experiences or procedures.
3. General memory and learning (Gy): an ability involved in tasks that call learning and memory of new content or responses.
4. Broad visual perception (Gv): an ability involved in tasks or performances that require the perception or discrimination of visual forms as such; involved only minimally, if at all, in the perception of printed language forms.
5. Broad auditory perception (Gu): an ability involved in tasks or performances that require the perception or discrimination of auditory patterns of sound or speech, particularly when such patterns present difficulties because of fine discrimination, auditory distortion, or complex musical structure.
6. Broad retrieval ability (Gr): an ability involved in tasks or performances that require that ready retrieval of concepts or items from long term memory.
7. Broad cognitive speediness (Gs): an ability involved in tasks or performances that require rapid cognitive processing of information.
8. Processing speed (Gt): an ability involved in tasks or performance that require reaction time and/or decision speed.

Finally, the narrow stratum contained more than sixty first-order elements which corresponded to more specific abilities such as sequential reasoning, reading



comprehension, memory span, speech sound recognition, etc. The whole scheme is showed in Figure 9.

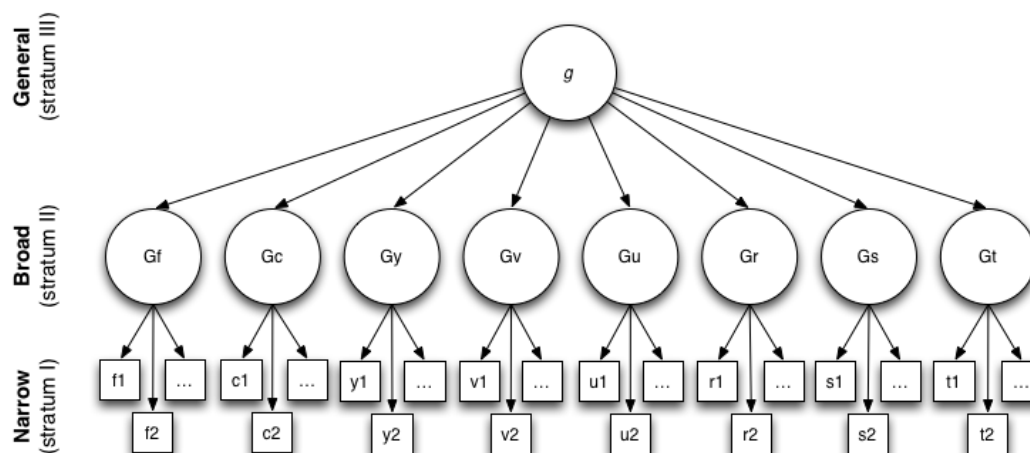


Figure 9. Carroll's Three-stratum model. Source: Carroll (1997).

Given that polymathy happens in the realm of cognitive processes and given the relevance of the C-H-C model, it is important to analyze how this model converges with the idea of polymathy. If polymathy were to be understood in a very strict sense (as accumulation of knowledge and learnings), it would appear to be a sub-aspect of the crystallized intelligence. However, if we take a wider sense of polymathy, it will involve and entangle most of the broad strata presented by Carroll, and elements that are not taken into account such as human emotion and desire, drives, motivations and inspirations and also the relationship of what happens in the realm of the individual (his cognition) with what happens in the meso realms (groups and social structures) as well as the philosophical realm (the formation of worldviews and a broader philosophy of reality), all of which are fundamental aspects of a wider sense of polymathy.

The last concept to be presented under the discussion of intelligence and cognition is in fact an effort on trying to fundamentally understand, emulate or create intelligence in machines: the Cortical Learning Algorithms. Some of these approaches are based on findings about the anatomy and structure of the brain itself: the columnar organization of the neocortex tells that the cortex is indeed a hierarchical structure, organized horizontally into six laminae (MOUNTCASTLE,

1997). Thus, scholars in Information Technology have applied this concept to artificial intelligence, creating models such as the Hierarchical Temporal Memory (HAWKINS and BLAKESLEE, 2007), where they present a memory-prediction framework which resembles some aspects of the neo-cortex itself. Since Artificial Intelligence scholars are trying to emulate complex processes which are, of course, related to intelligence, they have been very preoccupied with concepts which are also central in the discussion of polymathy. One of them is the Knowledge Representation, which is a form of representing information in a manner in which a system or entity can utilize to solve complex tasks. For DAVIS *et al.* (1993) a knowledge representation must play five distinct roles:

1. It is a surrogate, an imperfect approximation to reality, a substitute for the thing which will be represented. An entity uses this surrogate to determine consequences by thinking rather than acting, that is, by reasoning about the world rather than taking action in it.
2. It is a set of ontological commitments, that is, it depends on a set of decisions about how and what to see in the world.
3. It is a fragmentary theory of intelligent reasoning, it is fragmentary because the representation contains only part of the insight or belief that motivated it, and this insight or belief is also only a part of the complex and multifaceted phenomenon of intelligent reasoning. It can be expressed in terms of three questions: (1) What does it mean to reason intelligently?; (2) What can we infer from what we know?; and (3) What should we infer from what we know?
4. It is a medium for pragmatically efficient computation, which is related to how the whole system operates, to how information is organized in ways that facilitate making inferences.
5. It is a medium of human expression, which is the medium of expression and communication in which we can tell one another (or perhaps machines) about the world.

The findings of neuroscientists and computer scientists turn the analogy of the software of the mind (HOFSTEDE *et al.*, 2010) into a very serious and pragmatic discussion on how to make a software that is actually intelligent.

Nevertheless, right now machines stand as the perfect example of anti-polymathy: they operate as limited specialists that require the world around them to adapt to them, not the contrary, e.g.: a building machine can differentiate between different kinds of building blocks and place them in the very same spot at every time, however if the building blocks are not carefully arranged in the machine's restricted "catching space", it won't use reason to perceive that the blocks are just a few centimeters away and will engage into a senseless loop of catching emptiness every time. In other words, it cannot learn. Naturally, it does not mean that artificial systems will continue to operate in such a limited fashion for very long. Once those systems start to broaden their faculties and have more resources to make sense of, operate in and solve problems in a complex world, they will be approaching the attainment of polymathy.

## 2.2. CREATIVITY

According to Amabile (1996), "creativity is the production of novel and useful ideas in any domain". Her definition also binds closely the constructs of creativity and innovation as she defines innovation as "the successful implementation of creative ideas within an organization" (AMABILE, 1996, p. 1). In this sense, creativity is viewed both as a process and a product. The input of creativity are ideas that are processed in someone's mind, however, in order to be creative, those ideas must be expressed and also judged as appropriate and valuable (AMABILE, 1996).

Koestler (1967) wrote a seminal work on creativity. From describing and comparing many different examples of invention and discovery, Koestler concludes that they all share a common pattern which he terms "bisociation" – a blending of elements drawn from two previously unrelated matrices of thought into a new matrix of meaning by way of a process involving comparison, abstraction and categorization, analogies and metaphors. He regards as special cases of "bisociation" many different mental phenomena based on comparisons (such as analogies, metaphors, parables, allegories, jokes, identification, role-playing, acting, personification, anthropomorphism etc.). Later, cognitive scientists Gilles Fauconnier and Mark Turner would utilize Koestler's ideas to develop the theory of Conceptual Blending. According to this theory, elements and vital relations from

diverse scenarios are "blended" in a subconscious process, which is assumed to be ubiquitous to everyday thought and language. Insights obtained from these blends constitute the products of creative thinking. According to the authors, blending is a powerful basic mental operation in which input mental arrays are integrated to create a new mental array, called "the blend" (FAUCONNIER and TURNER, 2008). The theories of bisociation and conceptual blending will intersect or blend with the idea of polymathy in several ways. The capacity to associate somewhat dissimilar concepts is one of the core abilities of the polymath, which can explain some aspects of the relationship of polymathy with creativity.

Fauconnier and Turner's theory do not aim to create a typology of creativity. This kind of work was done by Kaufman and Beghetto (2009), with their Four-C model of creativity. Traditionally, scholars of the field have divided creativity in only two types: the Big-C and the Little-c (they will be explained below). Kaufman And Beghetto (2009) proposed to extend this model adding two more types of creativity: mini-c and Pro-c. Each of them guards important differences that will be retaken while discussing polymathy in the organizational context.

In their model, the first and highest-level creativity is the Big-C. That is, creativity at the most eminent level. Big-C includes accomplishments that transform fields and, generally, their impact lasts for years. The achievement of this high degree of creativity is also commonly accompanied by wide social recognition and top prizes such as the Nobel or Pulitzer prizes. Thus, it is expected Big-C creativity to be very rare and dependent on a series of aspects, including time for the maturation of potential "Big-C ideas".

The second category, which stays in the middle of the four hierarchically, is the Little-c. This creativity is the "everyday" innovation. These are "creative actions in which the non-expert may participate each day" (KAUFMAN and BEGHETTO, 2009). It may be combining ingredients in a different way to make a new dish in your kitchen, even if you are not a professional chef by any means. Kaufman and Beghetto (2009), in fact, argue that the standard definition of creativity (as new and useful ideas) is most appropriate for Little-c rather than Big-C. They allege that too much emphasis on Big-C creativity may lead to the idea that only extraordinary feats done by extremely gifted people can be considered as creative. A similar situation to what happens with polymathy.

The third category is the Mini-c. It means “novel and personally meaningful interpretation of experiences, actions, and events” (BEGHETTO and KAUFMAN, 2007). This category concerns to the creative insights and interpretations involved in learning, thus it is restricted to the realm of the individuals’ mental processes. It is similar to the notion of “individual creativity” (NIU and STERNBERG, 2006), and guards resemblances to ideas of intuitive tools for innovative thinking (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013), as the mini-c is a learning tool inherent to everyone and to the process of constructing personal knowledge and understanding (KAUFMAN and BEGHETTO, 2009).

The last category is the Pro-c creativity, concerning to the professional expertise. It is the mid-point between little-c and Big-C. It is a step further from little-c once it involves a wider social recognition of the ideas’ usefulness and newness, but it is a step shorter of the eminence characterized by the Big-c, as put by the authors:

Pro-c represents the developmental and effortful progression beyond little-c (but that has not yet attained Big-C status). Anyone who attains professional-level expertise in any creative area is likely to have attained Pro-c status.

(KAUFMAN and BEGHETTO, 2009, p. 5)

With this framework of creativity, we have two types of creativity that are also restricted to one’s private sphere (mini-c and little-c) and other two types of creativity that involve appreciation by a wider public (Pro-c and Big-c).

	Brief definition	Example	Types of measures
mini-c	Novel and personally meaningful interpretation of experiences, actions and events.	Student's new and meaningful insight about how to use a strategy learned in math class to analyze data in her science fair project.	Self-assessment, micro genetic methods.
little-c	Everyday expressions of novel and task appropriate behaviors, ideas or products.	Combining left over Italian and Thai food into a new and tasty fusion of flavors that your family enjoys.	Ratings (teachers, peers, parents); psychometric tests (e.g., Torrance tests); Consensual assessment.
Pro-c	Expert expressions of novel and meaningful behaviors, ideas or products (that exceed everyday but have not attained legendary status).	A professor's psychological study that receives an award from a professional psychological association.	Consensual assessment; peer review; prizes/honors.
Big-C	Legendary novel and meaningful accomplishments, which often redirect an entire field of study or domain.	The scientific theories of Isaac Newton. The innovative social justice work of Martin Luther King, Jr.	Major prizes/honors; historiometric measures.

Figure 10. The Four-C model of creativity.  
Source: Kaufman and Beghetto (2009).

### 2.3. CULTURE

Culture is understood as the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving (SAMOVAR *et al.*, 2014). If polymathy is developed through the social exchanges of the individual and his environment, a close relationship is expected to exist between culture and polymathy.

Cultures are not fixed, they “exist in a dynamic interchange with their environment” (GIDDENS and TURNER, 1988, p.212), so are the individuals. Polymaths, especially creative polymaths, play a determining role in constantly shaping the components of culture as well as they are constantly being influenced

by culture itself. As an author struggles to make a contribution to social knowledge by writing his work, at the very same moment he is being influenced by hundreds of other authors who passed through the same process.

Although this dynamic interchange is inevitable, there are cultures which are more favorable to the appearance of polymathic individuals than others. Curiously, astronomer and science writer Carl Sagan also thought on this question. He pointed out, in prose writing, a variable called “pressures for social conformity” as a negative moderator of polymathy, i.e. when pressures for social conformity are present, less polymaths are expected to emerge:

Because of the strong pressures for social conformity both by the government and by peer groups in the United States - and even more so in the Soviet Union, Japan and the People's Republic of China - I think that such countries are producing proportionately fewer polymaths.

(SAGAN, 2012, p.133).

Carl Sagan, although not a social scientist, was the first contemporary author (as far as my exploration reached) to write about polymathy and the different cultures, however briefly. He also pointed out to another relevant aspect: the learning and education of the polymath. He criticized traditional education as a reptilian ritualization process when it should, instead, be appealing to higher levels of our cognition, where our higher intellectual capacities and creativity can flourish.

## **2.4. STRUCTURE AND AGENCY**

The concept of polymathy that will be presented in this work defends the idea of an autonomous individual influencing (and being influenced by) groups, social systems and structures. This view is in fact grounded on Anthony Giddens's Structuration Theory (GIDDENS, 1984). He proposed a model whereby neither the agent (the individual) nor the structures are unequivocally predominant over one another; the creation and reproduction of social systems are negotiated between autonomous agents and the existent structures which influence them, in turn these autonomous agents have the capacity to influence, arrange and rearrange the very same structures and social systems. In this theory the social systems are never enclosed, they are ever changing as a result of the clash between agents and

structures, as asserted by the author: “(the reproduction of social systems) are an active constituting process, accomplished by, and consisting in, the doings of active subjects” (GIDDENS, 2013, p.128).

The theory of Structuration has a deep and comprehensive reach. It served as a theoretical basis for the work of DESANCTIS and POOLE (1994), who devised the theory of Adaptative Structuration. Their theory was utilized as a lens to analyze a variety of business situations such as the impact of the introduction of new technological solutions on the structure of the organizations, and its influence on processes, procedures, norms and even on the identity of the firms (DESANCTIS and POOLE, 1997).

Structuration theory, thus, can also serve as a lens to analyze the influence of the polymathic individual in his social systems. It seems to intersect with the concept of leadership, i.e. the process whereby an individual influences a group of individuals to achieve a common goal (NORTHHOUSE, 2013, p.5). While some authors, e.g. Genovese (2013), chose to focus on the figure of the leader – their development into a more polished and a more suitable figure to face the uncertainties and complexities of our time –, in this work, I intend to focus on the quality of the processes, traits and structures that the leader will promote on their groups and environment. I defend that the social systems and structures in organizations can be more or less consonant with the ideas of polymathy, which, in turn, will reflect on different (and more desirable) qualities of group processes, structures and norms. The view I propose for polymathic leadership is consonant with a conceptualization of leadership focused on *processes* rather than the leader’s traits or skills. (KOTTER, 2008; DAY and ANTONAKIS, 2011; NORTHHOUSE, 2013).

## 2.5. LEARNING AND EDUCATION

As with many concepts seen in this work, learning does not possess a universally consensual meaning (DOMJAN, 2014). Nonetheless, it is possible to point out important elements that make for a common idea of what learning is. Thus, I start the discussion bringing three different definitions of learning:



Learning is a change in our capacity for behavior, as a result of particular kinds of experiences.

(LIEBERMAN, 2011, p.40)

Learning is an enduring change in the mechanisms of behavior involving specific stimuli and/or responses that results from prior experience with those or similar stimuli and responses.

(DOMJAN, 2014, p.14).

[Human learning is]...the combination of processes whereby the whole person - body (genetic, physical, and biological) and mind (knowledge, skills, attitudes, values, emotions, beliefs, and senses): experiences a social situation, the perceived content of which is then transformed cognitively, emotionally, or practically (or through any combination) and integrated into the person's individual biography resulting in a changed (or more experienced) person.

(JARVIS, 2012, p.13)

It is clear that learning involves some kind of input which is then processed cognitively, emotionally, or practically and finally results in a change in the individual. It is also clear, by the core definitions of polymathy, that no one is born a polymath, this attribution must be attained. Taking Jarvis's (2012) definition, a non polymathic person must pass through uncountable experiences of learning in order to be transformed into a changed person who can be considered a polymath.

Domjan's definition is closer to the idea of the *software of the mind* presented by Hofstede (2010). Hofstede poses that patterns of thinking, feeling and potential acting which one acquires during his exposure to the social environment work are somewhat similar to computer software programs. The same analogy could be used to say that learning is a change of one's programming regarding the response to certain stimuli. The mind, however, runs an astounding number of programs, many of them interconnected and simultaneously. An operation system runs on "soft" and "hard" types of information; the hard type of information has a structural emphasis while the soft type has a procedural emphasis. Polymathy needs both of them; patterns of data, memories, information and knowledge must be stored and retrieved (hard type) while procedures to call them must be executed

with efficacy (soft type). When a system is capable of amalgamating this in a broad, deep, connected and efficacious way it has achieved the condition of polymathy.

In this sense, it is possible to understand polymathy as a *result condition* (*Zustand*). An idea that guards resemblance with the German concept of *Bildung* and the *gebildete* individual. *Bildung* is the German word for education, but with a richness and profoundness of concept that is absent in the English term “education”. The concept of *Bildung* refers to the process (*Prozess*) of forming and the condition (*Zustand*) of the formed individual consciousness which is constituted by one’s reflective awareness (*reflektierte Verhältnis*) of the self (*zu sich*), of his relationship to others (*zu anderen*) and with the world (*zur Welt*) (PEUKERT, 2002; FELLEENZ, 2015).

This concept has been developed by a long lineage of philosophers and it involves deep philosophical discussions. Nevertheless, for this work, it is important to bring a concept of education that not only embeds the learning and acquisition of skills and bodies of knowledge but also involves the role of the free and educated (*gebildete*) individual as an agent of change and transformation in the society:

Bildung should then indeed not be understood as the mere appropriation of the stores of knowledge, the interpretations and the rules of a present cultural form of life. It should rather be understood as the ability to go beyond the present state of affairs and to transform the structures and prevailing rules of this form of life, should it in any way endanger itself.

(PEUKERT, 2002, p.422)

Polymathy can be related to *Bildung* in at least two ways: polymathy as the acquisition of broad knowledge and learnings can be seen as a necessary step for *bildung*; or polymathy can be a complementary philosophy to *Bildung*, with the two ideas working together: on the one hand, *Bildung* (the process of forming one’s reflective awareness of the self, of his relationship to others and with the world) is a necessity for polymathy, and on the other hand the truly educated individual (*gebildete*) can only be formed through the execution of polymathic processes and behaviors such as keeping an open mind to a wide variety of experiences and challenging one’s existing mental structures and beliefs with the application of critique. The philosopher Paul Fairfield exposed the link of polymathic qualities

and *Bildung* while writing about the influence of Hegel in John Dewey's philosophy:

A harmonization of the individual's mind and heart and a unification of society evidence this maturation [*Bildung*]. Harmonization of the self is achieved through a *wide variety of experiences and challenges to the individual's accepted beliefs*; in Hegel's writings, these challenges entail agonizing alienation from one's "natural consciousness" that leads to a reunification and development of the self. Similarly, although social unity requires well-formed institutions, it also requires a diversity *of individuals with the freedom to develop a wide variety of talents and abilities*.

(FAIRFIELD *et al.*, 2010, p.53, emphasis added)

Thus, whichever sense of polymathy considered is entangled with the idea of learning and the greater concept of *Bildung*. A polymath who is transforming the world is educated, and a fully educated person must have some degree of polymathy or at least must display some polymathic behaviors.

### 3. POLYMATHY: CONSTRUCT DEVELOPMENT

Polymathy is still an obscure concept (CHRISOMALIS, 2015). Due to this situation, before presenting propositions about the nature or the effects of polymathy, it is necessary to present a clear, precise and articulated definition and description of the construct. This effort starts with the very roots of the term, the etymology of word, then proceeds to a historical overview of how polymathy has been referred to and documented since its appearance in a 17<sup>th</sup> century treaty. This section aims to contextualize polymathy in the different eras and provide more resources to study the phenomenon. After that, since the academic literature on polymathy is yet scarce, the analysis proceeds to an exploration of the popular and scholarly literature about polymathy, leading to a categorization of the different meanings of polymathy. This will lead to a classification system for the perspectives on polymathy and the development of an operational construct in the social sciences.

#### 3.1. ETYMOLOGY AND HISTORICAL OVERVIEW

##### Etymological considerations

The modern usage of the word polymathy in the English language dates from the 17<sup>th</sup> century (HARPER, 2014), but its origin can be traced back to the old Hellenic world. The word is formed by two radicals from Ancient Greek; *polys*, meaning “much” or “various”, plus the root of *manthanein*, meaning “to learn” or “that which is learnt” (HARPER, 2014). Therefore, polymathy implies the idea of “much or varied knowledge or learning”. Of the two root words, the first one, *Poly* (*πολυ*), offers very little ambiguity of meaning, and it is a very common prefix for many modern English words such as polygon, polytheism, polyester, polymorphic, etc. On the other hand, the second root word, *mathema* (*μάθημα*), may lead to different understandings, a *mathema* can be a lesson, a subject (an area of knowledge to be taught) or an experience, and it can also mean knowledge gained from an incident in life (HARPER, 2014). All these meanings, despite their subtle differences, have in common the idea of learning.

Besides that, some words that contain *mathema* as root had its original meaning totally transformed. The word mathematician is a great example: from Ancient Greek, *μαθηματικός* (*mathēmatikós*) would mean “fond of learning” (WIKITIONARY, 2015), but somehow the sense of this word became restrict only to the field of learning we now understand as Mathematics.

Later in this work, the discussion on the meaning of *mathema* is retrieved for the development of a new view on polymathy.

## Historical Overview

Even though the term was utilized in ancient texts from the old Hellenic world, this review begins in the 17<sup>th</sup> century, when the first known treaty on polymathy was written and less obscure material on the topic starts to appear. While researching about the use of the word polymathy by the early Hellenic philosophers, all sources obtained were fragments. Among them, fragments from Heraclitus of Ephesus, ironically nicknamed “the obscure” (HOCKEY *et al.*, 2007). Heraclitus has very deep material, being the father of an important philosophical school. The study, in depth, of how polymathy is understood by Heraclitus escapes from the scope of this work. However, it can be said that he does not speak very fondly of polymathy, he framed it as the mere piling up of bits of knowledge and then regarded it as abominable, since it would divert man from the “one, eternal and divine Truth” (ROBIN, 2013 p. 75). It appears that polymathy, to him, does not include a strong sense of depth and it leads to the pursuit of many, sometimes hedonistic, things, while for the Greek author, the truth would lie in understanding how everything manifests in a single “eternal and divine Truth”. It is seen, however, that the majority of thinkers who followed him had very different ideas about polymathy.

### 17<sup>th</sup> century

The first modern treaty on polymathy, *De polymathia tractatio*, was published in 1603, in Latin (including many passages in Greek), by the Hamburger writer Johann von Wower (BURKE, 2014). It was not by chance that such work appeared on this specific period. Polymathy was one among the many Renaissance

ideals, a period where an influential part of the Western Europe was especially concerned about achieving its own excellence through arts, reasoning and the study of ancient classical texts. The Renaissance belief that Man could (and should) achieve excellence in the most diverse domains was a fertile ground for the flourishing of polymathy.

It is important to remember that the institutionalized compartmentalization of knowledge and sciences we take for granted today (such as Biology, Chemistry, Physics, etc.) did not exist at that time (DABARS and UNIVERSITY OF CALIFORNIA, 2008); in fact, much of the knowledge we today call science was still being constructed and consolidated in that era (DAMPIER and COHEN, 1948). However, things were starting to change at an accelerated rate; a great catalyst for this change were new groundbreaking ideas such as Copernicus's model of the universe (KUHN, 1957) and inventions such as Gutenberg's printing press (EISENSTEIN, 2005). Hence, possibly due to this burst of optimism generated by formal knowledge being more accessible to people outside the walls of the monasteries for the first time in centuries, the idea of grasping the whole scope of academic knowledge from the western world seemed like an achievable dream. It is important to contextualize that, for contemporary standards, the volume of knowledge which even a highly educated man of that time would expect to encounter was very limited. This limitation, as ironic as it may sound, was a major component that made the dream of knowing everything possible. Another point is that the Renaissance concept of "knowing everything" did not encompass all kinds of knowledge. For instance, it tended to disregard non-academic knowing, which accounts for many sources of non-academic knowledge such as experiences, and bodily and athletic skills.

The Renaissance is often considered a period in which medieval ideas were despised. However, a more careful examination will show that the line that "divided" those periods are much subtler than it appears. For instance, concepts born in a medieval context were of central relevance for the emergence of the 17<sup>th</sup> century idea of polymathy: the notion of the liberal arts (i.e. education considered essential for a free person) and its seven branches of knowledge that initiate the young into a life of learning. These branches of knowledge were the sum of the medievalist concepts of the *Trivium* and the *Quadrivium*. The *Trivium*, or "the three

ways” comprised of three subjects which were understood as pertaining to the mind: (1) logic, the art of thinking; (2) grammar, the art of inventing and combining symbols; and (3) rhetoric, the art of communication (JOSEPH and MCGLINN, 2002). The *Quadrivium* consisted of the four arts of quantity pertaining to the matter: (1) arithmetic, the theory of number; (2) music, the application of the theory of number; (3) geometry, the theory of space; and (4) astronomy, the application of the theory of space (JOSEPH and MCGLINN, 2002).

The importance of the *Trivium* and *Quadrivium* to the Renaissance polymathy can be exemplified by the picture at the beginning of Wower’s book *De polymathia tractatio* (Figure 11). In this figure, a boy carries a sphere in whose center lays a triangle with the subjects of the *trivium*. The other disciplines (ancient studies, theoretical philosophy, practical philosophy, medicine, jurisprudence and theology) revolve around it in this specific order. Above the sphere and the boy, there is a sign with the writing: “this is the burden of this work, philologists” (*Hoc Onus Hoc Opus Philologi*).

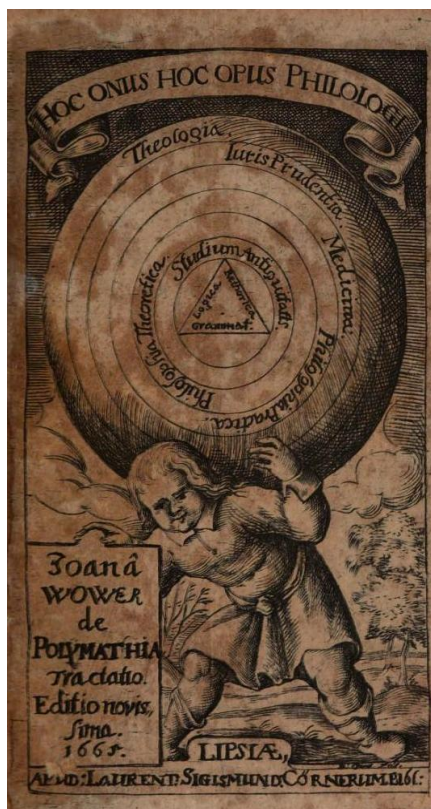


Figure 11. Cover of Wower’s *De polymathia tractatio*.

Source: Wower (1665).

It is seen that already in the early 17<sup>th</sup> century, the effort of being a polymath was comparable to Atlas's burden (WOWER, 1665), the Greek titan who was condemned to eternally carry the heavens above his shoulders, showing once more the influence of the Classical Hellenic thought in Wower's work. Although a great burden, the idea of holding the entire "sphere of knowledge" (whereby only academic knowledge was emphasized, as discussed) was still thought to be possible. A major concept that contributed to the possibility to aspire the condition of "universal man" (sic) also appears in the medieval *Trivium*: greater and more complex domains of knowledge are built on common foundations. It was in the *zeitgeist* of Renaissance that by conjugating the study the classic Latin and Greek texts, the careful observation of phenomena, the testing of hypotheses, plus one's systemized use of reason, it would be possible to engage in the path of the whole knowledge and become a true universal man.

This idea of grasping the whole knowledge of the world gave birth to another movement called Encyclopedism. Though somewhat similar to polymathy, their scopes are clearly different. Encyclopedism is related to collection, classification and compilation of knowledge – it is a technical approach, often a taxonomical problem, thus, more specific and strict –, while polymathy, even in the 16<sup>th</sup> and 17<sup>th</sup> centuries, tended to have a wider approach: an attempt to explain knowledge globally; a way in which different subjects or domains are connected, combined and explained on a common ground or with common principles (DOUKAS, 2011).

In sum, the term polymathy arose in a context of renewed anthropocentrism during the Renaissance; a context of a strong belief in the capacities of Man, especially in the development of the human mind and knowledge through reasoning. The ties of polymathy and the period of Renaissance remain strong until today: the term "Renaissance Man" has become a synonym of polymath in many contexts.

### *18<sup>th</sup> and 19<sup>th</sup> centuries*

As the 18<sup>th</sup> century arrived, the Renaissance ideal of polymathy encountered more and more obstacles to its survival. Intercontinental travels, the



maturation of scientific method and the flourishing of technical knowledge which led to groundbreaking innovations such as Hargreaves's Spinning Jenny (circa 1764), Watt's Steam Engine (circa 1776) and Edison's carbon filament lamps (circa 1878) contributed to a complete transformation and amplification of Man's knowledge at an unseen rate: while in the year 1500 a large enough library could contain a great deal of the western's world formal and explicit knowledge, the modern era deluged the western world with information and knowledge in a scale, depth, plurality and comprehensiveness which made it impossible for a single man to even be superficially acquainted with all the new information which was being created during his lifetime, let alone be capable of deeply understanding it. If the concept of polymathy was to remain linked to the idea of a man who could "know everything" it would readily become unsustainable. "Knowing everything" had become an antiquated idea, a laughable impossibility for the modern world. Still, some ideas of polymathy and some so-called polymaths still remained in this era, particularly regarding those special individuals who made contributions to more than a single domain of the human knowledge. If, by the one hand, the complexity and breadth of knowledge made it impossible to "know it all", the opportunities brought from the development of modern technology and modern types of social organization gave many more men the chance of becoming very knowledgeable in various domains, besides new ranges of experiences, travels, and contact with different products and cultures, enriching immensely a person's intellect. The "first American" Benjamin Franklin is one of the best examples of a polymath and his biography can provide an idea of what a man with multiples interests and multiples talents could do in the environment of the United States East Coast in the 18<sup>th</sup> century if not held by deterrent conditions such as the pressure to submission, extreme poverty, sickness, slavery, etc.

Franklin could exercise his creativity in many distant domains (he was an author, printer, political theorist, politician, postmaster, scientist, inventor, civic activist, statesman, and diplomat) since he possessed the qualities necessary and his environment provided the means for him to pursue his interests. Not so many people were as fortunate as him to have such access in a period when some more fundamental discoveries in science were still being made. The modern age saw the organization and crystallization of knowledge in well-defined disciplines. It saw the

institutionalization of the teaching and practicing of these disciplines and, along with it, the advent of gatekeepers guarding the entrance to the territory of these subjects or, as put by Aby Warburg, the *Grenzwachturm* (BURKE, 2014). The 18<sup>th</sup> and 19<sup>th</sup> centuries are regarded as the last period in which individuals who contributed to very distant domains were not so rare (KAUFMAN *et al.*, 2010).

## 20<sup>th</sup> century

In the twentieth century, the word polymathy fell into obscurity whereas another term had an explosive growth: expertise. The contrasting number of mentions to the nouns “polymath” and “expert” (and their derived words) in publications in Google books’ database from the year 1800 to 2000 highlights this trend (Figure 12).

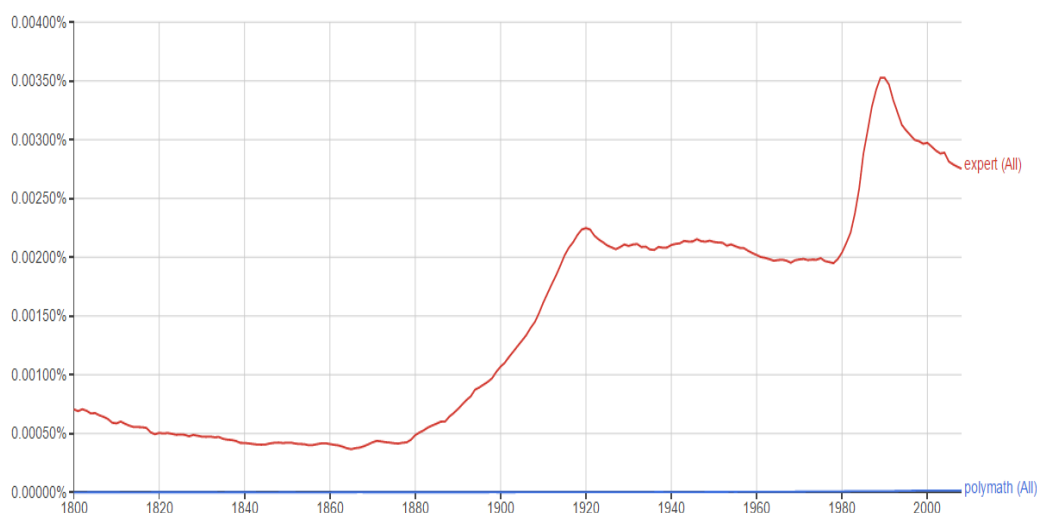


Figure 12. Counts of “expert” and “polymath” from 1800 to 2008.<sup>8</sup>

Source: Google Books Ngram Viewer (2015).

Specialization and expertise were the hallmarks of the 20<sup>th</sup> century. The division of labor that started with the industrial revolution reached new heights in the end of the 19<sup>th</sup> century and the beginning of the 20<sup>th</sup>. Organizational models such as Taylorism and Fordism had been very successful in generating

<sup>8</sup>A graph of the relative usage of the words “expert” and “polymath” by Ngram Viewer, a tool from Google Inc. which counts the appearances of words and their related percentage to books registered in their database in each period of time.

unimaginable output and raising productivity to new standards (MATTHEWS, 1996).

In this environment, the idea of someone being capable of knowing everything – the ideal universal man – would be considered utterly unrealistic. Knowledge had become so vast and so complex that only with a high degree of specialization one could expect to make new contributions. The world of labor, a major source of social exchanges, suffered the very same pressures for specialized skills and knowledge. The kind of organization of labor, which started in the 19<sup>th</sup> century and peaked in the 20<sup>th</sup> still evokes heated discussions. For some thinkers, hyper-specialization and the fragmentation of knowledge were collateral effects of a positive change that produced knowledge, growth, riches and a standard of living unrivaled in our history. However, for others, this new way of organizing labor and the production is target of heavy criticism. One of these authors, Karl Marx, criticized this process still in its dawn, in the 19<sup>th</sup> century:

For as soon as the distribution of labour comes into being, each man has a particular, exclusive sphere of activity, which is forced upon him and from which he cannot escape. He is a hunter, a fisherman, a herdsman, or a critical critic, and must remain so if he does not want to lose his means of livelihood.

(MARX *et al.*, 1972, p.53).

Eminent polymaths who were creative in more than one domain were rare in this period, as expected from the configuration of the new workplace. Discoveries now happened within specific domains; only highly learned individuals in those increasingly complex and vast domains could pass through all the stages required to achieve eminent creativity in the field. Thus, it was expected that broad-range creative polymaths such as Da Vinci or Benjamin Franklin would not have had the same incentives and open possibilities for producing creative work in many different areas during the 20<sup>th</sup> century. Possibly, most of the discoveries that could be made in places with little structure, such as one's garage, garden, or personal lab, had already been made. From the 20<sup>th</sup> century on, most of the new discoveries would require highly complex and coordinated systems and structures such as a research and development lab from a corporation.

Regarding the literature on polymathy in this period, most of the 20<sup>th</sup> century texts that had used words related to polymathy, such as “polymath”, were

not about the construct of polymathy itself. They were mainly biographies. Some of them were about 20<sup>th</sup> century smaller-range polymaths, especially scientists with interests in other fields, such as Schrodinger (KILMISTER, 1987), Gamow (HARPER, 2001), and others were about wider range polymaths from the past: the Renaissance, the Victorian period and other eras. Figure 3 shows how the relative use of the term ‘polymath’, which characterizes an individual as polymathic, is much more pronounced than the adjective ‘polymathic’ or the noun ‘polymathy’. The latter noun would be of natural and expected usage if the aim of the text were to discuss polymathy instead of the lives of polymaths.

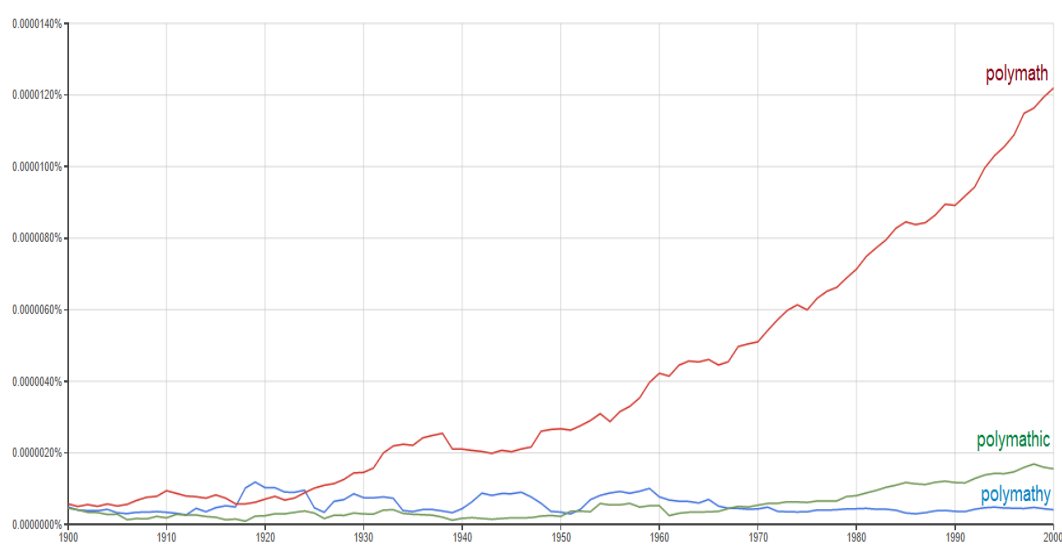


Figure 13. Relative uses of polymath, polymathic and polymathy in the 20<sup>th</sup> century.

Source: Google Books Ngram Viewer (2015).

### 3.2. EXPLORATION OF THE LITERATURE ON POLYMATHY

In this section, I conduct a review of the scholarly and popular literature about polymathy. The term has remained an obscure concept (CHRISOMALIS, 2015), with very few publications debating the polymathy specifically, especially in the academic literature. This obscurity becomes even more flagrant when we consider the usage of the two related nouns: polymathy and polymath - “polymathy” is so obscure that even in the *Dictionary of Obscure Words* just the other noun (polymath) is cited (CHRISOMALIS, 2015). Thus, with the aim to include more variety of usages and understandings about polymathy, I did not restrict the review to academic texts only. Rather, I included utilizations of the term in the popular literature, dictionaries, encyclopedias, web pages, blogs, etc. This exploration of the literature, though extensive, is not exhaustive; there may be other views, probably with less relevance, in other sources. Besides that, at least one view on polymathy was intentionally left out of this work<sup>9</sup>.

#### 3.2.1 Research on scientific databases

My research in the SCOPUS, SciELO International, Web of Science, ScienceDirect, PsycINFO, JSTOR, Business Source Premier, Directory of Open Access Journals, E-brary, open science directory, PsycArticle, SAGE Journals Online and WILEY Interscience databases utilizing the keywords “polymath”, “polymathy” and “polymathic” yielded very few results of articles and books concerning specifically to the development of the concept. The majority of the results are articles, references and extracts of biographical works about individuals who were considered to be polymaths. Some examples are: “The last man who knew everything: Thomas Young, the anonymous polymath who proved Newton wrong...” (ROBINSON, 2006); “Ronald Ross: malariologist and polymath: a biography” (NYE and GIBSON, 1997); “Schrödinger: Centenary celebration of a

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<sup>9</sup>One example of a different utilization of polymathy that is not covered by this work is polymathy in sports. This meaning is generally used by the English. Although this specific conception is not very relevant for the objective of this work, it may prove noteworthy as to enrich the panorama of the current utilizations of the term. A sports polymath is a person who excels in more than one sport (RAJEEV, 2015). He can sometimes be attributed supernatural capacities or talents, as in this example: a “multi-talented sporting demi-God” (INDEPENDENT, 2006).

polymath” (KILMISTER, 1987). Rarer were the works which included a debate about polymathy itself, even though it might not be the main topic of the text, such as: “A Social History of Knowledge II: From the Encyclopaedia to Wikipedia” (BURKE, 2014); “The information professional of the future: polymath or dinosaur?” (BROADY-PRESTON, 2010); and “The last days of the polymath” (CARR, 2009). When polymathy was addressed, it was generally in the light of the discussion about creativity (ROOT-BERNSTEIN *et al.*, 1995; ROOT-BERNSTEIN, 1997; KAUFMANN and TÖDTLING, 2001; ROOT-BERNSTEIN and SHAVININA, 2003; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2004; KAUFMAN *et al.*, 2010; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013).

The term polymath seems much more popular than polymathy because, as the examination of the literature has shown, it is more common to use the term to characterize someone, simply stating he or she is a polymath, than to discuss polymathy itself. As far as my exploration could reach, two contemporary scholars seem to be seminal about the rekindling of the academic discussion on polymathy: Robert Root-Bernstein and James Kaufman. The approaches of these authors are fundamental for the following development of polymathy in this work.

#### *Root-Bernstein's approach*

Root-Bernstein was the most prolific author to dissert specifically about polymathy since the end of the 20<sup>th</sup> century, as far as the literature review conducted in this study concerned. Root-Bernstein and his colleagues' approach presents multiple arguments for the development of avocations, broad interests and an interdisciplinary thinking in order to be creative in multiple areas (ROOT-BERNSTEIN *et al.*, 1995; ROOT-BERNSTEIN, 1997; ROOT-BERNSTEIN and SHAVININA, 2003; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2004; ROOT-BERNSTEIN *et al.*, 2008; ROOT-BERNSTEIN, 2009; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013).

Root-Bernstein's approach defends the universality of the creative process; the creative ideas or insights that lead to creative products occur not as products pertaining to particular disciplines, but as emotions, intuitions, images and bodily feelings at a pre-verbal state (ROOT-BERNSTEIN and ROOT-

BERNSTEIN, 2013). Thus, they cannot be disciplinary in this stage. The link of this idea with polymathy is the following: as polymathic individuals have a larger number of avocations, they pursue many different activities and they have broader interests, it leads to their development of a greater and wider repertoire of mental tools. These plural experiences provide them with different, new possibilities to conjure them into creative products involving different domains of knowledge (ROOT-BERNSTEIN and SHAVININA, 2003; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013). In fact, in the mind of a creative, polymathic individual it does not matter much how society divides the products of creativity in different disciplines. They operate connecting emotions, intuitions, images and feelings, and then it takes shape into a disciplinary product, which may need disciplinary tools, such as the knowledge of mathematics, musical composition, chemistry, poetry, etc., in order to become finished and “disciplinary” products.

According to the authors, the capacity of manipulating preverbal insights, feelings and ideas is mediated by what they called “the thirteen thinking tools” (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013). Those involve very comprehensive and universal mental capacities which occur pre-verbally and pre-logically, they are: (1) observing; (2) imaging; (3) abstracting; (4) pattern recognizing; (5) pattern forming; (6) analogizing; (7) bodily kinesthetic thinking; (8) empathizing; (9) dimensional thinking; (10) modeling; (11) playing; (12) transforming; and (13) synthesizing.

Root-Bernstein’s approach prominently defends the role of inter-connectivity and connected thinking as a decisive trait of polymathy:

These [the polymaths] were whole people, not specialists. They made contributions to particular disciplines because of, not in spite of, their broad interests. They were pioneers, generalists, who *bridged areas* of expertise and pulled together disparate areas of knowledge. [...] Polymaths master their activities to a significant degree and perceive the *fundamental connections* between them.

(ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013, p.322-323, emphasis added).

The idea that connectedness (the capacity to perceive connections between different elements and articulate them) is an element of polymathic thinking is vital for the later development of the construct in this work.

### *Kaufman's approach*

Kaufman and colleagues make for the second group of scholars who are debating about polymathy. However, they do not address the construct as directly as the first group. Polymathy is, mostly, inserted as an element in the discussion about creativity (KAUFMAN *et al.*, 2010).

Regarding creativity, Kaufman and colleagues present a model called the amusement park theoretical model. It proposes that there are some pre-requisites in order to be creative in any domain in the same sense as you have some basic requirements in order to enter an amusement park. The analogy proceeds as the following: first you must have the ticket and a way to get to the park; similarly you must first have some degree of intelligence and motivation, as well as an environment in which one can focus on being creative. Once you are in the park, you can visit some of the general thematic areas and, inside them, there are still sections in which you can go, suchlike, in order to be creative in a specific area you must first enter and understand the upper-level domain and, after that, delve into the sub-areas of this domain. Kaufman and his colleagues make an important contribution to the discussion of polymathy by articulating the different qualities of polymaths very precisely; most of the polymaths are creative in different micro-domains but which belong to the same greater domain in a hierarchy, however some polymaths are able to be creative in very distant micro-domains, and those would be the pinnacle of polymaths, as put by Kaufman *et al.* (2010, p. 384):

We believe that many interesting creative polymaths can be uncovered within these strange connections. Certainly, in examining people who are creative in two micro-domains, these areas are typically within the same overall general domain. Examples can be found easily; consider the late Jim Carroll. He was a memoirist (*The Basketball Diaries*), a poet, and a punk rock singer ("People Who Died") known for his provocative lyrics. His micro-domains are distinct, but they all center on his possession of a strong narrative voice. Those rare people who are creative in dissimilar areas – like Franklin's accomplishment in politics, science, inventing, journalism, and literature – represent the pinnacle of creative polymathy.

In the paper "Creativity polymathy: What Benjamin Franklin can teach your kindergartener" (KAUFMAN *et al.*, 2010), Kaufman and colleagues gave a great contribution to the topic by delving into the kinds of personality traits that



might antecede polymathy and the types of environments that can foster or undermine the development of polymathic individuals. These subjects will be retrieved in later sections.

### **3.2.2 Non-scientific approaches on polymathy**

I divided the non-scientific approaches on polymathy in two categories: (a) popular literature, texts that do not contain or seek a high degree of scientific formality, and (b) semi or quasi-academic literature - texts that contain some features of scientific formality, but are not completely academic. In both categories, the levels in which the texts are preoccupied with the quality, integrity and substance of the information vary; nonetheless, the latter category is more robust compared to the former.

#### **Popular literature**

I searched for popular literature about polymathy using libraries from Amazon.com and Google books. Most of my results in this category were books that fit in the “self-help” genre. They are generally intended for a large audience of lay people in the subject who wish to improve aspects of their lives. It, however, does not mean that these works are void of contributions to an academic dissertation; they aggregate important value in at least two ways: by shedding different lights on how polymathy is viewed and understood in contemporary times, and by displaying different strategies to achieve polymathy.

In this section, I review three of these very recent works and comment on their views and contributions.

The first work is “How To Be A Renaissance Man” (HARDCASTLE, 2014). It is a very short book (25 pages) that aims at helping people develop new skills, gain new and varied points of view, and become more knowledgeable. Despite the length, the book touches on some topics that will be very important in the development of polymathy and polymathic leadership. One of them is the balanced processing of information (AVOLIO and GARDNER, 2005;

GARDNER *et al.*, 2005; LUTHANS *et al.*, 2006). The author states: “part of being smart is the ability to analyze fully and come back with a balanced decision” (HARDCASTLE, 2014, p. 17). For this, developing the qualities of a Renaissance Man (polymath) is necessary. The author does not provide a clear definition of a Renaissance Man, but he hints that it involves doing a variety of activities well, having a “broad mind”, having a wide range of experiences such as travelling and volunteering, and trying different things. Most of the book is about strategies to achieve that.

The second work is “Jack of All Trades: How to Master All Sorts of Skills in Short Amount of Time and Be a Modern Renaissance Person” (INSTANT-SERIES, 2015). This book does not have a single author, it is part of a series called Instant-series. This series, whose commercial motto is “Instant Solutions FOR Instant Problems TO Instant Results” aims to provide immediate solutions for common problems. Most of the book is about strategies to develop one’s capacity to learn and retain information, to improve self-understanding and to stimulate the mind.

There are, though, various arguments for polymathy in this book, some of them are practical and some are philosophical in nature. First, polymathy is seen as a response to some human anxieties, anguishes and desires, it would be a way to “reach the end of your existence with no regrets or lingering curiosity” (p. 16). Second, polymathy is appealing to the intellect: they defend it is rewarding to learn new skills and feel accomplished in various subjects. Third, polymathy is a protection in a similar fashion to diversifying investments in the stock exchange or investing in trade options, i.e. relying in only one skill is dangerous if the situation changes. Fourth, learning a new skill or gaining new knowledge enhances abilities in many different areas.

Regarding the definition of polymathy, the authors use the expression “Renaissance man” interchangeably with polymath, and they describe these as “people who devote their lives to the pursuit of knowledge and skill acquisition” (p. 32). Polymathy is also referred to as the development of multiple specialties. The book clearly emphasizes the practical aspects of polymathy, i.e. having applicable skills, performing tasks well and displaying know-how in many areas.

The idea of polymathy is attached to profundity, the authors put “the desire to discover something profound” (p.36) as the main antecedent trait of both geniuses and polymaths. They also state that being superficially skilled or knowing superficially is not polymathy (p. 9, 24, 28, 128).

Finally, the book discusses the trade-off between being a specialist and a generalist, and how to become a polymath with a limited amount of time. The answer lies on being more effective in many aspects of life, especially at learning.

The third work is “The Renaissance Soul: How to Make Your Passions Your Life - a Creative and Practical Guide” (LOBENSTINE, 2013). It shares some similarities with the previous work. First, they defend the development of polymathy as a life philosophy, i.e. achieving polymathy is both a life-long process and objective, thus it is necessary to have a set of beliefs, views, values and practices that are resonant with that. Second, they devote considerable part of the work aiming at the development of self-understanding (although it might be a general trait of this literature genre). Third, they cover the topic of effective time management and the trade-off of specialism and generalism. Forth, they view polymathy as anteceded by a desire and love of learning and knowledge in the most varied fields.

Lobenstine’s work, however, is longer, denser and offers different insights from the work by Instant-Series. In addition, the problem addressed by this book is different; the angst that people with many passions and interests suffer when faced with the decision to choose one career path. The “Renaissance souls”, as the book describes, are:

people whose preference is for variety over concentration; whose process involves widening their options rather than narrowing their choices as they go with their energy flow, and whose success involves moving on to something different rather than going on and doing more of the same.

(LOBENSTINE, 2013, p.19)

They are people with many (and sometimes volatile) passions. They change interests frequently and do not feel comfortable with the idea of committing

themselves with a single career path. Nonetheless, they face pressures (either internal or social) to stick to a single career path and it causes all sorts of problems. This discussion covers many topics: it is existential, social, professional and philosophical.

Thus, the focus of the book is on such individual characteristics and how to lead successful life in current's environment by embracing, rather than disregarding, these traits. It is an indirect approach on polymathy, but that addresses problems related to the topic.

### **Semi or quasi-academic literature on polymathy**

In this section, I review works that, despite their differences, are somewhere between popular and academic literature.

The first work in this category is “Rebuilding the Polymath – and other insights into the World of Innovation” (SPALDING and GIBSON, 2013). As the authors put, this is a manifesto rather than an academic text or a popular science book. The aim of the work is to defend and support a new paradigm whereby individuals can pursue their interests, be more innovative and, thus, “release a torrent of productive innovation that the lives of every human being for the better” (p. 2) in opposition of today's paradigm of excessive specialization. This work was included in the category of “semi or quasi-academic literature” because its main objective is to explore, discuss and explain a topic, rather than sell strategies to improve the reader's life, and its structure, though informal, contains more research than the usual commercial book.

This work describes polymathy as the lack of intellectual constraints such as the pressure for intellectual specialization; polymaths are individuals “not bound by labels on degrees and job descriptions” (p.14). The link of polymathy with creativity and innovation is also ubiquitous in this work. It defines the polymaths of the past as follows: “innovators, who used their time and talents to pursue a broad range of social and scientific pursuits” (p. 17). In their view, innovation is component of polymathy, as well as the breadth (and depth, implicitly) of one's pursuits.

The main discussion of this work is how the current paradigm of specialization has obliterated an intellectual type (the polymath) and how this

choice has undermined humanity's general capacity for innovation. During the discussion on how to rebuild the polymath, the work also approaches, with some degree of depth, philosophical topics such as ethics, and the meaning of work and thrift in our society.

The second work is "Ferocious Minds: Polymathy and the new Enlightenment" (BRODERICK, 2005). This is a quasi-academic work. It contains many elements of a scholarly work: the text structure, references, citations, footnotes and, especially, an in-depth research of the topics discussed.

This work, like many others, recognizes the benefits of specialization. Nonetheless, it points out that the promise that a scientific, mechanistic and specialized approach could cure the ills of mankind proved itself elusive.

The author sees polymathy as a goal to be attained by those who, like Faust – the protagonist of a traditional German legend, possess a hunger to know everything that can be known. According to the author, the only requisite for polymathy is "informed enthusiasm for more than one narrow field of knowledge or expertise, framed by a capacity to gain a certain measure of competence in several realms that might seem distant from one another" (BRODERICK, 2005, p. 10). Therefore, polymathy depends on both one's disposition to pursue different kinds of knowledge and the capacity to develop competence in those fields. Thus, in order to achieve polymathy, the development of variety (breadth) and profundity (depth) of insight is necessary.

The work ties the concepts of polymathy and Enlightenment together through shared principles and values, such as maintaining an open-minded stance but keeping the criticism, having an exploratory enthusiasm, treating situations with honesty and fairness, and – above all – freedom of thought and of contesting opinions and dogmas. The author argues that these practices and values, which are components of polymathy, are also vital for the sustainability of the Enlightenment. In his view "without a deep, broad understanding of the world, the emerging Enlightenment was left floundering" (BRODERICK, 2015). It is one more work to put the dimensions of depth and breadth as constituents of polymathy.

### *Polymathy beyond the individual*

The book “The New Polymath: Profiles in Compound-Technology Innovations”, by the technophile, entrepreneur and lover of multiple endeavors Vinnie Mirchandani (2010), casts a different view on polymathy. It extends the understand of the term by portraying polymathy as a characteristic held not only by people but also by abstract entities such as companies, cities and countries.

While the traditional polymathic individual is described by the dimensions of depth and breadth of learning, the “modern-day technological polymath” is characterized by the capacity to integrate multiple disciplines. He describes the disposition and capacity of “integrability” as reflexing a specific type of mindset. The polymaths have an “inclusive mindset” rather than an “exclusive mindset”. An inclusive mindset means thinking in terms of “and” instead of “or”, i.e. thinking of including many different facets together in opposition of thinking that it is only possible to include either one thing or the other. The author implies that sometimes there is an illusion that a choice is necessary and you have to abandon one pursuit over another; often it is possible to embrace both possibilities equally well, and this is having an inclusive mindset: “those are modern-day polymaths. (...) they exemplify an AND not OR mind-set” (MIRCHANDANI, 2010, p.xxiii).

The author soon expands the meaning of polymathy towards companies especially. For instance, General Electric is deemed as polymathic company because it is as multi-faceted as a polymathic person. As a polymath is not “just one person but a collection of many” (MIRCHANDANI, 2010, p.xxiv), polymathic entities other than individuals are alike, they possess multiplicity inside, and are capable of integrating this various facets in a productive way.

Mirchandani’s work demonstrates that polymathy is beginning to surpass its original attribution. In this book the polymath (which can be any entity) is not only defined by the depth and breadth of coverage, but also by a set of behaviors, practices, mindsets and values. From this observation it is possible to interpret that polymathy is beginning to encompass many elements of a *Weltanschauung* (i.e. a worldview: an articulated system of philosophy and/or an attitude toward life and the world).

### *Polymathy and leadership*

“Building Tomorrow's Leaders Today: On Becoming a Polymath Leader”, by the writer and political scientist Michael Genovese (2013), seems to be the first publication to join polymathy (though only the noun “polymath” appears in his text) and leadership. It starts with the adagio (also utilized in this work) of how leadership is a complex, multi-layered and multi-dimensional phenomenon, and follows to some relevant questions of leadership.

The author takes a leader-centric approach on leadership in this work. It is especially preoccupied with the kind of individual who should occupy the role of leader, how this individual should behave and which kinds of skills he or she should develop in order to achieve the condition of a polymath leader. In this matter, the author states: “The leader of the twenty-first century must be a master of many talents; he or she must be a polymath leader” (GENOVESE, 2013, p.4).

Once again, I highlight, the dimensions of depth and breadth are represented in a definition of polymathy, the former by the term “master” and the latter by the term “many” in this case.

The focus audience of the book is aspiring leaders, ground in very practical pursuits, i.e. individuals “committed to making a difference in their communities” (GENOVESE, 2013, p.xiii). Therefore, the author proposes a pragmatic model of the polymath leader.

Like Mirchandani, Genovese includes other elements in the description of polymathy. Since he is preoccupied with building new leaders, as the title suggests, the antecedents of polymathy are of utmost importance. In this excerpt he describes them: “preparation, temperament, opportunity, and drive all play a significant role in your quest to be a polymath leader” (GENOVESE, 2013, p.99).

These are developable individual characteristics (temperament and drive), environmental factors (opportunity) and developable traits (preparation) that will promote the emergence of this kind of leader.

Thus, Genovese offers the first view of joining polymathy and leadership, focusing on developing individual characteristics and capabilities towards achieving a desired condition of polymath leader. My work, however, takes a different stance. Regarding polymathy, its main preoccupation is to understand it as an overarching concept and to apply it as a comprehensive worldview that can

make a positive impact on the world. Regarding leadership, my work addresses it in a *process perspective*. The main difference is that Genovese's work is oriented towards the development of the individual as a polymath leader and this work is oriented towards the academic pursuit of comprehending, describing, developing and theorizing about the construct of polymathic leadership.

### 3.2.3 Educational initiatives on polymathy

Besides the above mentioned works there was an educational initiative on polymathy called "Polymathy, Interdisciplinarity, and 'The World in Ten Curves'" developed in American universities such as Harvard and the Massachusetts Institute of Technology by Fadel and Bosch (2013).

Regarding the assessment of the situation, I take the same stance as Fadel and Bosch's, viewing polymathy as a possible response to VUCA problems: "In a world of increased volatility, uncertainty, complexity, and ambiguity, versatility (polymathy) is a hedge, and a powerful tool to be mastered" (FADEL and BOSCH, 2013). Polymathy as a hedge was also seen in the Instant-series' work: "Why would you want to learn everything? Because it protects you" (INSTANT-SERIES, 2015, p. 19).

The authors argue that the world today has automatized and digitized many basic skills. Nonetheless, some skills – which include interdisciplinary thinking, strategy and methods for learning, and self-directed learning – cannot (yet) be automatized. In this sense, polymathic versatility is seen as both a strategy and strength to be cultivated. The authors also defend that polymathy is constituted by the dimension of breadth and depth, and that polymathy depends on the capacity to integrate disciplines or, as they put: "connect across epistemological cultures" (FADEL and BOSCH, 2013).

The authors point to difficulties of achieving the condition of polymathy, including the problem of entrance barriers in each discipline, a similar discussion to Warburg's *Grenzwachstum*. Thus, they argue for the establishment of some kind of cross-disciplinary discourse, a common language that facilitates bridges and bonds between fields. For this end, they see the utilizations of symbols, such as curves (e.g. the bell, exponential and logarithmic curves) as a fit strategy to demonstrate how to think and communicate across discourses and disciplines.



Finally, the authors argue that the cultivation of polymathic skills along with the utilization of cross-disciplinary symbols can have positive consequences for individual creativity and innovation, and for the society as a whole.

### 3.3. DISCUSSIONS ON THE LITERATURE REVIEW

In the previous sections, I presented an exploration and review of the literature. This outline now allows for a deeper discussion involving many relevant topics for the development of the construct. First, I present a proposal for a typology of the different kinds of polymathy. Second, I discuss whether the different types of polymathy belong to the public or private sphere. Third, I propose three dimensions to conceptualize the construct. Finally, I delve into the nature of the construct, revisiting and discussing its root word *mathema*.

#### 3.3.1 A typology for polymathy

In this section, I propose five different types of polymathy, based on the characteristics derived from the exploration of the literature and the context that each interpretation of polymathy is inserted in. Sometimes polymathy refers to academic knowledge, sometimes to different experiences in life, sometimes to the extent an impact of an individual's actions in the society and sometimes it refers to the capacity of being creative in many fields. Thus, the five classifications of polymathy are: (1) philosophical, (2) experiential, (3) pragmatic, (4) creative, and (5) ideal. The unique contributions of each type of polymathy are delineated below.

##### *Philosophical polymathy*

Polymathy is commonly located in the realm of knowledge and learning. Dictionaries and encyclopedias tend to define it in these terms. The noun “knowledge” or the verb “to know” appear in almost all definitions of the term. Perfect examples are provided by Oxford, Merriam-Webster and Longman dictionaries: “A person of wide-ranging knowledge or learning” (OXFORD, 2015); “A person who knows a lot about many different subjects” (MERRIAM-WEBSTER, 2015d); “someone who has a lot of knowledge about many different subjects” (LONGMAN, 2015).

Thus, the first classification of polymathy, *philosophical polymathy*, refers to the pursuit and development of profound wisdom, knowledge and learning in

many fields. Here, the adjective “philosophical” is understood in terms of its etymology: the love of knowledge, and the pursuit of wisdom (HARPER, 2014).

Sometimes, it is not the condition of having wide-ranging knowledge or learning that defines polymathy or the polymath, it is the trait (i.e. a fairly steady, reliable, and enduring interior characteristic) of wanting to pursue knowledge and wisdom that defines it. An example of such approach is seen in Wower (1665 apud DOUKAS, 2011, p. 271): “The polymath is defined by the sheer diversity of his philosophical interests”, and Ross (2011, p. 401): “they [the polymaths] were ‘devoted to the pursuit of knowledge’ and sought or possessed ‘great or varied learning’; in short, they were philosophical polymaths”.

Thus, philosophical polymathy can be seen in a developmental perspective, where there are two different stages of polymathy: (1) the finished stage, when the individual has attained the condition of having a wide-ranging knowledge, and (2) the “fledging” stage, when the individual is still in the process of attaining wide-ranging and deep knowledge. The difference between them is that the former has achieved “the goal” and the latter has yet to achieve it.

In the following sections, I will further discuss the understanding of polymathy as a condition or as a trait. If it is a trait, it implicates that polymathy could be attributable to someone still in the fledging stage of his development; one’s love of knowledge and his determination to pursue his multiple interests would be enough for philosophical polymathy. If it is a condition, this love and drive to pursue knowledge and wisdom can be seen not as polymathy itself, but as antecedents of the polymathic condition. Nonetheless, for the aim of this section, it is important to explicit that one major strain of polymathy is related to knowledge and wisdom, a category I call philosophical polymathy.

### *Experiential polymathy*

In today’s society, reaching the ultimate depths of any area of knowledge is an enterprise that requires a substantial amount of time and effort, and almost inevitably requires somebody to immerse in a specific domain, i.e. becoming a specialist. The second classification of polymathy, *experiential polymathy*, is a more mundane form of philosophical polymathy accessed through one’s life

experiences. It refers to the breadth of one's *meaningful experiences* in diverse domains. This classification is inspired by the etymology of a word that is a synonym for wisdom: sapience. Sapience comes from the Latin verb *sapere*: "to taste, have taste, be wise" (HARPER, 2014). It means that in order to gain wisdom, the experiential polymath tries, proves and tastes a multitude of different experiences in the world.

Experiential polymathy differs from philosophical polymathy as the latter presupposes varied, serious and deep training and/or knowledge while experiential polymathy means "trying", "experimenting", and "tasting". Terms that do not entail the same profundity and thoroughness as the ones related to philosophical polymathy. The idea behind experiential polymathy is the "savoring" (*sapere*) of multiple experiences that will fulfill the individual's curiosity and desire for new learnings. Most of those experiences will be latently stored in the person's mind; however, depending on the occasion, they might come to surface and become a useful instrument in a totally different context.

It is important to note that not all kinds of experiences should be accounted for this construct. Experiential polymathy presupposes meaningful experiences that have become integrated in the individual's memory, that can generate some kind of learning and can, at some point, form new ideas, enhance the individual's worldview, or contribute to his general wisdom. Other sorts of experiences that happen when the subject's mind is in a passive state, which do not become ingrained in the person's memory, and thus cannot offer any meaningfulness, should not be considered as elements of the construct.

One of the great advocates of this kind of polymathy (without using the term) was Apple's founder Steve Jobs. He mentioned the importance of meaningful experience in diverse areas in at least two public speeches: "if you are going to make connections which are innovative to connect two experiences together then you have to not have the same bag of experiences as everyone else" (JOBS, 1982); "much of what I stumbled into [e.g. the calligraphy course he had taken] by following my curiosity and intuition turned out to be priceless later on" (JOBS, 2005). Other authors interested in the phenomenon of creativity also reinforce this view: "the most creative people pursue an expansive range of experiences, which gives them the fuel for ideas" (BAER, 2015).

The contribution of Steve Jobs's engagement in a course of calligraphy to the development of the first Macintosh computer became legendary. He did not need to turn into a professional calligrapher or understand all the depths of this craft, the open hearted experience and the taste of that knowledge were meaningful enough to be stored in his mind and expand his horizons. Ultimately, this experience led to a creative breakthrough that transformed a whole market. This is something which we might not expect from all experiential polymaths, but the expansion of one's horizons and the additional "database" of experiences to be retrieved later are outcomes reached by every experiential polymath.

In popular literature, it is possible to find uncountable texts and articles sustaining the importance of the breadth of meaningful experiences to enhance creativity and to assist in the development of solutions. Although these thinkers mention core aspects of what this work calls experiential polymathy, they do not use the term polymathy. This can be due to two reasons: the term's current state of obscurity, and its strong association with incredibly gifted people, not normal people. Thus, the advent of the term experiential polymathy brings two contributions: covering an aspect of polymathy that is many times overlooked (meaningful experiences in diverse domains) and proposing a more attainable and mundane kind of polymathy that does not necessarily involve the full attainment of philosophical polymathy (i.e. deep and broad knowledge in many areas), but can offer real value in the form of providing possibilities for connecting different ideas and the expansion of the individual's worldview.

### *Pragmatic polymathy*

Some authors emphasize the practical aspects of polymathy rather than the pure acquisition of knowledge or the engagement in meaningful personal experiences. In this sense, the element of *doing* is fundamental. This view is found in both popular and scholarly literature: "if your friend is not only a brilliant physics student but has also published a poetry collection and won prizes at political debates, you can describe her as a polymath" (VOCABULARY.COM, 2015); "I would argue that a new group of cultural polymaths is emerging who are doers in a wide variety of areas" (ROBINSON, 2010); "most of the greatest innovators in every discipline have been polymaths [...] who demonstrated their creative abilities

in several fields of endeavor” (ROOT-BERNSTEIN and SHAVININA, 2003, p.268); “[polymathy] is the study of individuals [...] and their interdisciplinary thinking traits which enabled them to contribute to a variety of disciplines” (SRIRAMAN *et al.*, 2009 p. 79).

Thus, I propose a third category called *pragmatic polymathy*, referring to verified and applied skills and competences in more than one domain. While both philosophical polymathy and experiential polymathy refer to the individual’s sense of self achievement (these polymathies consider the attainment of broad and deep knowledge, learnings and experiences as complete and fulfilling objectives for the satisfaction of the self), pragmatic polymathy, on the other hand, brings a social and practical approach to the discussion. Pragmatism, comes from the Greek *pragmat*, stem of *pragma*, and it means “that which has been done” (HARPER, 2014). Thus, pragmatic polymathy is centered on the aspect of *doing*. Conjugating pragmatism and polymathy means that there are polymaths whose attribution is grounded on the breadth of their verified skills and competences which led to social contributions in more than one domain. While philosophical polymathy is well exemplified by Leonardo da Vinci and his multiple intellectual interests, pragmatic polymathy is observed in the case of Benjamin Franklin: he was a competent and successful doer in many fields and his social and political contributions had (and still have) great impact, especially in the American culture. Many of the feats by which Franklin is celebrated regard to his social and political contributions: he was an author and spokesman in Europe for several of the American colonies, he was the first United States Ambassador to France, he was a publisher and printer of books, he was a postmaster and, of course, he played an important role in American revolution. His valuable inventions and scientific inquiries crown his attribution as one of the widest-ranging polymaths, and a stalwart of practicality.

Naturally, not all pragmatic polymaths will be as successful or as broad as Benjamin Franklin, he should be taken as an ideal example of a pragmatic polymath: a person who does many things successfully in different fields.

### *Creative polymathy*

In many scholarly texts, the discussion of polymathy often appears intertwined with creativity (ROOT-BERNSTEIN and SHAVININA, 2003; ROOT-

BERNSTEIN and ROOT-BERNSTEIN, 2004; KAUFMAN and BEGHETTO, 2009; ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2013). Creativity, as well as polymathy, is a complex construct that intersects different levels of analysis. Creativity concerns to the manner ideas are formed in the individual's mind, the relation of this individual and the environment, i.e. other individuals, structures and systems that collectively decide what should be considered new and valued (creative), and the relationship of every previously mentioned element and the general culture (CSIKSZENTMIHALYI, 1999; CSIKSZENTMIHALYI and WOLFE, 2014). This multifaceted understanding of creativity is important to the following discussions on polymathy.

Despite this complexity, for the purpose of this typology, creative polymathy means the production of new and useful ideas and things, spanning more than one domain, field or area of knowledge. As creativity also contains pragmatic components – it is the production of new and *useful* ideas (AMABILE, 1983, emphasis added; STERNBERG and LUBART, 1999) –, differentiating this category from the previous (pragmatic polymathy), centered on the idea of doing, is salutary. While some polymaths are doers in many fields, it does not mean that all of them will make *new and useful contributions* to various fields, they may be experts in doing what has already been done in different domains. Thus, it is a special kind of effect in the world (new and useful contributions in many fields) that constitutes creative polymathy.

If we make a link between this category of polymathy, Kauffman and Beghetto's (2009) Four-C theory of creativity and Amabile's (1983, 1988, 1996) definition, we tend to see creative polymathy as the development of Pro-c and/or Big-C creativities in more than one area. The rationale is that the other two types of creativity, mini-c and little-c, belong to the individual's private domain, thus they cannot be socially useful, which is a condition for creativity according to Amabile's view.

This definition, however, will suffer from the same problem as the Big-C creativity. It tends to put creative polymathy in the realm of only very gifted and talented people. In fact, when people equalize polymathy to achievements that only great people like Leonardo da Vinci or Benjamin Franklin can produce, it is this kind of view they have in mind. Even Kaufman presented a similar view: "those

rare people who are creative in dissimilar areas [...] represent the pinnacle of creative polymathy” (KAUFMAN ET AL., 2010, p. 284)

### *Ideal Polymathy*

Polymathy has also been associated or even equalized to the idea of the *Universal man*, sometimes appearing as *Homo universalis*, *Uomo Universale* or *Renaissance man*. These expressions derived from the ideal in Renaissance Humanism that, in order to develop one's potential, an individual should seek universal learning. This Renaissance author Leon Battista Alberti (1404–72) exemplifies this view when he declares that “a man can do all things if he will”. History books and encyclopedias are more likely to address polymathy in such fashion:

The ideal [of polymathy] embodied the basic tenets of Renaissance Humanism, which considered man the centre of the universe, limitless in his capacities for development, and led to the notion that men should try to embrace all knowledge and develop their own capacities as fully as possible.

(BRITANNICA, 2015)

Nevertheless, even when using the term “Renaissance man”, only few contemporary authors rely on the definition of polymathy as the capacity to know literally everything.

This view is generally tied to the Renaissance era and utilized in historical works to highlight the ideal of universality, such as in the following examples, taken from sources from the history of literature and the history of education: “to know all the questions and all the arts [...]. It sums up, in different terms, the old Hellenic ideal of universal knowledge: *polimathia*” (MARINO, 1996. p. 15), and “this meant that his competence had to be universal, his knowledge had to extend over every kind of specialized study [...] he must have a ‘polymathy’” (MARROU, 1956. p. 54-55).

The meaning of polymathy as the attainment of universal knowledge and universal skills is an easy target of criticism. Even if we considered polymathy to encompass just the traditional academic fields, attaining depth in all subjects today is humanly impossible. Numerous deterrents can be listed to demonstrate its



infeasibility: the lack of time for one to really develop depth in all subjects, the humongous amount of discipline one would have to exert, the adamant desire and will one would have to keep during a lifetime, and, finally, the overwhelming amount of information one would have to filter and process in order to achieve this ideal. Thus, polymathy as the ideal of the universal man is understood here –such as the notion implies –as an *ideal*, not a real or achievable possibility.

Table 1 summarizes the proposed typology for the construct of polymathy, with its five categories, their respective meanings, plus citations and authors that exemplify them.

Classification	Meaning	Citations	References
Ideal polymathy	Universal knowledge or competence	<p>"To know all the questions and all the arts (...). It sums up, in different terms, the old Hellenic ideal of universal knowledge: <i>polimathia</i>" (MARINO, 1996, p.15).</p> <p>"This meant that his competence had to be universal, his knowledge had to extend over every kind of specialized study (...) he must have a 'polymathy'" (MARROU, 1956, p.54-55.)</p>	<p>(MARINO, 1996) (MARROU, 1956)</p>
Philosophical polymathy	Deep and broad knowledge or learning	<p>"A person of wide-ranging knowledge or learning" (OXFORD, 2015).</p> <p>"The polymath is defined by the sheer diversity of his philosophical interests"(WOWER, 1665 <i>apud</i> DOUKAS, 2011, p.271).</p> <p>"they were 'devoted to the pursuit of knowledge' and sought or possessed 'great or varied learning'; in short, they were philosophical polymaths" (ROSS, 2011, p.401).</p>	<p>(OXFORD, 2015) (MERRIAM-WEBSTER, 2015) (LONGMAN, 2015) (WOWER, 1665) (ROSS, 2011)</p>
Experiential polymathy	Breadth of meaningful experiences	<p>"the most creative people pursue an expansive range of experiences, which gives them the fuel for ideas" (BAER, 2015).</p> <p>"if you are going to make connections which are innovative to connect two experiences together then you have to not have the same bag of experiences as everyone else" (JOBS, 1982)</p>	<p>(BAER, 2015) (JOBS, 1982) Popular literature</p>
Pragmatic polymathy	Verified skills or competences in more than one domain	<p>"Do organizations have enough polymath leaders: multi-skilled individuals who combine designer flair, engineering skill and marketing imagination?" (ROONEY <i>et al.</i>, 2012, p.156)</p> <p>"a new group of cultural polymaths is emerging who are doers in a wide variety of areas" (ROBINSON, 2010).</p>	<p>(ROONEY <i>et al.</i>, 2012) (SRIRAMAN <i>et al.</i>, 2009) Popular literature</p>
Creative polymathy	Creativity in more than one domain	<p>"Those rare people who are creative in dissimilar areas (...) represent the pinnacle of creative polymathy" (KAUFMAN <i>et al.</i>, 2010, p.384).</p> <p>"Most of the greatest innovators in every discipline have been polymaths (...) who demonstrated their creative abilities in several fields of endeavor" (ROOT-BERNSTEIN e SHAVININA, 2003, p.268).</p>	<p>(ROOT-BERNSTEIN &amp; SHAVININA, 2003) (KAUFMAN <i>et al.</i>, 2010)</p>

Table 1. The five proposed classifications of polymathy. Elaborated by the author.

## **Polymathy in the personal and public spheres**

Besides existing in different contexts, the different categories of polymathy also vary in a continuum of personal and public practice.

Experiential polymathy, like mini-c creativity, is always restricted to the private practice; what counts are the personal interpretations and representations based on events experienced, not social contributions, or verified knowledge and skills.

Philosophical polymathy can also be restricted to a private sphere, especially if taken into account Wower's view of it as a trait. Nonetheless, philosophical polymathy generally requires some kind of social verification. Even if philosophical polymathy is understood as a trait rather than a condition, the polymathic individual must somehow express his desire to achieve vast and deep knowledge and wisdom. If polymathy is viewed as a condition, then, it can only be validated by external assessment; it is evident that in order to judge an individual's degree of philosophical polymathy, this person has to first publicly display the elements of polymathy: deep and broad knowledge.

Pragmatic polymathy, of all three, is the most dependable of social recognition, as the very definition includes social verification and application of one's skills and expertise in various areas. Thus, it can only exist in relation to the public practice.

Creative polymathy, as discussed before, also carries a pragmatic element. Thus, it also needs to be assessed and verified by the society, belonging, then, to the public sphere. The exception would be considering creative polymathy in the realm of mini-c and little-c, which happen inside the individual's mind, belonging, then, to the private sphere.

### **3.3.2 The three great dimensions of polymathy**

It was seen that polymathy can be defined by one's knowledge, experiences, competences or creativity. However, to assess the degree of one's polymathy, generally two dimensions of those elements are considered: their breadth and their depth. For instance, the broader and deeper one's knowledge is

the greater one's philosophical polymathy is; "breadth" and "depth" are the dimensions whereby the substance (and substantive) of philosophical polymathy, knowledge, is evaluated.

In this section, besides delving into the discussion of these two dimensions, I propose the inclusion of a third dimension of polymathy called connectedness.

### *The first dimension: breadth*

All approaches on polymathy so far studied have in common the idea that polymathy requires breadth, either of knowledge, learnings, experiences, skills, competences, accomplishments or creative endeavors. Thus, it is natural to admit "breadth" as the first dimension of polymathy.

In the literature, the idea of breadth can sometimes be expressed as vastness, plurality, variety or comprehensiveness. Nonetheless, breadth is a good choice for a term to cover all of these ideas. Breadth means the quality of including many things; for instance, the more pieces of knowledge or skills one has, the greater is one's breadth. If an entity is detained to a single domain or area of the expertise, it is definitely not polymathic.

Developing a large array of competences in many subjects, especially if crossing traditionally defined domains of knowledge (e.g. arts and sciences) is the core idea of this dimension of polymathy.

### *The second dimension: depth*

Is such polymathy possible any longer [...]? Clearly the flowering of knowledge in the last two centuries, and the ever-more specialized means of obtaining it, suggest powerfully that nobody can hope to achieve such *breadth and depth* of available insight".

(BRODERICK, 2005, p. 10, emphasis added)

Depth means the quality or state of being profound, intense, complete or thorough; for instance, the more profound, intense, complete or thorough is one's knowledge about a subject the greater is his depth. Although polymathy is

intimately associated with the idea of breadth, it alone is not enough for the whole encompassing of the phenomenon. Polymathy requires not only the knowledge about many subjects but, as importantly, it must account for profundity, intenseness and thoroughness. This dimension is cited in different ways by a multitude of sources, including scholarly and popular authors, dictionaries and encyclopedias: “A person who *knows a lot* about many different subjects” (MERRIAM-WEBSTER, 2015d, emphasis added); “someone who has *a lot of knowledge* about many different subjects” (LONGMAN, 2015, emphasis added); “[a polymathy needs to] cultivate breadth AND depth” (FADEL and BOSCH, 2013, emphasis by the authors); “[the secret of polymathy is] the desire to discover something *profound*” (INSTANT-SERIES, 2015, p.37, emphasis added); “[In the past, polymaths could] attain such breadth and *depth* of available insight” (BRODERICK, 2015, p. 10, emphasis added); “[creative polymathy] is largely the result of a long period of training usually necessary to become *proficient* in any field (KAUFMAN *et al.*, 2010, p. 380, emphasis added).

Thus, for a more thorough picture of polymathy, the necessity of not only breadth but also depth as a constituent dimension is made evident. The possession of breadth lacking depth is not polymathy. It receives, instead, the classification of dilettantism, which is interest in an art or in an area of knowledge that is not very deep or serious (MERRIAM-WEBSTER, 2015c).

### *The third dimension: connectedness*

Connectedness, as expected, stems from the verb “connect”, “to join (two or more things) together” (MERRIAM-WEBSTER, 2015b). In the sense presented here, connectedness is the capacity to associate or relate things, concepts or ideas, especially from disparate areas or fields. It involves forming connections of data, information, experiences, skills, knowledge and competences; encompasses the creation of useful relationships and webs of knowledge, and the perception of synergies among different bodies of knowledge.

Many propositions of polymathy involve connectedness, i.e. interdisciplinary thinking, and joining distant disciplines, areas or fields together, as a fundamental dimension. Here are some examples: “polymaths master their

activities to a significant degree and perceive the fundamental connections between them” (ROOT-BERNSTEIN AND ROOT-BERNSTEIN, 2013, p. 323); “[polymathy] will likely require learners to connect across epistemological cultures” (FADEL AND BOSCH, 2013); “the point is to acquire broad knowledge, find connections and exploit those connections to create innovations” (SPALDING and GIBSON, 2013, p. 45). Another – and surprising – argument in favor of connectedness as a dimension of polymathy is found in an essay by Howard Goodman, a scholar who studies polymathy in ancient China. The author poses that “the study Chinese polymathy touches on three areas: cultural history and its local features, *synergies among skills*, and, at a secondary level, the impact upon our historical methods” (GOODMAN, 2005, p. 105, emphasis added), later in the text he reaffirms the importance of interrelations and connections in the standpoint of ancient Chinese polymathy: “we should observe how certain skills in a polymathic set interpenetrated and created new connections” (p. 107).

Polymathy, then, can be seen as a triune construct, depending on the dimensions of breadth, depth and connectedness to be complete. The absence of any of the three would transform the construct into something else: lack of breadth would translate into specialism rather than polymathy; lack of depth would produce dilettantism rather than polymathy and lack of connectedness makes for schizoidism rather than polymathy; and sets of knowledge and skills with no connection, either with each other or with some other factor would be schizoid, rather than polymathic.

Thus, the idea behind polymathy is not only possessing breadth and depth of knowledge, but also being able to perceive the fundamental connections between the different bodies of knowledge, and to bridge them, as defended by many authors, such as in the examples above.

The term *schizoid* is used for the lack of connectedness, as the absence of this element denotes a condition of complete rupture between pieces of knowledge:

Imagine an expert in a discipline, for instance, syllabification; he knows almost all the words in the English language and knows how to separate their syllables accurately, for every word that is given to him, he can separate its syllables. However, when writing a very long word in a letter and noticing there will be no space for it in the line, he fails to

realize that a hyphen can be put to separate the syllables and continue the word in the next line.

The illustration above shows a person that, despite his expertise in syllabification, could not be able to connect his knowledge to a practical application. A person with such characteristics, even if he had breadth and depth of knowledge, would not be considered polymathic. His lack of connectedness causes a “rupture” between subjects taught, as if when a subject is being utilized the others have to “shut down”.

At the organizational level, the importance of connectedness becomes even pronounced. A good example of an entity that often behaves similarly as the individual in the illustration above is the traditional school. The traditional is an institution with a very strong focus is on deepening knowledge (depth) and covering many disciplines (breadth); however, connectedness is generally very poorly represented. Most traditional schools, like the example above, are schizoids; when one discipline is being taught the others are completely “shut down”; there is little or no space to discuss the integration of disciplines. For instance, the connections of what is being learnt in math with biology are ignored and vice-versa, as well as the integration of the subjects being taught with the rest of the real world outside the school. The obligation of learning a discipline for the sake of passing a test, with no connection with real and relevant problems is not the idea behind polymathy at all. Thus, even an entity that is undoubtedly concerned with the depth and breadth of learning is not polymathic if it fails to heed the importance of connectedness.

### 3.3.3 *Mathema*: the substantive unit of polymathy

*Mathema* is the substantive root of the word polymathy and its further exploration can assist in the development of the construct of polymathy. *Mathema*, as presented in the etymological discussion, has various meanings; it can be a lesson, a subject (an area of knowledge to be taught), an experience, or knowledge gained from an incident in life. This multitude of meanings leaves room for confusion and vagueness. Here, I propose that *mathema* can be understood in two different ways: (1) as an internal representation of something learned, and (2) as an organization of smaller bodies of knowledge as a “subject of instruction”

If *mathema* is understood as an internal representation of something learned, it will reside at the data representation level. By being an internal cognitive representation, it only makes “sense” in the mind of the holder, it is a product of his mental activity. A *mathema* would, then, be formed from the organization of inputs, data and other *mathemata* (the plural of *mathema*) into new conceptual representation that can be called a “lesson”.

Here follows an illustration exemplifying this meaning of *mathema*:

Imagine a tennis player that wants to learn how to hit a ball effectively. After hitting thousands of balls, i.e. receiving tons of inputs and feedback, the player ‘discovers’ that if he waits for a certain time and if he turns the racket just a little bit before hitting the ball, the stroke will hit with much more spin. In his head this ‘lesson learned’ is labeled as ‘forehand topspin’.

In this case, the *mathema* was the lesson resulted from the player’s purposeful training. His mind formed this lesson, or *mathema*, pre-verbally. It, though does not exist alone; it is entangled in a unique environment of several other data and *mathemata* existing in his brain. The consolidation of this *mathema*, depended on a universe of inputs, other little *mathemata* and sub-concepts (such as the bounce of the ball, the weight of the racket, his movement, etc.) interacting with each other in his brain, being constructed and deconstructed until it finally gave birth to the concept of “forehand topspin”. This “discovery” happened after reaching a threshold of manipulating inputs, data, information and sub-concepts, which, at some point, could finally be organized in his mind in a cogent way.

Understanding *mathema* at the data representation scale has major implications for the conceptualization of polymathy. For instance, taking the term *mathema* in this sense would mean that everybody would be a polymath, since it is impossible to pass through life without learning multitude of lessons and forming uncountable *mathemata*. Therefore, polymathy could not be about learning many different lessons (that would be done by every human being). It would, then, concern to a special characteristic (or trait) of dealing with the construction, deconstruction, reception, connections and interrelations of *mathemata*. This view is better suited for the understanding of polymathy as a trait or as a worldview



(*Weltanschauung*), rather than a condition. These conceptualizations are discussed further.

On the other hand, if *mathema* is viewed as “subject of instruction” or an “area of knowledge”, it will not reside in the individual, but in the realm collective knowledge. Society must have institutions agreeing on the existence of subjects such as “painting”, “engineering” and “anatomy” for us to say that Leonardo da Vinci was a polymath because he was an acclaimed painter, engineer and anatomist. Thus, Leonardo’s polymathy is assessed by the variety of “subjects” he could handle with mastery, not because the manner he handled his internal conceptual representations.

The meaning of *mathema* is of “a subject or an area of knowledge” is, in fact, the *default* utilization of the term. Mainly because most authors generally use the term polymathy, or polymath, to refer to individuals who possess a degree of command in different “subjects of instructions” or in different “areas of knowledge”.

In this sense, *mathema* exists as an abstract construct involving another abstract construct, which is knowledge. One problem with this is that it is very difficult to define what constitutes a single “*mathema*” or a “subject of knowledge”. Areas, fields, subjects or domains such as Arts, Science, Mathematics, and Literature are all abstractions, and their frontiers are not clear sometimes. Even if we could unequivocally arrive at a hermetic subject of knowledge, it would still be constituted of many smaller bodies of knowledge. For instance, if we start with the term “science”, what “unit” would proper suit a *mathema*, a “subject of instruction”, the whole body of scientific knowledge? A branch of it, such as biology? Or a part of it, such as genetics? Or even a smaller part, like chromosomal evolution research?

In sum, the term polymathy is generally used without much heed for the role and meaning of its root word *mathema*. Authors generally take their meaning for granted as a “subject”. Here, I defend that, while most usages assume that polymathy means “many subjects of knowledge”, if the origins of the term are retrieved, we can advance to a new understanding of the construct, with polymathy pertaining to the way that one deals with the construction of knowledge at the data representation level. This view can be helpful later, in the discussion of polymathy as an individual trait and as a worldview.

In conclusion, the term *mathema* as a whole can contemplate the idea of learning, knowledge and experiences both internally, as an inner representation and externally, as a discipline or subject. While the latter is more widely utilized, the former may be helpful to understand other conceptualizations of the term.

Since the term *mathema* does not exist in the English language and has the dual meaning exposed above, in this work, the terms “learning” and “learnings”, given their comprehensiveness, will often substitute *mathema* or *mathemata*, respectively.

### **3.4. THREE DIFFERENT CONCEPTUALIZATIONS OF POLYMATHY**

#### **Considerations on categorizing a complex construct**

The problem of categorizing polymathy was already faced by professionals of a completely different context: the video game industry. The analysis of how developers of the computer game “The Sims 4”™ solved the problem of including polymathy in the game will yield insights about the manners that this construct can be conceptualized and operationalized, and how it differs from other constructs that can easily fit into categories such as traits or skills.

The Sims 4 is a game where you control the “lives” of simulated characters called “Sims”, hence the name of the game. In the start of the game, the player has the possibility of customizing his or her playable character, the “Sim”. The player can choose many characteristics for the “Sim”, which includes his or her personality traits. The game offers a big list of traits to choose from: “Sims” can be gloomy, hotheaded, perfectionists, clumsy, lazy, neat, outgoing, etc. Each trait has different effects on how the character will behave. However, polymathy is treated differently; it enters the game not as a trait, but as a life goal or aspiration. In the game, it receives the name of “Renaissance Sim” aspiration. Thus, becoming a “Renaissance Sim” is both a life goal and an attainable condition. To achieve the condition of “Renaissance Sim”, the player must achieve a very high level of mastery in many skills, as well as attaining moderate success in different careers.



Figure 14. Screenshot of the game “The Sims 4™” showing personality traits.

Source: The Sims 4™.



Figure 15. Screenshot of the game “The Sims 4™” showing the “Renaissance Sim” aspiration.

Source: The Sims 4™.

Naturally, the choices made by game developers have the goal to improve the game’s playability and the enjoyment of the audience. They have no

preoccupation of scientific accuracy whatsoever. Nonetheless, the game, which intends to be a life simulator, serves as a salutary analogy because it involves categories that are here discussed (traits, skills, life goals and aspirations), and it is expected that these categories should work in a coherent way in the game. In the game, traits can function as moderators, e.g. having the “perfectionist” trait improves the results of the utilization of the skill “gardening” while increasing the time spent for gardening tasks. Skills function as variable that will affect the result of a given task, e.g. the higher the skill “writing”, the better books the character can write. Thus, the game intended that these constructs would follow a plausible and expected relation.

In a scientific perspective, we are likewise dealing with a construct that can be conceptualized in different perspectives, with different effects and different operationalizations. In this work, I propose three possible conceptualizations for polymathy: (1) as an attainable condition, (2) as a trait, and (3) as a worldview. They are discussed in the following sections along with their specific implications.

Since each conceptualization will also affect the type of construct concerned, as well as the relation of the construct to its dimensions, I apply Law’s taxonomy for multi-dimensional constructs (LAW *et al.*, 1998) with the aim to offer the best clarification about the nature of each conceptualization of polymathy. Law’s taxonomy organizes and classifies the possible relations of the constructs and their dimensions. It poses that some constructs exist at the same level as their dimensions, while others exist as higher-order abstractions behind their dimensions. This model is especially helpful for clarifying the level of analysis that a given construct exists in relation to its dimensions.

### **3.4.1 Polymathy as an attainable condition (*Zustand*)**

By the exploration of literature, when most authors refer to polymathy, or the polymath, the implicit meaning is that it is a condition. A condition is understood as *a mode or state of being that is achieved by individuals or entities*. In the discussion about education and polymathy, I introduced the German term *Zustand*, which refers to a condition attained after a process. In that case, the

condition or “status” to be achieved was of a *gebildete* (educated) individual, and the process was *Bildung* (education). In the case of polymathy as a *Zustand*, the process that one has to go through is the development of broad, deep and connected knowledge, learnings, experiences, competences or creative endeavors.

The meaning of polymathy as a *Zustand* is implied when, for instance, we say that “Leonardo da Vinci was a great polymath”. What is meant by the sentence is that the individual Leonardo achieved the condition of being knowledgeable (for his time), skilled and creative in many areas. In other words, he attained the condition of polymathy.

Furthermore, it is important to emphasize the developable and attainable aspect of this condition. In this sense, polymathy would not be innate (i.e. individuals are never born polymaths); rather, it would be an aspiration, or a desirable objective to be reached, that depends on achievements such as the gathering of vast and deep knowledge or learnings.

If polymathy is understood as an attainable condition, elements that influence individuals towards developing polymathy such as personality traits, intelligence, behaviors and motivations would be considered as antecedents of the construct, not as constituents of the construct itself.

In this sense, to assess an entity’s polymathy, it would be necessary to evaluate the aggregate level of the three great dimensions (breadth, depth and connectedness) of one’s knowledge, experiences, competences and creativity, depending on the type concerned. The greater one’s breadth, depth and connectedness of one’s knowledge the greater is his philosophical polymathy; the greater one’s breadth, depth and connectedness of one’s experiences the greater is his experiential polymathy and so on. In the case of creative polymathy, the dimension of connectedness would be implied in the breadth of one’s creative endeavors, once creativity already contain a great element of making connections.

According to Law’s taxonomy (LAW *et al.*, 1998), this conceptualization would figure as an aggregate model. In the aggregate model, the construct exists at the same level as its dimensions and it is formed as a mathematical function of these dimensions. Thus, polymathy as a condition would be measured by the sum of an entity’s level of breadth, depth and connectedness of knowledge, experiences, competences and/or creativity, given that all three dimensions are present in a

substantial level. The entity should not be considered polymathic if it fails to reach a minimum threshold in each dimension.

### **Considerations on polymathy as a condition**

#### *Eminent polymathy and Latent polymathy*

Polymathy as a condition should be socially manifestable. The attribution of a *Zustand* depends on a way for society to assess the attainment of the requisites for this condition (in the case of polymathy, having a high degree in each great dimension of breadth, depth and connectedness). Every author that writes about polymaths of the present or past performs this assessment, deliberately or instinctively. Some authors put a very high threshold for calling some entity a polymath, requiring a large degree of development, especially in the dimensions of breadth and depth, which are very difficult to achieve together. In an extrapolation of this reasoning, if the threshold for polymathy is set too high, all individuals, including celebrated polymaths such as Da Vinci and Franklin, would have spent most of their lives not as full-fledged polymaths but as immature, “wannabe-polymaths”, that would make the condition of polymathy almost unreachable. Kaufman and Beghetto (2009) point to a similar problem with the construct of creativity. If all existing creativity was Big-C, only very few people could be considered as creative, hence the necessity to create lower levels of creativity. I propose something similar here, positing two conditions regarding polymathy: a fledging condition called “latent polymathy” and a “finished” condition called “eminent polymathy”.

Eminent polymathy is evident, distinguishing and rare, like Big-C creativity. Latent polymathy, on the other hand, is neither clearly evident nor rare. It is the potential of an entity to achieve eminent polymathy. Latent polymathy involves the desire and the potential ability and being in the middle of the process of developing broad knowledge, experiences and competences with depth, and being able to connect them in functional ways.

Latent polymathy is not clearly evident, as its holder is still in the process of developing polymathy. Only after some maturation, it can be manifested in the

form of socially applicable products, e.g. manifest knowledge, competency and Pro-c and Big-C creativity in various domains.

There is an interesting consideration regarding the condition of latent polymathy which is the degree of pervasiveness of this condition in our species. It is possible to defend the hypothesis that, in our species, features fundamentally linked to polymathy, such as the desire to discover, to gather knowledge and different experiences, to express creativity, etc. are rather common. In other words, some polymathy is natural in humans. Examples of authors who follow this idea are given: “humans are natural polymaths. This is what our giant brains were developed to help us be” (HOLLOWAY, 2014); “Our age reveres the specialist but humans are natural polymaths, at our best when we turn our minds to many things” (TWIGGER, 2015); “children were natural polymaths, interested in the full color of the rainbow” (BOTEACH, 2011, p.xiv). They defend that if this drive, hunger or desire for knowledge is not realized by many individuals, it may be due to a series of reasons despite their will (e.g. environmental pressures, lack of opportunities, the inherent difficulties of learning, etc.), but that it is possible to assume the “polymathic intent” was there in first place.

Finally, construing polymathy as a latent potential rather than a condition would require a deep conceptual change. The following conceptualizations of polymathy as a trait and as a worldview will encompass this different view, focusing on aspects that antecede the attainment of the finished *Zustand* of eminent polymathy.

### *On artificial intelligence and polymathy*

There is an important issue of polymathy as a condition that requires attention, which involves ethical and philosophical questions, as well as the capacity of polymathy to be a hermetical system. If polymathy means achieving a high degree of breadth, depth and connectedness of knowledge, learnings, competences and creativity could an artificial entity be polymathic?

This question is actually troubling thinkers in current times. There is an apprehension among some scholars concerned with Artificial Intelligence (AI) that a machine might - in a not distant future - achieve the condition of knowing “everything” and become an Artificial Superintelligence (ASI), i.e. “an intellect that



is much smarter than the best human brain in practically every field, including scientific creativity, general wisdom and social skills” (BOSTROM, 2006, p. 11). The concern is not that the ASI will become the greatest mind in the world and solve all the problems that afflicted mankind in a matter of minutes; the main preoccupation is that the “polymathic” ASI, if not carefully engineered, will not share any of the polymathic human aspirations, values and objectives (BOSTROM, 2014).

It begs the question whether an artificial intellect that has some form of consciousness and can gather, understand, utilize and build upon all sources of human knowledge should be called a polymath. If polymathy is a condition that requires breadth, depth and connectedness of knowledge, competences and even creativity, this entity would easily fit in the description, even though its existential objective might be something like making an infinite number of paper clips or calculate the number of *pi* (BOSTROM, 2014).

The example of a broad and deeply intelligent, competent and creative ASI caring about nothing more than paper clips brings the discussion to fundamental aspects of polymathy. Many approaches of polymathy, latent polymathy included, encompass not only the resulting condition, but especially the human motivations and desires (of learning, discovering, exploring, feeling and experiencing the world, and developing our individual capacities to the fullest potential) behind the pursuit of this condition. For instance, Wower views the intellectual disposition of seeking a variety of interests as the core principle of polymathy: “the polymath is defined by the sheer diversity of his philosophical interests” (WOWER, 1665 apud DOUKAS, 2011, p.271).

These motivations and desires are forerunners for a polymathic condition for human beings, but an artificial entity should not be expected to possess similar “aspirations” just because it possesses a very high level of general intelligence. Unless purposefully engineered this way, an AI will probably have no philosophical interests. The acquisition of knowledge, for this kind of entity, might be just an instrumental objective in order to achieve its greater objective, which can be anything the machine was programmed to do in first place (BOSTROM, 2006).

It, thus, begs the case whether we should call a self-conscious entity that has surmounted certain degree of knowledge a polymath, despite its motives, behavior and morality, if any. The view of broad, deep and connected knowledge,

experiences, competence and creativity as either an instrumental objective or an end in itself appears to be a key issue of polymathy. It seems that it will only work as a desirable system if the polymathic condition is not an instrumental means but an end in itself.

### **3.4.2 Polymathy as a trait**

As seen in the literature review, while many authors see polymathy as a condition, others tend to understand polymathy as a characteristic of a person, or a trait. It means that polymathy would be a distinguishing and enduring interior characteristic pertaining to the individual.

This section starts with the discussion of polymathy under the lenses of evolutionary biology. It presents two views of polymathy as a hereditary trait: (1) as an individual trait, which means that the characteristic is only held by some individuals, not the whole species, and (2) as a species trait, which means that this characteristic would be shared by all human beings.

After that, polymathy is analyzed through the lenses of personality psychology. The construct is confronted with theories of the field, heeding possible relationships of well-established ideas of the Psychology field with some of the proposed concepts of polymathy featured in this work. This discussion leads to a more encompassing model of polymathy that is presented in section 3.5.

### **Evolutionary biology and polymathy as a trait**

According to Buss (1984), the study of personality and the study of human nature should be interconnected, especially through the lenses of evolutionary biology. This necessity of this interrelation becomes evident when we pose the problem that characteristics of the individual have to be separated from characteristics shared by the species as a whole.

The conceptualization of polymathy faces the same question; polymathy can be conceived both as a universal human trait (i.e. a species trait) and as a particular trait held by some individuals (i.e. a personality trait). The concept of latent polymathy, for instance, leans towards the view of polymathy as a species trait, while the concept of polymathy as the unusual capacity that some individuals

have to pursue and acquire knowledge leans towards the view of polymathy as a personality trait.

Buss (1984) proposed three criteria for determining important species-typical characteristics and four criteria for separating important individual differences from unimportant differences such as “ear wiggling capacity”, for instance. Whether polymathy is a species or a personality trait, it is definitely an important characteristic, as it affects profoundly the lives of those possessing it. Thus, the discussion here is first concentrated on the understanding of polymathy either as a species trait or as an individual trait in the evolutionary biology point of view.

### *Polymathy as a species trait*

According to Buss, the first criterion to consider a feature part of human nature is *universality*. It regards to the idea of prevalence, it means that features found across cultures, races, and populations are assumed to be more part of human nature than features that are unique to certain subgroups or individuals. In this sense, polymathy as a condition would fail to meet this criterion, once the attainment of a high degree of breadth, depth and connectedness of knowledge, learnings, competences and creativity is rare. It means that if polymathy is understood as a condition, it cannot be shared by everyone, only some people will have achieved such condition. Nonetheless, it is seen that some authors understand polymathy as a universal human trait; i.e. it is as a latent desire to pursue a variety of knowledge and experiences that is embedded in every human being (see BOTEACH, 2011; HOLLOWAY, 2014; TWIGGER, 2015). In this sense, polymathy would meet the criterion for universality.

The second criterion is the feature’s *spontaneity, automaticity, and intractability*. Spontaneity is the feature’s capacity to manifest spontaneously, with little or no environmental impetus or incentive; automaticity is the extent to which a behavior or attribute is reflexively displayed in response to a given environmental elicitor, and intractability is the degree of difficulty in which the feature can be altered by environmental forces, intractable features are very hardly or virtually impossible to alter. When authors say that children or humans are natural polymaths (e.g. BOTEACH, 2011; HOLLOWAY, 2014; TWIGGER, 2015) they imply that

polymathy is a spontaneous and automatic feature that is somehow stifled by environmental pressures. Thus, the sense of polymathy as an inner desire to pursue a variety of knowledge, as conceived by these authors, would meet the criteria for spontaneity, automaticity but not for intractability. When polymathy is understood as a condition the analysis becomes more difficult once the criterion was devised to be applied to trait features, not conditions (*Zustände*). Moreover, unlike the criterion of universality, these specific criteria make the transposition more troublesome. However, we can postulate that the condition of polymathy is not spontaneous in the sense it requires a great effort to be attained. At least two dimensions of polymathy, depth and connectedness also do not seem to be automatic responses of human nature, it is plausible to assume that in most cases we can expect see more shallow and disconnected answers from any member of our species than deep and connected ones.

The third criterion, *adaptation*, departs from an evolutionary biology standpoint. A feature that is adapted solves some kind of ecological problem and helps the organism to survive and/or reproduce (BUSS, 1984). An in-depth analysis for applying this criterion to polymathy would require a specific work, only for this purpose. However, it is possible to speculate here that the desire to pursue a variety of knowledge and experiences, as a feature, might have propelled early humanoids to explore new niches. It is possible that the rewards obtained by humans who were more prone to exploration, novelty and seeking breadth rather than constriction ultimately paid out, and this feature became prevalent in the human gene pool. A speculative evidence for that would be the overwhelming comprehensiveness of different habitats we occupy on Earth. This argument depends on the idea that our restlessness and exploration instinct and the feature of polymathy are somehow connected. The possibility of this feature being not universal, i.e. not a species trait, and rather a personality trait is discussed further.

In sum, if polymathy is understood as the desire or motivation to pursue broad, deep and connected experiences, knowledge and competences, and develop one's creativity, we can assume it is a good candidate for a species trait; it meets all the criteria proposed by Buss, with the exception of intractability. Thus, one possibility of viewing polymathy is as a rather fragile, but universal human trait.

### *Polymathy as an individual trait*

While there are some arguments to defend that polymathy is a species trait, some authors tend to see polymathy as an attribute of specific individuals. Wower, the author of the first treaty on polymathy, is a good example; he asserted that polymathy is defined by an individual's "sheer diversity of philosophical interests" WOWER (1665 apud DOUKAS, 2001). Other authors, albeit focusing on different aspects, also follow the same direction: "[polymaths are individuals] not bound by labels on degrees and job descriptions" (SPALDING and GIBSON, 2013, p. 14); "[polymaths are] people whose preference is for variety over concentration; whose process involves widening their options rather than narrowing their choices as they go with their energy flow" (LOBENSTINE, 2013, p. 19).

This view implicates that some individuals possess specific traits (e.g. having a broad range of interests, not being bound by labels, having a preference for variety, etc.) that are not shared by everybody. Therefore, only the individuals who possess those characteristics would be polymaths.

The assessment of polymathy as an individual characteristic, utilizing Buss's criteria, can be conducted in a similar way to what was done in the previous section. It is important to emphasize that Buss established his criteria from an evolutionary biology standpoint. Thus, such analysis depends on presupposing that the features of polymathy are heritable. In the same work, the author warned about some of the shortcomings of this approach. Nonetheless, regarding the development of the construct of polymathy, it will provide a base for rational and organized proposals about the construct.

In the previous section, during the adaptability discussion, it was posed that the desire to pursue a variety of knowledge and experiences became prevalent in the human gene pool, resulting in a universal species trait. Here, we can speculate towards another direction: that this feature did not spread evenly in the human race. Thus, some individuals might have inherited a high degree of "polymathic genes" while others inherited a smaller degree of these characteristics. This would result in polymathy as an individual trait rather than a species trait, similar to Wower's view that some individuals are endowed with more diversity of interests than others.

From an evolutionary biology standpoint, polymathy as an individual trait must have been neutral or aided some individuals' fitness and/or reproductive

success in certain circumstances, but not in a way that it became prevalent in the whole species, such as the universal possession of molar teeth, for instance. Genes that were responsible for lack of molars were wiped out of our species gene pool because the “trait” of having molars was such an enormous evolutionary advantage. If polymathy is viewed as a genetic individual characteristic, the genes responsible for “non-polymathy” were not punished with the elimination of the gene pool, they co-exist with their counterparts in the human gene pool in the same sense that there are extravert and introvert people.

### **Personality psychology and polymathy**

The aim of this section is to advance in the understanding of polymathy as a trait by articulating well-developed theories of the study of personality with the construct of polymathy. While the previous approach focused on aspects of the evolutionary biology, in this section the approach is done through the study of personality and the psychological components of the mind.

There is a tradition in Psychology to partition human consciousness in three domains: cognitive, affective, and conative (TALLON, 1997; HUITT and CAIN, 2005)

The first domain, cognition, refers to the process of coming to know and understanding something, utilizing existing knowledge and generating new knowledge. It involves encoding, perceiving, storing, processing, and retrieving information.

The second domain, affect, is sometimes substituted by the term emotion. It refers to the emotional interpretation of perceptions, information, or knowledge. It is generally associated with one’s attachment (positive or negative) to people, objects, ideas, etc.

The third domain, conation, refers to a conscious effort to carry out self-determined acts (KOLBE, 1990). It is also referred to as “will” and is sometimes replaced as a domain by “volition”. Conation derives from the Latin *conari*, which means “to endeavor, to try” (HARPER, 2014). It has been associated with the concepts of intrinsic motivation, volition, agency, self-direction, and self-regulation (Kane, 1985; Mischel, 1996 *apud* HUITT and CAIN, 2005). Conation has received different definitions by various authors:

The conscious drive to perform apparently volitional acts, with or without knowledge of the origin of the drive, distinguished from affection and cognition.

(RIGGS, 2007, p. 1)

The mental process that activates and/or directs behavior and action. [...] It is the personal, intentional, planful, deliberate, goal-oriented, or striving component of motivation, the proactive (as opposed to reactive or habitual) aspect of behavior.

(HUITT and CAIN, 2005, p. 1)

The ability to apply intellectual energy to a task, as needed over time, to achieve a solution or completion.

(REITAN and WOLFSON, 2000, p. 1)

In this work, I chose the term “conation” over the more popular term “volition” because the former is more encompassing; it includes volition, but also additional aspects such as planning and perseverance (HUITT and CAIN, 2005).

The concept of polymathy as a personality trait encompasses all the three domains of a person’s psychology while the view of polymathy as a condition seems more concerned with the cognitive domain of the mind.

The deep involvement of polymathy and cognition is expected; after all, polymathy has to do with *mathema*, which, as seen, is intrinsically connected to the concept knowledge and knowing. Nonetheless, the concept of polymathy as a trait must pay special attention to the interplay of cognition, affection and conation. Studies have shown evidence for an integration of emotion and cognition in human consciousness (GRAY *et al.*, 2002). It is expected that emotional interpretations of information and knowledge will play an important role on polymathy as a trait. For instance, people with multiple interests may have a different type of attachment to certain areas of knowledge, than individuals without this characteristic. Finally, conation, or the mental process that activates and/or directs behavior and action will also be fundamental for the composition of polymathy as a trait, as it propels

individuals to action. For instance, we can imagine how important the conative aspect of perseverance is for an individual striving to develop depth of knowledge in more than domain.

In the next part, we advance in the discussion through the articulation of one of the most prominent models of personality, the Big Five model, with concepts regarding to polymathy. The rationale is that the confrontation of the still provisional concepts of polymathy with the more robust and well-studied dimensions of the Big Five will yield insights and add value in order to build a more solid model of polymathy, which is proposed in the following section.

### *The Big Five and polymathy: possible correlations*

One of the most widespread and consensual systems of personality description in the field of psychology is the Big Five model (GOLDBERG, 1990, 1993; SOLDZ and VAILLANT, 1999). This model operates with five superordinate dimensions, the so-called Big Five factors. They are: openness, conscientiousness, extraversion, agreeableness, and neuroticism. Below them, there are clusters of correlated and more specific primary factors. For instance, “extraversion” includes sub-elements such as gregariousness, assertiveness, excitement seeking, warmth, activity, and positive emotions (MATTHEWS *et al.*, 2009). One of the qualities of the Big Five model is its well-developed instruments and measurements tools, along with an uncountable number of studies that add to the robustness of the model.

In this work, I will concentrate in only two dimensions of the Big Five: openness and conscientiousness. The justification is that these two elements present the best prospect of having a strong correlation with the construct of polymathy, either understood as a trait or as a condition, for reasons discussed below.

### *Openness and polymathy*

Among the Big Five factors, openness (sometimes referred to as openness to experience) appears to hold the closest association with the construct of polymathy. Openness regards an individual tendency to be curious, intellectual,



imaginative, creative, innovative, and flexible (PARKS-LEDUC *et al.*, 2014); it entails six sub-dimensions: (1) fantasy, i.e. receptivity to the inner world of imagination; (2) aesthetics, i.e. appreciation of art and beauty; (3) feelings, i.e. openness to inner feelings and emotions; (4) actions, i.e. openness to new experiences on a practical level; (5) ideas, i.e. intellectual curiosity; and (6) values, i.e. readiness to re-examine own values and those of authority figures (WEINER and GREENE, 2011).

Openness to experience has been associated with a variety of other constructs, including divergent thinking (MCCRAE, 1987), and artistic and scientific creativity (PERRINE and BRODERSEN, 2005). Also, individuals who score high on openness to experience also have a tendency to value stimulation and self-direction while giving less importance to conformity, tradition, and security values (LUK and BOND, 1993; ROCCAS *et al.*, 2002; OLVER and MOORADIAN, 2003). Of these aspects, I will focus on divergent thinking and self-direction as hold important relations with polymathy.

Divergent thinking is “cognition that leads in various directions” (RUNCO and STEVEN, 2011, p. 577). It is a thought process or method used to generate creative ideas by exploring many possible solutions. I defend that divergent thinking and polymathy share a vital connection: if one is expected to explore many possible solutions, or cognize in various directions, the development of breadth and depth of knowledge and the inclination for making connections of ideas (or *mathemata*) must be essential. It might even be a reciprocal process: if one is used to exercising divergent thinking, i.e. exploring plural possibilities, it is expected that this individual will tend to develop at least plural and connected knowledge (two great dimensions of polymathy) more easily.

Another feature that is associated with openness that might possibly be also connected with polymathy is self-direction. The concept of self-direction is closely connected with “autonomy” (CANDY, 1991) Self-direction is the quality of being guided by oneself, as an independent agent. It involves how individuals control their behavior by using their convictions and internal demands (CANDY, 1991; SCHWARTZ, 1992). According to Gibbs (1979), “the autonomous person is an independent agent, [...] not subject to the authority of other persons or things”. The interplay of self-direction and polymathy is especially important when the individuals are faced by social pressures that may limit their autonomy. Carl Sagan

(2012) stated the preoccupation that “strong pressures for social conformity both by the government and by peer groups” (p. 133) can undermine the development of polymathy. To him, polymathic individuals must be able to “develop and pursue his or her own interests no matter how unusual or bizarre” (SAGAN, 2012, p. 133). Thus, the role of autonomy becomes crucial. Autonomy would work as a resource for polymathic individuals to endure pressures for conformity and to enable the exercise of intellectual freedom even when it opposes or displeases some kind of authority. In sum, it is expected that individuals who are more self-directed will tend to resist pressures for conformity more effectively and will pursue their interests despite the existing oppositional social pressures. This characteristic appears in individuals with a high degree of openness (LUK and BOND, 1993; ROCCAS et al., 2002; OLVER and MOORADIAN, 2003) and is expected to appear in individuals with a high degree of polymathy as well.

#### *Conscientiousness and polymathy*

Conscientiousness overall refers to “the degree to which a person is responsible, dependable, persistent and achievement-oriented. A conscientious person is focused on a few goals, which he or she pursues in a purposeful way, whereas a less conscientious person tends to be easily distracted and impulsive” (DAFT, 2007, p.100). Here, I posit that the construct of conscientiousness as a whole might be positively associated with polymathy. Nevertheless, the aggregate construct of conscientiousness contains sub-dimensions that might interact with the polymathy in a different way from the overall construct; while some elements of conscientiousness might be vital for the development of polymathy, others might be neutral, having no obvious or direct connection to polymathy as a trait or condition, and others might even be negatively related to polymathy as a trait. The sub-dimensions of conscientiousness are: (1) competence; (2) order; (3) dutifulness; (4) achievement striving; (5) self-discipline; and (6) deliberation (WEINER and GREENE, 2011).

Moon (2001) poses that the construct of conscientiousness has two factors (duty and achievement striving) that can conflict with each other:

The author proposes that 2 facets of conscientiousness, duty and achievement striving, affect decision makers in escalation of commitment dilemmas in opposing ways, thus masking the predictive ability of a broad measure of conscientiousness. It is proposed that duty is associated with an other-centered orientation and that achievement striving is associated with a self-centered orientation. Analyses of decisions from 360 respondents showed that duty was associated with a de-escalation of commitment, achievement striving was associated with an escalation of commitment, and the broad measure of conscientiousness was unassociated with commitment. The author advocates the utility of understanding potential self-centered versus other-centered aspects of the criterion of interest when conducting personality-based research.

(MOON, 2001, p.533)

I propose that conscientiousness will be positively associated with the trait polymathy especially by the sub-dimensions of competence, achievement striving and self-discipline. Completing tasks successfully (competence), working hard (achievement striving) and not wasting time (self-discipline) appear to be very important aspects of the conative process of developing polymathy.

As seen, polymathy can be manifested in the personal sphere alone (in the form of philosophical and experiential polymathy) or include the public sphere (in the form of pragmatic polymathy and creative polymathy). It appears that the sub-dimension achievement striving affect polymathy in the individual in different ways. If achievement striving is working hard, the question is what and whom the individual is working for. Two types of polymathy (philosophical and experiential) are chiefly self-centered oriented, i.e. they are mainly concerned to the individuals' own interests, while two others (pragmatic and creative) need an other-centered orientation since their products and actions need to be perceived as valuable by the members of society. A self-centered oriented achievement striving seems to be critical for the development of philosophical and experiential polymathy (the achievement of outstanding broad and vast knowledge and experiences can be seen as an end in itself and fully satisfying for some people, even in the absence of wide social recognition). An achievement striving that is other-centered oriented may be essential for pragmatic polymathy (the individual will solve different social

problems with his actions) and helpful for creative polymathy (the individual must heed the necessities of society and the gaps that can be filled with creative ideas).

The other “facet” of conscientiousness is dutifulness. It is essentially an other-centered oriented feature and, as posed by Moon (2001), it is associated with a de-escalation of commitment. Dutifulness (or duty) may have counterintuitive relations to polymathy. On the one hand, it might be helpful for the achievement of depth, thoroughness and completion of tasks by adding external pressure and motivation for the fulfillment of external expectations and/or commitments by the polymathic individual. On the other hand, if a different aspect of dutifulness is considered, for instance, the attachment to rules, we can expect a conflicting relation: polymathic individuals might be disregarding of rules but extremely conscientious of commitments pledged with other individuals. These subtle questions may be easily overlooked while measuring the degree of conscientiousness of polymathic individuals. With the maturation of the construct polymathy and the development and validation of measurement tools, future studies may confirm or disprove these postulations.

### **Considerations on polymathy as a personality trait**

The discussion of polymathy as a trait evokes important philosophical issues regarding standpoints in the debate of freedom versus determinism, heredity versus environment, and uniqueness vs. Universality. Engler (2013) suggests that these dichotomies are important questions to be addressed by theories of personality psychology. One of these dichotomies, the question of uniqueness vs. universality, was already discussed in the section about evolutionary biology. Now, the work will focus on issues about freedom versus determinism and heredity versus environment. These two issues are closely related and have been a theme of discussion for another construct that, like polymathy, is regarded as complex and multi-faceted and is central to this work: leadership.

One of the first systematic attempts to study the phenomenon of leadership was done with a strong focus on individual characteristics (DAY and ANTONAKIS, 2011; NORTHOUSE, 2013). This perspective is sometimes called “the great man [sic]” approach. It is characterized by the belief those “great” people were born with certain traits that would clearly differentiate them as leaders. This

view has three important implications: (1) it places low or no degree of freedom for the individuals to control their traits; they are viewed as innate, thus cannot be developed if it is “not there” in first place, (2) it places little importance on the environmental factors that may help shape the individual’s behavior, and (3) it is extremely person-centric, it pays too much attention to personal factors while tending to disregarding that some behaviors may be attributable in particular cases of social exchanges.

This work’s proposition of polymathy drifts away from deterministic perspectives such as the great person approach of leadership in at least two ways: (1) this work sees personality as somewhat malleable, not as something completely fixed, studies have pointed that personality does have some degree of plasticity and individuals can successfully and durably change it (HAYES, 2000; CASPI and ROBERTS, 2001; BOYCE *et al.*, 2013); (2) this work supports the idea that the interplay of genetics and the environment is part of a complex process in which reciprocal influence occurs, thus, for the manifestation of a trait, the genes and the environment have a “joint responsibility”, neither of them is completely preponderant over the other (PLOMIN, 1994; HAYES, 2000; RIDLEY, 2006; GOLDHABER, 2012).

Another important issue is the degree of malleability of human personality in the different stages of life and the how different stimuli can affect the development of a characteristic, making it flourish or stifling it. As discussed in the section about evolutionary biology, polymathy would be a fragile trait. Even though some people might have the disposition to pursue multiple interests as adults, this broad curiosity appears to be more easily manifested by children. Somewhere in our development, many of us tend to stifle this characteristic. The astronomer Carl Sagan supposes that the kind of culture that a child is raised will play an important role in the continuity of this trait (SAGAN, 2012). An opinion shared by the author.

Regarding the construct analysis according to Law’s taxonomy (LAW *et al.*, 1998), polymathy as an individual trait would fit the category of *latent model*, which means that the construct is an underlying higher-order abstraction behind its dimensions. In this conceptualization, polymathy would have different dimensions from the ones proposed before (breadth, depth and connectedness), which were more suitable for the conceptualization of polymathy as a condition. Those three elements, however, would remain as consequences, but not the determinants of the

trait of polymathy. Polymathy as a trait would have different dimensions and they would not exist at the same level of the construct; they would be lower-order manifestations of it, as Law's latent model of multi-dimensional constructs suggest.

To summarize the discussion, if polymathy is regarded as an individual trait, I defend that:

- Polymathy is a developable feature;
- Both the environment and genetics play a role in its formation;
- Polymathy is very sensitive: depending on the environment the trait of polymathy would be either nurtured or repressed in the individual;
- Polymathy is a higher-order latent construct, not an aggregation of its dimensions;
- In a nomological order, polymathy as an individual trait antecedes polymathy as a condition (the attainment of breadth, depth and connectedness of knowledge, experiences, competences or creativity).

### 3.4.3 Polymathy as a worldview (*Weltanschauung*)

A worldview, or *Weltanschauung* in the German philosophy, is a person's total phenomenal outlook on the world. It is a "set of assumptions about physical and social reality that may have powerful effects on cognition and behavior" (KOLTKO-RIVERA, 2004, p. 3).

As seen, polymathy is a complex construct that possibly involves all aspects of human consciousness, with powerful effects on the individuals' cognition and behavior, as well as their affection and conation.

It can be conceptualized as a condition to be aspired, as in the discussion of polymathy as an attainable condition. In this case, polymathy would refer to the amassment of breadth and depth of learnings, with the capacity to form connections among them. However, I pose that the term "trait", utilized in the second conceptualization of polymathy, might not be the most suitable category for such phenomenon.

First, the conceptualization of trait in an evolutionary biology view presupposes that we are referring to specific genotypes (genes) that will influence the manifestation of certain phenotypic (observable) traits under certain conditions. In a trait like neuroticism, this approach works well: individuals may have genetic dispositions towards developing greater neuroticism, guarding the fact that the manifestation of this trait is mediated by environmental factors. It is a more linear thought. Nonetheless, in regard to the phenomenon of polymathy, which involves a complex web of relations of both individual features and environmental influences, the view of evolutionary biology appears to offer just the part of the explanation that concerns to the individual's natural inclinations, not an explanation to the whole phenomenon.

Second, in the psychological standpoint, a trait is seen as a fairly steady, reliable, and enduring interior characteristic which is inferred from a trend of actions, outlooks, feelings, and habits within the person. Although it appears to be an adequate category for polymathy, we would still need to address it as a latent construct which is behind its behavioral manifestations, and maybe another type of conceptualization might be more suitable to perform this function and encompass other aspects of the phenomenon.

Thus, in this section I present the proposal of polymathy as worldview or *Weltanschauung* and pose some advantages and disadvantages of conceptualizing polymathy this way.

The first advantage is that a worldview is more encompassing than a trait. Generally, the term trait is used as a category for types of constructs that are somewhat idiosyncratic characteristics in the individual that have a limited effect on his behaviors, e.g. gregariousness, laziness, impulsiveness, bravery, obedience, etc. It is not usual for a trait to affect the individual's whole psyche very deeply, as a worldview does. In fact, worldviews encompass traits in the sense that, depending on one's worldview, some traits are valued differently. For instance, we can assume that the traits of "piety" and "humility" are seen as positive in a Christian worldview, while the trait of "inquisitiveness" is valued in a scientific worldview. It is possible to advance one step further and propose that adopting a certain worldview might induce the individual to develop traits positively associated to it. Nonetheless, traits interact with worldviews in complex ways, maybe the fact of possessing some trait will make the individual change his worldview, not the other

way around. In the case of polymathy, the same complexity is expected. It favors the choice of a more encompassing category, which can include complex relations with sets of individual traits, but is not restricted to them.

Second, a worldview deals with profound aspects of the individual, especially concerning one's life goals, aspirations and purpose in life. It involves complex set of variable such as one's culture, assumptions, interpretations of reality, in-looks, outlooks and the manner one interacts with the world. Traits are much more restricted categories for such discussions.

Third, the term worldview offers a better conception of malleability, development and plasticity whereas the term trait has already been associated with fixed, rigid views on the individual (see DAY and ANTONAKIS, 2011; NORTHOUSE, 2013). Thus, it contributes for the understanding of polymathy as a developable feature.

Finally, the conceptualization of polymathy as a *Weltanschauung* makes it easier for applying the construct to other entities besides the individual, such as seen in the work by Mirchandani and even in the discussion of polymathy and artificial intelligence.

On the other hand, considering the construct as a trait would make it easier to fit the new theory into existing models of personality psychology, compare it to other constructs and, most importantly, operationalize it. Nevertheless, I defend that those things can be done guarding the fact that, although polymathy is more complex than the standard view of trait can encompasses, the construct will be manifested through specific behaviors (the dimensions of polymathy), which can be assessed and operationalized. These dimensions will be discussed in the further sections.

### **A worldview as a complex mental programming**

Geert Hofstede, a Master in mechanical engineering and acclaimed organizational psychologist, came upon an interesting analogy called the “software of the mind” to describe his findings about the complex phenomenon of culture (HOFSTEDE *et al.*, 2010). The term “mental programming” is used to represent the patterns of thinking, feeling and potential acting that one acquires during his exposure to the social environment.



Here, I propose that Hofstede's analogy, which was valid for culture, is equally – or even more – valid as a tool to understand the phenomenon of polymathy. Polymathy, just as culture, can be seen as a set of mental programs; it involves specific patterns of thinking, feeling, and potential acting in the world.

Hofstede *et al* (2010) clearly defines the level of analysis in which culture occurs. Thus, it should be distinguished from other realms such as human personality on the one hand, and the universal human nature on the other hand. Nonetheless, he is careful to note that these borders might be subtle or cloudy sometimes.

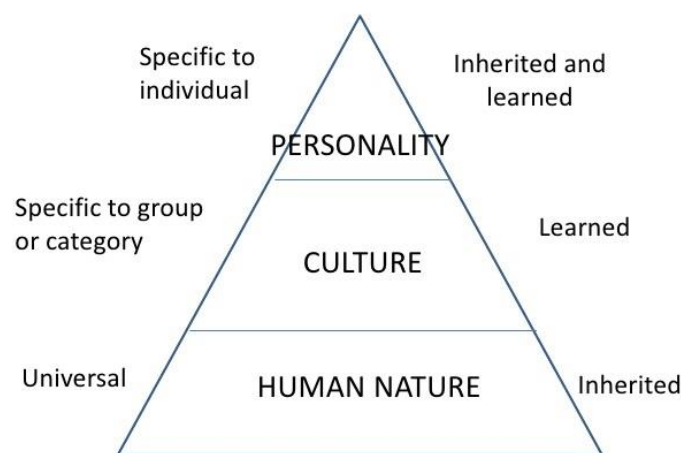


Figure 16. Three levels of uniqueness in human mental programming.  
Adapted from Hofstede *et al.* (2010).

Polymathy, unlike culture, is not restricted to a single level of analysis in that pyramid, it permeates human nature (as discussed in the section about evolutionary biology), culture (specifically discussed in the topics of culture and structuration and agency, but implied in the whole discussion), and personality (as discussed in section 3.4.2).

In the next section, a definition and description of the phenomenon is presented along with a nomological network of how the elements in different levels of analysis may interact for the formation of a polymathic worldview.

### 3.5. A THEORETICAL MODEL OF POLYMATHY

In this section, I present the definition of polymathy as a worldview, its description and the proposed dimensions and sub-elements of the construct. Also, some relevant issues about this conceptualization are discussed.

#### 3.5.1 Definition and description of polymathy

Based on the previous discussions, and considering polymathy as a worldview, this work proposes the following definition for polymathy:

*Polymathy is a fundamental orientation of individuals or groups towards the pursuit of breadth, depth and connectedness of learning. It involves the practice and development of behaviors and capacities that concern this pursuit. It also implies that this pursuit will result in positive transformations and contributions to society.*

Considering polymathy as a fundamental orientation is consonant with the idea of polymathy as a worldview. The basic standpoint of this perspective is considering the pursuit of breadth, depth and connectedness of learning as a central axiological value. Here, it is useful to bring another construct that is well-established and utilizes the term “orientation” to draw an analogy and assess the adequacy of this utilization. A construct that fits these requirements is concept of “goal orientation”. Goal orientation is a "disposition toward developing or demonstrating ability in achievement situations" (VANDEWALLE, 1997 p. 8). Thus, a polymathic orientation would be a disposition toward developing the required elements of polymathy. An orientation serves as a direction, but needs a framework and a praxeology to achieve the objective. A worldview, or *Weltanschauung*, includes such framework and praxeology.

This definition emphasizes that polymathy as a worldview can be applied both at the individual level and at the group level. Therefore, individuals, groups, organizations and societies can be polymathic.

A polymathic worldview encompasses behaviors and the development of certain capacities. The behaviors are the manifest dimensions of this worldview and the capacities are tools for personal and group development, which are instrumental for the attainment of the goal of polymathy.

Finally, polymathy should never lead to an unsustainable social system or condition. On the contrary, the fundamentals of polymathy as a worldview embed the idea of a positive feedback loop between individuals, groups and societies: the groups and the society's systems must be conducive to the development of multiple learnings, while the learning and knowledge developed by individuals and groups will lead to an enhanced general social condition and better systems, which by its turn will provide even more possibilities for the development of learning and knowledge by groups and individuals, and so on.

## Discussion

Regarding the discussion of freedom versus determinism, , heredity versus environment and uniqueness vs. universality, this model assumes the following standpoints:

Polymathy is based on a fundamental orientation of pursuing multiple learnings. There is, possibly, a species component that impels humans to be curious, as discussed in the topic about latent polymathy. Thus, there is a universality component affecting polymathy. Nonetheless, there is also uniqueness: individual differences might make some individuals more prone to display a broad wide-ranging curiosity, while other individuals might naturally be inclined towards a narrower range of interests. This natural "proneness", is however, deeply affected by the environment. Thus, as discussed in the topic of polymathy as a trait, this work defends a position of balance between heredity and the environment: their interplay constitute a complex process in which both factors influence each other. Also, this view of polymathy assumes that both the volitional part of the polymathy, i.e. the desire of pursuing multiple interests, as well as the capacities that are

instrumental for the attainment of the polymathic condition are developable. Thus, it takes a freedom instead of a deterministic stance; individuals are capable to act upon and change their worldviews, alter their behaviors and develop their capacities.

Another topic of discussion is the importance of the *praxis* that the individuals or groups embody. In environments where the pursuit of multiple or different interests are discouraged, the volitional force of polymathy might waver or be redirect towards different endeavors. It means that polymathy as an individual worldview is deeply affected by the systems and environments that he or she is inserted in. Environments in which there is a high degree of pressure for submission or conformity are less likely to produce individuals exercising a polymathic worldview. That is the sense of polymathy as a “sensitive” feature discussed in the topic of polymathy as a trait.

### **Axiological considerations on polymathy as a worldview**

When the definition of polymathy entails that the polymathic pursuit will result in positive transformations and contributions to society, it embeds an axiology, or a theory of value. Therefore, it is important to discuss what should be considered valuable, i.e. “good” or “positive”, in a polymathic sense. The whole discussion entails deep philosophical issues that escape the scope of this work. Nevertheless, I must highlight this important component of a *Weltanschauung* and pose the principles whereby it works based on the discussion on the concept of polymathy so far.

Polymathy has the three great dimensions of breadth, depth and connectedness of learnings, knowledge and experiences as its foundation. Anything that favors at least any of these dimensions without hampering the development of the other dimensions is good, in a polymathic sense. For instance, an artwork that offers the audience a new, pleasurable or even odd experience embeds breadth (it adds to the variety of the world), depth (it depends on the development of technical skills), and, possibly, connectedness (it can be a form of communication). The same reasoning serves for a new product or the development of new ways of making products, or offering services.

Thus, the golden rule for goodness in a polymathic worldview is assessing the contribution of actions according to the three great dimensions of polymathy. If they work against a dimension of polymathy, they are fundamentally anti-polymathic. Here are some examples of anti-polymathic categories because they harm at least one dimension of polymathy: (1) *monomathy*, the corruption of depth, it involves insistence in only one subject disregarding the breadth of the world, it is related to the idea of narrowness; (2) *dilletancy*: the corruption of breadth, it involves lack of conative efforts in pursuing depth in at least one subject, it is related to the idea of vagueness and superficiality; (3) *schizoidism*: the lack of connectedness, it involves a rupture while dealing with different subjects and ideas, disregarding the connectivity between them; (4) *the act of “bridling”*, i.e. imposing pressures for submission or conformity, hampering the pursuit of different interests by the individuals.

### **The construct's classification**

Polymathy as a *Weltanschauung* entails a model of polymathy as an abstract latent construct that is influenced by aspects existing at different levels: human nature, culture and individual personality. Furthermore, this model of polymathy encompasses all domains of human consciousness (cognition, affect and conation). My proposition is that polymathy as a *Weltanschauung* exists as a higher-order abstraction behind dimensions that will be described in the next section. These dimensions are the manifest part of polymathy and can be expressed (and assessed) through actions, outlooks, feelings, behaviors and habits of the individual.

According to Law's taxonomy (LAW *et al.*, 1998), this conceptualization of polymathy fits the category of a latent construct, i.e. a higher-order abstraction that exists behind its dimensions.

### **3.5.2 Dimensions of polymathy as a worldview**

The essence of polymathy as a worldview is intangible. Thus, the dimensions of polymathy presented here are the behaviors, attributes and capacities of individuals and groups that possess polymathy as their main worldview, i.e. they

carry a fundamental orientation towards the pursuit of breadth, depth and connectedness of learnings. The choice of each feature that constitutes a dimension of polymathy is based on the discussions held so far. In this section, I define and explain each dimension, with its rationale.

Therefore, I propose the following ten behaviors as manifested dimensions of polymathy as a worldview: (1) broad curiosity; (2) thoroughness; (3) connectedness; (4) ambidexterity; (5) critical open-mindedness; (6) polymathic confidence; (7) mathematical empathy; (8) challenging humility; (9) unbridledness; (10) transcendancy.

### **Broad curiosity (or pluri-mathematical eagerness)**

Broad curiosity, or pluri-mathematical eagerness, implicates the *desire to learn, seek knowledge and acquire skills regardless of area or domain*. It involves an outstanding and broad curiosity and also the desire to explore multiple aspects of life and acquire multiple experiences. It leads to the broad way of thinking that Carl Sagan noted as “desperately needed” (SAGAN, 2012, p.133). It is associated with the great dimension of breadth (described in section 3.3.2).

Seeking plurality of learning is related to the axiological principle of polymathy that the human mind should be broad and plural instead of narrow and limited. Breadth, of the three dimensions of polymathy, is the closest to being *bono simpliciter*, i.e. good in itself, fittingly valued by everyone (SUIKKANEN, 2009). Thus, fostering plurality of experiences, breadth of knowledge and learnings is desirable for a polymathic system.

This dimension involves a conative force towards the development of multiple *mathemata* (learnings and experiences). In other words, it represents a “multi-learning drive”. It encompasses the characteristic of possessing multiple interests, described by some authors as a fundamental component of polymathy (see ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2004; and WOWER (1665 apud DOUKAS, 2011).

Many authors have described the intimate relation of curiosity and polymathy: “polymathy (...) is truly about the profound curiosity for the world

around” (SANDRINE, 2014); “a polymath usually does not think of his or herself as being particularly smart, only curious” (LACEY, 1999); “curiosity and interest are the true motivation for work, both intellectual work and the nitty gritty of hands on inventing” (LACEY, 1999).

Curiosity as an eagerness for knowledge was described by Litman (2005). The author proposes a framework of curiosity that incorporates findings of neuroscience about one’s appreciation for and wanting of knowledge. According to his view, curiosity reflects both experiences of interest in learning something new and a feeling of knowledge-deprivation by wanting to close a perceived knowledge gap (LITMAN, 2005). In its highest degree, curiosity “stimulates an intense desire for knowledge, the satisfaction of which requires the acquisition of substantive facts” (LITMAN, 2005, p.806).

This dimension possesses subtle differences in relation to the traditional concept of curiosity, hence the name of “broad curiosity” or “pluri-mathematical eagerness”. Its main difference is the emphasis on breadth and plurality. Curiosity alone, as posed by authors such as Litman (2005) refers to the desire of closing a knowledge gap. However, for fulfilling the criterion of a polymathic dimension, this curiosity must be broad, i.e. span different areas of knowledge. The term pluri-mathematical eagerness would be more precise in representing the concept, as the dimension involves specifically a desire, or eagerness, to develop multiple *mathemata*. Nonetheless, since the construct of curiosity has a great history of usage, and given the similarities to the construct proposed, the term “broad curiosity” is also adequate to represent this dimension.

## Thoroughness

Thoroughness stems from the Old English *puruh*, meaning "from end to end, from side to side" (HARPER, 2014). It relates to the idea of completeness, accuracy and carefulness. In this work, thoroughness refers to *executing philosophical investigations with depth, attention and accuracy; without negligence, omissions or dishonesty*.

Thoroughness is closely related to the great dimension of depth (described in section 3.3.2) and its pursuit. It involves important conative aspects in the individual, such as the persevearance against difficulties of executing the long process of really achieving a satisfyingly thorough knowledge about something. This process often involves gathering data, sifting through the information and applying systematized reason in order to transform unorganized amounts of data into valid knowledge or wisdom.

In the psychological literature, thoroughness can be related to the concepts of “grit” and “perseverance”. They involve the passion and the capacity to persist until the achievement of long-term goals. Grit entails “working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress” (DUCKWORTH *et al.*, 2007, p. 1087-1088). Thus, it involves a conative element that drives individuals away from quitting on difficult challenges and towards delving into them until they are resolved.

Thoroughness, in conjugation with pluri-mathematical eagerness, leads to the development of a broad and profound worldview, by the thorough investigation and search for satisfyingly rational and plausible explanations for the greatest number possible of phenomena in the world.

The final aspect of thoroughness is that it must be balanced. An endless desire of thoroughness would lead to a similar situation as described by the example of the artificial intelligence that “desires” to calculate, from end to end, the value of  $\pi$ . In polymathic individuals, groups and entities, the employment of thoroughness must be always balanced by applying criticality to it and specially by heeding that the equally important quest for developing breadth of learnings and knowledge must not be hurt by the quest for thoroughness or depth.

### **Connectedness**

Many dimensions of polymathy as a worldview involve the development of a capacity or skill. They guard the property of being observable as behaviors but they require specific capacities or abilities to be operationalized. Connectedness is one of them.



The dimension of connectedness presented here has similar characteristics to the great dimension of the same name, discussed in section 3.3.2. Thus, connectedness is *the capacity to associate or relate things, concepts or ideas, especially from disparate areas or fields*. It involves forming connections of data, information, experiences, skills, knowledge and competences; encompasses the creation of useful relationships and webs of knowledge, and the perception of synergies among different bodies of knowledge.

Some very useful tools of thinking are deeply linked to the idea of connectedness, especially when it involves relating collections of knowledge, patterns, data, information and discoveries from one domain, discipline or area to another.

Analogizing, i.e. “recognizing a functional likeness between two or more otherwise unlike things” (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003, p. 381), is an important feature of intelligent thought linked with the idea of connectedness. This tool is useful for a series of circumstances, for instance, while learning a tool or concept that can be applied to different areas of knowledge; e.g. any person who has the understanding of the phenomenon of clogging from a life experience, can use the analogical capacity to notice that, in the field of Medicine, there is a condition called thrombosis, which is the formation of a blood clot inside a blood vessel, and that can be associated to the already known concept of clogging. In this example, the ability of analogizing correctly made the understanding of a new piece of knowledge easier, but its uses are far wider.

The paleontologist, evolutionary biologist and historian of science Stephen Jay Gould(2003) went further on the importance of the capacity of connectedness, especially for people considered polymathic. Gould, while investigating the unusual interests of the acclaimed writer and professional lepidopterist Vladimir Nabokov (the author of “Lolita”), came with the hypothesis that the two great life interests of Nabokov were somehow connected in his mind, and that both areas could please and nourish his intellect in similar ways. Gould was intrigued by the fact that Nabokov had invested so much time in the scientific activity of lepidopterology (the study of butterflies and moths) and he was trying to draw connections between his unusual interest in strange, intricate insects and his outstanding writing abilities:

I know no better case than Nabokov's for testing the hypothesis that an underlying unity of mental style (at a level clearly meriting the accolade of genius) can explain one man's success in extensive and fully professional work in two disciplines conventionally viewed as maximally different, if not truly opposed. [...] Perhaps the major linkage of science and literature lies in some distinctive, underlying approach that Nabokov applied equally to both domains — a procedure that conferred the same special features upon all his efforts. [...] Nabokov's two apparently disparate careers therefore find their common ground on the most distinctive feature of his unusual intellect and uncanny skill — the almost obsessive attention to meticulous and accurate detail that served both his literary productions and his taxonomic descriptions so well, and that defined his uncompromising commitment to factuality as both a principle of morality and a guarantor and primary guide to aesthetic quality.

(GOULD, 2003, p. 43)

Gould ends this essay with the proposition that Nabokov's scientific inclinations and authorial brilliance were two sides of the same coin, and that something in his way of thinking helped elevate the whole coin (his intellectual brilliance in both areas). He speculates that the common element that connected, united and served both passions in Nabokov's case involves his “almost obsessive attention to meticulous and accurate detail” (GOULD, 2003). Maybe not surprisingly, Nabokov's characteristic of being meticulous and accurate is related to another dimension of polymathy: thoroughness.

Even if Gould's hypothesis does not hold true, the development of connectedness adds to new ideas opportunities by bringing together concepts and ideas that were considered unlike and disconnected. It is valid in the realm of the individual and in the realm of the group. As all parts of the brain are already physically connected, the dimension of connectedness gains a new meaning when the bits of data, information and knowledge are scattered through lots of individual, separate brains.

### **Ambidexterity**

Traditionally, ambidexterity has three meanings: (1) the capacity of using both hands with equal ease; (2) being unusually skillful, versatile; and (3) being characterized by duplicity (MERRIAM-WEBSTER, 2015a). This term was also appropriated by the organizational literature generating the construct organizational ambidexterity (DUNCAN, 1976). In this work, ambidexterity means *the utilization of seemingly disparate or oppositional skills, stances or concepts equally well and in balance*.

This dimension, like connectedness, is observable as a behavior but embeds the development of a capacity or skill. In a polymathic standpoint, ambidexterity is tool that enables the group or individual to operate well with multiple concepts, ideas, skills and modes of thinking, which can be quite disparate sometimes. A solid example of the relevance of ambidexterity in organizations is seen in the article of Karahanna (2013), in which the authors pose that it is helpful for the performance of an organization the development by Chief Information Officer (CIO) – traditionally a professional with very hermetic and technical language and background – of a *shared cognition and shared language* with other members of the Top Management Team (the CEO, CFO, CMO, COO, etc.) According to them, if a CIO can speak the “language of the finance”, he can better explicit the value of a very technical and important project to the CFO; if he understands more of the business itself, he can improve his communication with the CEO and better align the Information Systems’ strategy with the firm’s strategy and so on. Thus, the more ambidextrous this professional is the more value he or she can generate to the organization. It is, though, important to highlight the absolute non triviality of easily bouncing from environment to environment, having to utilize different modes of thinking and different sets of skills in each circumstance. The image of leaving an information technology meeting filled with specific technical jargon of the sector and going to another meeting in which the tone is finance, whose terms and mindsets are completely different, gives an idea of the difficulty to achieve such ambidexterity.

Ambidexterity is also instrumental for behaviors that will be outlined further and involve the use of apparently oppositional ideas such as critical open-mindedness and challenging humility.

## Critical Open-Mindedness

Critical open-mindedness refers to *the behavior of being primarily open to new and different ideas, but also being aware and critical of the quality, accuracy and relevance of the information*. As the name implies, it involves two apparent oppositional aspects: open-mindedness and criticality.

Open-mindedness refers to receptiveness to new ideas. It means displaying an unprejudiced and unbigoted attitude towards other's ideas and arguments. It is an epistemic virtue according to Riggs (2010), i.e. it is a valuable behavior in the pursuit of knowledge. The author poses that being open-minded is "to be aware of one's fallibility as a believer, and to acknowledge the possibility that anytime one believes something, one could be wrong" (RIGGS, 2010, p. 172).

For the same reason that open-mindedness has epistemic value, it is a fundamental feature for polymathy, which encompasses the pursuit of learning and knowledge in many areas. Individuals, groups and systems that are closed-minded and unreceptive to new and different ideas will not have the means of developing a broad and profound worldview, which is a fundamental idea for polymathy.

Critical thinking is the other component of the critical open-mindedness dimension. It refers to the application of critique. One of the most comprehensive definitions of critical thinking is found in a statement at an International Conference on Critical Thinking and Education Reform, it goes as follows:

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness.

(SCRIVEN and PAUL, 1987)

Thus, critical thinking is a meta-quality of thought. It is applying critique to one's thoughts and other people's thoughts and ideas.

The conjugation of both components is one of the cornerstone behaviors of polymathy.

### **Polymathic Confidence**

Confidence refers to one's feeling or belief that he can do something well or succeed at something (MERRIAM-WEBSTER, 2015a). In the psychological literature, confidence is described as an "individual's conviction [...] about his or her abilities to mobilize the motivation, cognitive resources, and courses of action needed to successfully execute a specific task within a given context" (STAJKOVIC and LUTHANS, 1998). Confidence has also been associated with the concept of Positive Psychological Capital (LUTHANS *et al.*, 2004). Confidence is seen as a developable positive psychological capacity that can yield benefits to the individual, e.g. studies have shown a strong positive relationship between confidence and work-related performance (BANDURA, 1997).

Polymathic confidence is confidence in the context of polymathy, i.e. *the conviction about having the resources to succeed in the pursuit of breadth, depth and connectedness of learnings and knowledge*. It entails the conviction that one can mobilize their conative and cognitive resources successfully while engaging a new learning task. In other words, it is the attitude of approaching any body of knowledge with confidence that it can be mastered. Its opposite would be a perception of incapacity to develop either depth, breadth or connectedness of knowledge and learnings.

### **Mathematical Empathy**

Empathy means understanding a person from his frame of reference. In the psychological literature, empathy is associated with aspects of Emotional Intelligence, specifically concerning to the capacity of perception and appraisal of emotions. Salovey and Mayer (1990) define the empathic dimension of emotional intelligence as the one's ability to comprehend the feelings of others and to re-experience them as if they were his own.

Mathematical empathy entails the search to comprehend another person through their frame of reference, but instead of emotions and feelings it is focused on one's ideas (*mathema*). Thus, mathematical empathy refers to *the ability to comprehend another person's ideas and the true meaning or purpose behind them, seeking to utilize the other person's frame of reference*.

Since polymathy encompasses the pursuit of breadth of knowledge and experiences, mathematical empathy works as another instrumental tool in the toolset to develop higher levels of polymathy in the individual and the group.

### **Challenging Humility**

Challenging humility, in a similar fashion to critical open-mindedness, encompasses two apparent oppositional aspects: acting with humility and being challenging. Humility is here understood in the terms of intellectual humility, while being challenging involves courage and the disposition to face difficult situations in order to seek the truth, shun personal or collective irrational and unjustified beliefs and attain a deeper level of sapience about something.

Intellectual Humility entails the consciousness and recognition of our epistemic fallibility. It involves the acknowledgement of our sensitivity to biases and prejudices (see SPIEGEL, 2012). It is the opposite of intellectual presumptuousness, which entails arrogance and an unjustified conviction that one's ideas or viewpoints are utterly correct. Lack of intellectual humility may lead to self-deception and the entrapment of one's view.

As the term humility is used to describe a state of being humble and modest, it is important to highlight that intellectual humility does not imply submissiveness.

The component of challenging refers to the attitude of questioning the validity, correctness and truth behind ideas and positions even if represented by an authority figure. Sometimes it means standing up for an idea or a point, saying or showing that something may not be valid, true or correct when there are pressures for thinking or doing otherwise (see PAUL and BINKER, 1990). Courage, which

entails accomplishing a goal (in this case the pursuit of the truth) in the face of opposition or risk, is also implied (see PETERSON and SELIGMAN, 2004).

Thus, challenging humility is *the conjugation of courage, confidence and the desire to seek the truth with intellectual humility*. On the one hand, it encompasses questioning, seeking reason, asking for justification and not being submittable by force or authorities. On the other hand, it is being humble to observe biases and limitations in ourselves and in the others, as portrayed by the characteristic of intellectual humility. It is also a position of seeking understanding and perceiving the value of something before challenging it, especially concerning to complex structures and systems whose intricate composition, subtleties and inner workings and can easily perplex the brightest of minds.

### **Unbridledness**

A bridle is a device that fits on a horse's head and that is used for guiding and controlling the horse. Analogically, unbridledness means the absence of such “device”. Unbridledness is here defined as *the possibility of pursuing one's inner interests with little or no pressures for submission or conformity*.

For the development of polymathy, unbridledness (the absence of bridles) must occur at two levels: the individual and the group/society level.

In the individual, unbridledness entails displaying an internal disposition to resist to “social bridles”, i.e. pressures for submission or conformity. It is related to the concept of autonomy/self-direction, discussed in section 3.4.2, and the component of challenging described in the previous dimension.

In the group/society level, unbridledness entails the enactment of social norms, rules and systems that encourage diversity, variety and the proposal of new and different ideas. Groups and societies that, for whatever reason, cause the bridling of the minds by making strong pressures for submission or conformity on its members are the opposite of what unbridledness implies.

### **Transcendancy**

Transcendancy is the last dimension of polymathy and it is used here without any of the religious, mythical or metaphysical aspects that the term has acquired. The term stems from the classical Latin, *scandere*, which means "to climb, rise, mount" (HARPER, 2014). Thus, transcending means "climbing" beyond the usual limits.

In this work, transcendancy is a characteristic of agency in the world that can be displayed by individuals and by groups. It means *to rise above, go beyond and elevate the current state of affairs, making positive transformations and contributions to society*.

Transcendancy is a fundamental factor of polymathy, it functions as an aspiration, motivation and a goal to be achieved. Something that makes all the difficulties of developing broad, deep and connected learnings worthwhile. It is also related to the desire of achieving one's full potential and doing relevant works.

Polymathy as a *Zustand* can function as an aspiration and even an end in itself, however a complete polymathic process must entail a positive legacy that surmounts what has already been done; the dimension of transcendancy represents such pursuit and aspiration.

## Conclusion

Table 2 summarizes the definitions of each dimension along with a column with constructs approached and proposed by other authors that share similarities with the respective dimension.



Dimension	Definition	Related constructs
Pluri-mathematical eagerness	the desire to learn, seek knowledge and acquire skills regardless of area or domain.	Curiosity (LITMAN, 2005)
Thoroughness	executing philosophical investigations with depth, attention and accuracy; without negligence, omissions or dishonesty.	Grit (DUCKWORTH et al., 2007)
Connectedness	the capacity to associate or relate things, concepts or ideas, especially from disparate areas or fields.	Intuitive tools (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003)
Ambidexterity	the utilization of seemingly disparate or oppositional skills, stances or concepts equally well and in balance.	Organizational Ambidexterity (DUNCAN, 1976)
Critical Open-Mindedness	the behavior of being primarily open to new and different ideas, but also being aware and critical of the quality, accuracy and relevance of the information.	Critical thinking (SCRIVEN and PAUL, 1987); Open-mindedness (RIGGS, 2010)
Polymathic Confidence	the conviction about having the resources to carry out successfully the pursuit of breadth, depth and connectedness of learnings and knowledge.	Confidence (STAIKOVIC and LUTHANS, 1998)
Mathematical Empathy	the ability to comprehend another person's ideas and the true meaning or purpose behind them, seeking to utilize the other person's frame of reference.	Empathy (SALOVEY and MAVER, 1990)
Challenging Humility	the conjugation of courage, confidence and the desire to seek the truth with intellectual humility.	Intellectual Humility (SPIEGEL, 2012); Intellectual Courage (PAUL and BINKER, 1990)
Unbridledness	the possibility of pursuing one's inner interests with little or no pressures for submission or conformity.	Autonomy (GIBBS, 1979); Self-direction (CANDY, 1991)
Transcendancy	to rise above, go beyond and elevate the current state of affairs, making positive transformations and contributions to society.	<i>Bildung</i> (PEUKERT, 2002)

Table 2. Summary of the ten dimensions of polymathy as a worldview.

### 3.5.3 On measuring polymathy

Regarding measurements of the construct, polymathy as an adoptable and developable individual worldview is probably trickier to measure than polymathy as a condition. I posed that polymathy as a condition can utilize a simpler, aggregate model, and would be constituted by the sum of the degree of each of the great dimensions displayed by the entity (breadth, , and connectedness).

To accurately measure polymathy as a worldview, there are issues to be addressed at every instance and level of the process. At the lowest-order instance, there are the results of measurements for each dimension. This is a numerical representation of the dimension itself, manifested through actions, outlooks, feelings, behaviors and habits of the entity captured or collected by an instrument such as a survey.

The values of each dimension are not enough to reach the higher-order construct of polymathy as a worldview. Since this conceptualization of the construct fits the category of a latent construct, which means that polymathy is the common elements behind all its dimensions, I propose that it can be assessed through a covariance analysis of its dimensions (LAW *et al.*, 1998). According to this proposal, we can expect that, if the ten dimensions of polymathy are indicators of a latent construct existing behind them, their measurement will vary in tandem in the entity if it displays a polymathic worldview. It is important to note that, in this conceptualization, it is not the aggregate score that counts, but the consistent variation, in tandem, of all the dimensions.

For instance, if an individual has a high score in seven out of the ten dimensions of polymathy, but has a very low score in the other three, our assertive of his degree of polymathy might be low. While, if another individual has a medium to high score in all the dimensions, our assertive of his degree of polymathy may be higher than the individual in the former example, even if his aggregate score of all the dimensions is lower.

### 3.5.4 Proposed nomological network

#### Polymathy in the individual

The aim of this section is to organize the constructs (and their components) that concern to polymathy in the individual into a nomological network. Figure 17 represents this in a heuristic model with each relation in the form of a proposition.

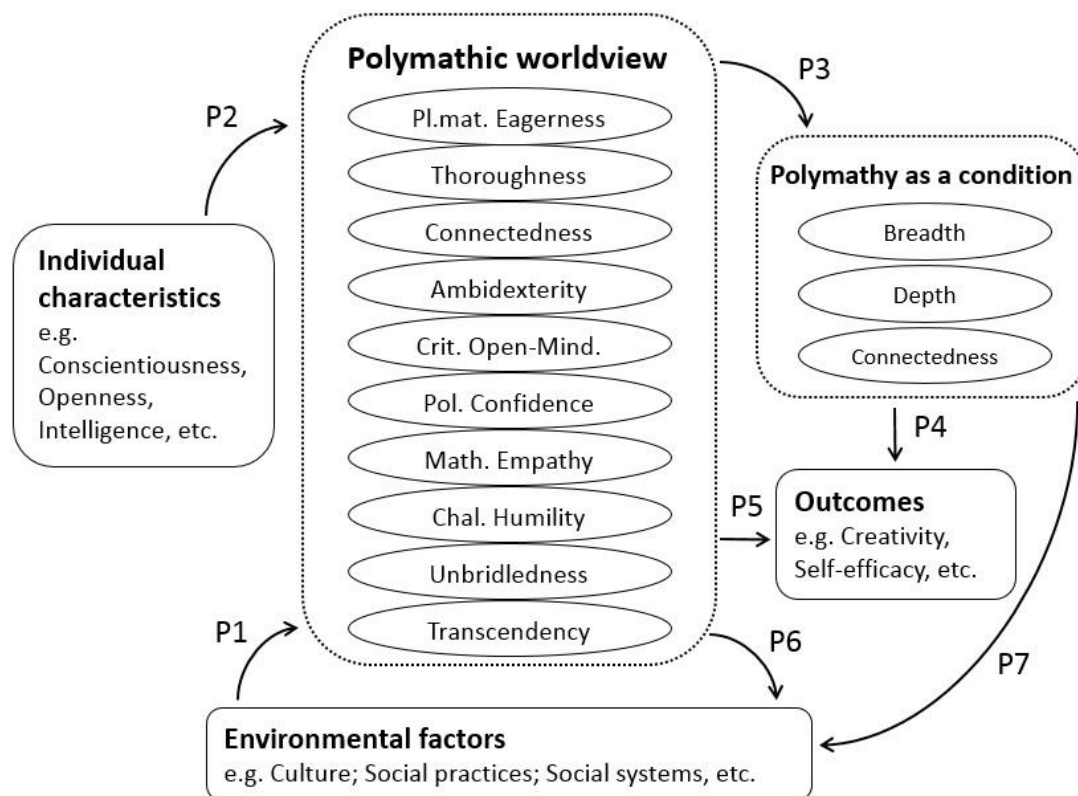


Figure 17. A heuristic model of polymathy in the individual. Elaborated by the author.

At the center of the model is polymathy as a worldview, which is an abstract concept represented by the dimensions outlined above. Polymathy as a worldview has two types of antecedents: factors that belong to the environment and factors that are associated with individual characteristics.

Environmental factors comprise the culture, social systems and structures. They affect the individual in multiple ways and it is expected that these factors will also have a great effect on polymathy as an individual's worldview (P1).

Individual characteristics comprise traits, features and capacities that differ from individual to individual. In this work, I discussed some of them, namely two elements of the Big-five factor model (conscientiousness and openness) and general intelligence (the g-factor). A high degree of these three characteristics are expected to have a positive influence on polymathy as a worldview (P2).

Among the consequences of polymathy as a worldview is the attainment of polymathy as a condition (*Zustand*) and other possible outcomes. Achieving the *Zustand* of polymath is an aspiration and goal of the polymathic worldview. Thus, it is expected that a polymathic worldview will lead to a polymathic condition (P3).

The other outcomes delineated in this model are consequences of both having the polymathic worldview and having achieved the condition of polymathy. It means that these consequences can be observed before the attainment of polymathy as a condition, just by displaying the behaviors associated with polymathy as a worldview. Although there might be uncountable outcomes of polymathy as a condition and as a worldview, I focus in two of them: creativity and self-efficacy.

Creativity, as posed in many sections above, is expected to be correlated with polymathy. The development of the polymathic behaviors and the attainment of the polymathic condition are expected to provide invaluable instruments for the production of new and useful ideas, i.e. creativity (P4 and P5).

A higher degree of self-efficacy might also be a consequence of polymathy. The rationale behind that is that the execution of the behaviors outlined as dimensions of polymathy as well as the attainment of broad, deep and connected learnings will positively influence the extent or strength of one's belief in one's own ability to complete tasks and reach goals, i.e. self-efficacy (P4 and P5).

Finally, the execution of a polymathic worldview and the attainment of a polymathic condition shall have a feedback influence into the environment. It is related to the discussion of structures and agency (GIDDENS, 1984). It is expected that individuals in the process of achieving polymathy and those who have already achieved its *Zustand* will engage in the world as agents of change and transformation, especially by the proposition and enactment of social systems that are consonant with the values of polymathy (P6 and P7). It is a very important idea

for the next chapter, which deals with the articulation of polymathy and the process of influence called leadership.

## 4. POLYMATHIC LEADERSHIP: CONSTRUCT DEVELOPMENT

This chapter presents and discusses the concept of polymathic leadership. It encompasses a definition for the construct, the description of its dimensions, a proposed model to operationalize the construct and, finally, a comparison with the two most similar approaches on leadership: transformational and authentic leadership.

### 4.1. CONCEPTUALIZING POLYMATHIC LEADERSHIP

#### The first work on polymathy and leadership

As far as my exploration of the literature could extend, there is only one work that attempted to integrate polymathy and leadership. It is Michael Genovese's book "Building Tomorrow's Leaders Today: On Becoming a Polymath Leader", which first edition was published very recently, in December, 2013. As discussed in a previous section, Genovese's work aims at a specific audience, conjugating some self-help aspects with interesting insights and research on the topic of polymathy. The book's objective is to develop the readers as future leaders, it aims at "those wishing to rise in their organizations, and anyone wishing to improve their skills and advance their causes" (GENOVESE, 2013, p.xiii - xiv).

An interesting aspect is that, although Genovese's work and my work set off from different contexts and have different audiences, both of them have in common the importance of polymathy in a changing environment: "it is a book designed to help you become more effective at creating and managing change" (GENOVESE, 2013, p. xiv).

While Genovese is evidently preoccupied with the figure of the polymath leader, my approach on polymathic leadership focuses on the profusion, creation and sustainability of systems and process that can be considered polymathic rather than the development of the leaders themselves. Thus, I start the discussion with the difference between a polymath leader and what polymathic leadership means.

## The polymath leader versus polymathic leadership

Becoming a polymath leader, i.e. a leader with broad learning and experience, who is flexible, adaptable, and able to use many talents and tools (GENOVESE, 2013), means achieving a specific condition or *Zustand*. In an approach centered on how to attain this *Zustand*, it is important to offer and discuss skills, tools and learnings that a person must harness in order to accomplish the goal of becoming a polymath leader. This is an example of an approach on leadership centered in the leader.

Polymathic leadership, as proposed here, is not a leader-centered approach. It is, instead, a system and procedural approach to leadership. It emphasizes the interactive events that constitute and that the leadership process is not restricted to the formally designated leader in a group. As pointed out by Northouse (2013, p. 5), “leadership is not a linear, one-way event, but rather an interactive event. When leadership is defined in this manner, it becomes available to everyone. It is not restricted to the formally designated leader in a group”.

It implies that, in the process of polymathic leadership, influence can be raised either from the appointed leaders or from other members of the group. Consequently, the focus of polymathic leadership shifts from the figure of the leader to the enactment, profusion and sustainability of processes that are consonant with the principles of polymathy. These are polymathic leadership’s main preoccupations.

Thus, even if engaged in a polymathic leadership process, the appointed leader will not necessarily be a polymath in a stricter sense of the term (i.e. a person with deep and broad knowledge, learnings and skills), but he or she will act as an influencer for the creation, profusion and sustainability of a polymathic worldview in the group. The polymathic behaviors and processes will ultimately empower the group as a whole to rise above problems they are facing. For polymathic leadership, promoting those behaviors is more important than the leader’s achievement or not of the polymath *Zustand*.

## The aim of polymathic leadership

In their review of the literature on the effectiveness of work groups, Kozlowski and Bell (2013) pose that, regarding the role of the leader in groups, the key question to be answered is: “what should leaders do to enhance team effectiveness?”. This is indeed a central question in the context of Organizational Behavior and many studies seek to investigate how different leadership actions can influence group or organizational performance (KOZLOWSKI and BELL, 2013). Nonetheless, polymathic leadership, being a multilevel construct that embeds an axiology, has to deal first with a more fundamental question: “what should the team be effective for?”

Polymathic leadership is intimately linked to the concept of polymathy as a worldview. As put before, it involves the practice and development of behaviors and capacities that concern the pursuit of broad, deep and connected learnings and it implies that this pursuit will result in positive transformations and contributions to society. Thus, polymathic leadership must always heed the development of broad, deep and connected learnings. In some circumstances, this may not be the most effective way of generating profit in the short term. In some cases, developing broad, deep and connected learnings might be unnecessary if the goal at hand does not require any complex new solutions and the problems can be solved by assembling a group in a traditional hierarchical model and applying traditional practices. In other cases, the circumstances of the environment and industry might make the company very profitable, despite the quality of the service. In Brazil, the great majority of telecommunication and internet services are provided by only four companies. Regarding internet, in many places, only one of them has coverage, constituting a monopoly in practice. Customers usually deem their services as very poor, with these companies consistently figuring in the top 10 companies with the most complaints in assessments made by PROCON-SP<sup>10</sup>, an autarchy of consumer protection and defense affiliated to the Secretary of Justice and Citizenship Defense of the State of São Paulo, the richest State in Brazil. Thus, in a company like that, which fails to solve problems such as integrating information in the CRM (Customer Relationship Management) systems throughout different units, an old

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<sup>10</sup>Source: List of “Reclamações Fundamentadas”, 2012, 2013, 2014, by PROCON-SP, accessed at [http://sistemas.procon.sp.gov.br/reclamacao\\_fundamentada/](http://sistemas.procon.sp.gov.br/reclamacao_fundamentada/)



problem that can be solved by the application of best practices<sup>11</sup>, an intelligent leadership model that is preoccupied with empowering the members might not have the best fit in the short and medium terms. In such context, even a polymath leader, like Genovese described, may choose not to apply principles of polymathic leadership and choose to exercise a more transactional style (see BURNS, 2012), with less meaningful exchanges with the group members.

Polymathic leadership is instrumentally useful for dealing with problems with VUCA characteristics, as addressed in the introduction of this work. However, polymathic leadership must zeal for its ultimate end of developing a polymathic worldview that will result in positive transformations and contributions to society. In other words, the enhancement of social practices and systems is a necessary outcome of polymathic leadership, whereas better performance, more effectiveness, better productivity and even more creativity are secondary effects of polymathic leadership.

Thus, addressing the question of “what should the team be effective for?”, for polymathic leadership, the team should be effective in creating positive transformations and contributions to society through the enactment and sustainment of a polymathic worldview. The roles of the polymathic leader are deeply connected with these concerns; however, the polymathic worldview, along with its focus on the development of broad, deep and connected learnings in the group may yield several benefits to the group, as discussed further.

### **A multilevel view**

Polymathic leadership, being the application of a multilevel concept (polymathy as a worldview) must also encompass a multilevel perspective.

Kozlowski and Ilgen (2006) proposed a very comprehensive model to understand team effectiveness that encompasses five elements: (1) the team task, (2) the team processes, (3) factors that influence team processes, (4) team

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<sup>11</sup>The author worked as a Business Analyst for ERPs (Enterprise Resource Planning) such as SAP®

effectiveness, and (5) organizational, contextual and environmental factors. Figure 18 illustrates the model.

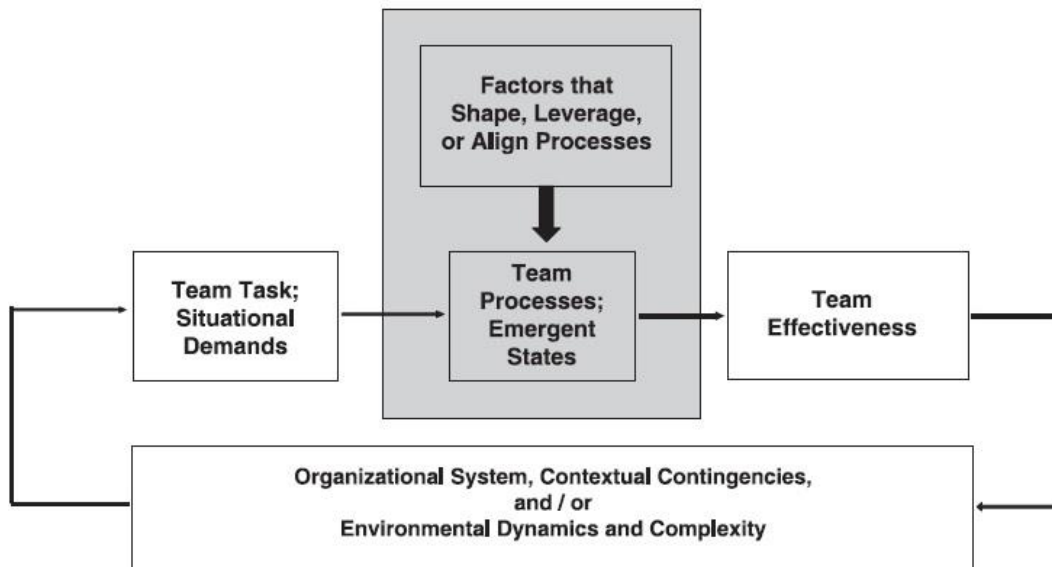


Figure 18. Conceptual framework of effectiveness in work groups and teams.  
Source: Kozlowski and Ilgen (2006).

This model covers most of the factors relevant for polymathic leadership. First, it heeds how the environmental context leads to a series of situational demands that will shape task characteristics performed by the team, which by its turn, will influence team processes. Second, those processes are also shaped, leveraged and aligned by factors such as leadership, as put by the authors: “a dynamic, shifting, and complex environment creates commensurate team task demands that members have to resolve though a coordinated *process* that combines their cognitive, motivational/affective, and behavioral resources” (KOZLOWSKI and ILGEN, 2006, p. 78, emphasis by the authors). Finally, this model is centered on how team processes and emergent states can influence team effectiveness, which is not the most crucial point of polymathic leadership, as discussed.

A strength of the model as a tool for the introduction of polymathic leadership is the use of what the authors called “emergent states”, i.e. a collective *Zustand* developed from “learning as a *dynamic behavioral process* of interaction and exchange among team members” (KOZLOWSKI and ILGEN, 2006, p. 86, emphasis by the authors). These emergent states, construed by dynamic behavioral processes are analogous to what I propose as a group worldview, or *Weltanschauung*, during the discussion of polymathy, which also encompasses

certain behaviors as its manifested dimensions. The same line of thought will guide the theoretical model of polymathic leadership.

### **The focus on groups rather than leader-follower dyadic relations**

In this work, I chose to focus on the phenomenon of polymathic leadership in groups within organizations. One aspect for the choice is the prevalence and preponderance role of groups and teams in the modern organizations (COHEN and BAILEY, 1997; DEVINE *et al.*, 1999; BURKE *et al.*, 2011). Another aspect is the group as a suitable unit of analysis for studying specific leadership processes that affect more than two persons (the leader and the follower). Many approaches on leadership tend to focus on the dyadic relationship of leaders and followers (KOZLOWSKI and BELL, 2013), this work approaches leadership in a group context.

The focus on groups emphasizes aspects of group processes, such as group cognition, affection, motivation and conflict, which will be very relevant for some propositions regarding polymathic leadership. For instance, it has already been verified that some group processes may lead to more innovation in the group (AMABILE, 1988). Thus, the leader can influence aspects that may either potentialize the development of ideas or undermine their production or their communication. As a result, different leadership styles may be more or less useful for solving different kinds of problems.

#### **4.1.1 Polymathic leadership: definition and description**

Based on the previous discussions, this work proposes the following definition for polymathic leadership:

*A pattern of leadership behavior that encourages the achievement of higher levels of breadth, depth and connectedness of learning in the group. It involves collectively rising above difficult problems and making positive transformations and contributions to society.*

This definition of polymathic leadership encompasses three aspects: (1) encouraging the pursuit and achievement of polymathy, (2) rising above difficult problems, and (3) making positive transformations and contributions to society.

The first aspect encompasses the development of the three great dimensions of polymathy, which is a core aspect of every definition of polymathy herein presented. Therefore, for the existence of polymathic leadership the development of higher levels of breadth, depth and connectedness of learnings in the group is a necessary condition.

The second aspect entails a more pragmatic aspect of polymathic leadership. Theories based on evolutionary biology pose leadership as a solution to complex coordination problems (see VAN VUGT, 2006). Here, I pose polymathic leadership as an enhancement of this solution, especially useful in situations where all the group members, including appointed leaders and followers, are prepared to engage each other at an equal level, in a state of social exchange that benefits all members with new learnings (*mathemata*) and joins minds together for the resolution of difficult problems. While polymathy in the individual draws upon one's multiple bodies of knowledge, learnings, experiences, skills and competences in order for him or her to advance to higher levels of sapience, polymathic leadership acts in a similar way in the group. It connects bodies of knowledge, learnings, experiences, skills and competences scattered through individual minds, empowering the group as a whole to solve problems that could not be solved without this cooperation.

The third aspect pertains to an embedded sense of responsibility and the legacy left when a cycle of polymathic leadership in a certain group ends. Polymathic leadership, especially when happening in a work group has a finite lifecycle. One of the key points of this process is leaving a certain legacy. One aspect of this legacy is the sustainability of polymathic behaviors by the members and within the organization, another aspect are the contributions left for society as a whole. This aspect is intimately linked to the axiology of polymathy, as discussed in section 3.5.1. It entails the multidimensional concern for breadth, depth and connectedness. Thus, when a cycle of polymathic leadership ends, it necessarily has to leave a legacy of more positive social systems and/or the development of new

products and ideas that will serve society and provide it with more elements to continue developing its breadth, depth and connectedness of knowledge and sapience.

Finally, this definition entails a multilevel analysis that includes and links factors belonging to the individuals, to groups, organizations and the society as a whole. Therefore, a thorough analysis of polymathic leadership must heed this multilevel nature even though the focal point might be the group, or the individual.

## 4.2. A THEORETICAL MODEL OF POLYMATHIC LEADERSHIP

Based on the discussions so far, and utilizing as a base the models of group effectiveness by Gist *et al.* (1987), Cohen and Bailey (1997), Kozlowski and Ilgen (2006) and Lepine *et al.* (2008), I present the following heuristic framework of polymathic leadership in the group, as depicted in figure 19.

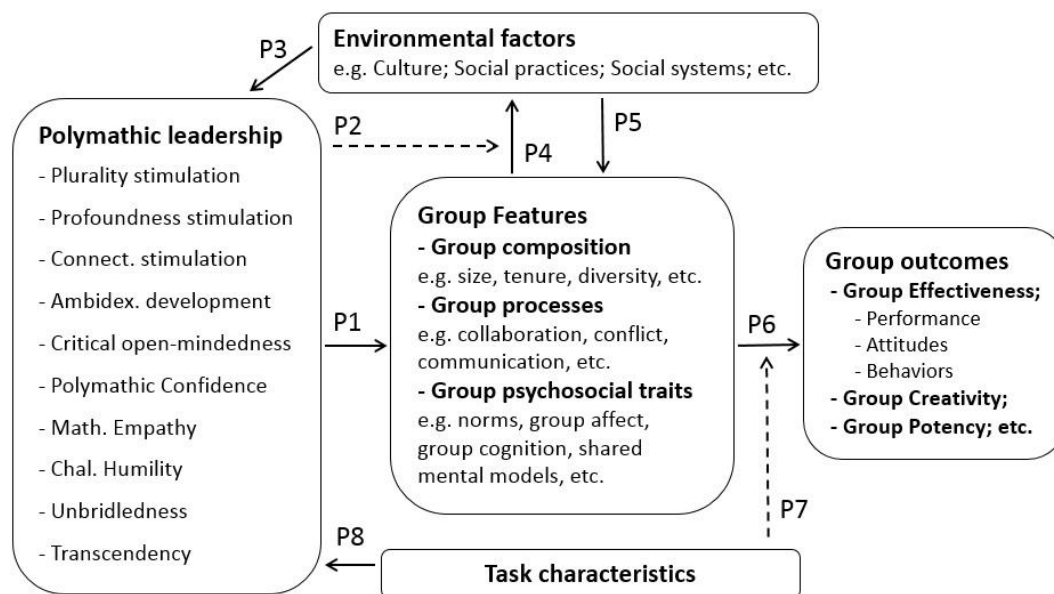


Figure 19. A heuristic framework of polymathic leadership in the group. Elaborated by the author.

The model encompasses multilevel aspects, in the example of the framework by Kozlowski and Ilgen (2006). However, it encompasses more aspects of the group besides its processes, such as group psychosocial traits (COHEN and BAILEY, 1997) and group composition (GIST *et al.*, 1987; COHEN and BAILEY,

1997). The aspects that Kozlowski and Ilgen (2006) treat as “organizational systems, contextual contingencies, environmental dynamics and complexity” are organized in the category of environmental factors. Task characteristics substitute the term “Team task”. The group outcomes encompass other aspects beyond team effectiveness, such as creativity and group potency, and, finally, the elements that Kozlowski and Ilgen (2006) called “factors that shape, leverage or align process” have given place to the behaviors of polymathic leadership. I will explain each element of the model in more detail first with the exception of polymathic leadership, which is treated in detail in the next section.

### **Environmental factors**

Environmental factors comprise a series of elements that are contextual or external to the group but are influential. It includes the overall culture the group is inserted in, the organizational culture, and the social systems and practices embedded within their context.

Environmental factors influence leadership styles and behaviors (P3) as well as group processes, psychosocial traits and even group composition (P5).

### **Group features**

Group features is an umbrella category that covers the actionable aspects in the group. It includes the group composition, the various group processes and the category that Cohen and Bailey (1997) called “group psychosocial traits”. Specific leadership actions and behaviors will directly influence specific elements within this category.

In the organizational management and behavior literature, some authors have opted to use a dual nomenclature of group processes and group structure (see STOGDILL, 1959; MILES *et al.*, 1978; SHAW *et al.*, 1981; GIST *et al.*, 1987; DESANCTIS and POOLE, 1994). Group structure refers to the “hard” elements of the group, they are not very flexible and they tend to remain more constant in the lifecycle of the group. GIST *et al.* (1987), for instance, listed in their model five elements of group structure: size, ability, personality, gender, and race. In this work,

I chose to use different categories; group composition covers aspects such as size, tenure and diversity whereas group psychosocial traits cover the elements with strong psychosocial aspects such as ability and personality.

Group processes refer to the “soft” elements of the group. Processes are a systematic series of actions directed to some end and, given its nature, they are much more volatile and prone to interferences and change than structural aspects of the group. Lepine *et al.* (2008) divide processes into three categories: (1) transition processes, involving mission analysis, goal specification and strategy formulation; (2) action processes, involving coordination, team monitoring, system monitoring and monitoring progress; and (3) interpersonal processes, involving conflict management, affect management and motivation.

The group features are central in the model and are related to every other element. The group influences and is influenced by environmental factors (P4 and P5). It also influences outcomes (P6). Groups are directly influenced by polymathic leadership behaviors (P1) and the manner that the group affects the environment is moderated by polymathic leadership, i.e. polymathic leadership behaviors change the way that groups influence its environment (P2). Finally, task characteristics also moderate or change the effects of group processes on outcomes (GIST *et al.*, 1987) (P7).

### **Group outcomes**

Outcomes are examples of dependent variables in the model such as group performance, potency and creativity, which are influenced by group processes (P6). The examples outlined in the model are not exhaustive.

### **Task characteristics**

Task characteristics refer to the nature of the tasks that groups perform. It involves task complexity, difficulty, interdependence and the nature of the task cycle (short, long, unique, or repeated). Tasks characteristics influence the necessity or the emergence of different types of leadership in the group (P8). As seen, tasks also moderate or change the effects of group processes on outcomes (P7).

#### 4.2.1 Components of polymathic leadership

Polymathic leadership aims at the construction and sustainability of social systems and structures that leverage new polymathic endeavors. In consonance with the categorization of polymathy as a latent construct (LAW *et al.*, 1998), the dimensions of polymathic leadership described below are manifest behaviors that involve all domains of human psyche (cognitive, affective, conative). These behaviors are the vehicle whereby the construct of polymathic leadership can be assessed and operationalized.

The dimensions of polymathic leadership mostly mirror the elements of polymathy as a worldview, as the former is a process that encourages the latter. The first three dimensions were conceived to cover aspects that guard a very intimate relation with the development of the three great dimensions of polymathy (breadth, depth and connectedness). The other seven dimensions mirror exactly the behaviors of polymathy as a worldview.

##### **Plurality stimulation**

Plurality stimulation, the first dimension of polymathic leadership, entails behaviors that encourage the development of factors related to the polymathic great dimension of “breadth”.

It embeds the concepts related to pluri-mathematical eagerness. Plurality stimulation involves the development and encouragement of the plurality of experiences, learnings, the exercise of different and varied thinking styles in the group, and the behavior of considering different perspectives for a given situation.

##### *Plurality of experiences*

Development of the plurality of experiences is the stimulation of experiential polymathy. Besides the advantages to creativity outlined in the



previous sections, plurality of experiences is also an effective tool to solve complicated problems and to assist in self-development.

One example of how the development of a plurality of experiences helps solving complicated problems is when a person gets stuck and cannot advance further to the solution of the problem with the material readily available. If he can count on numerous different experiences, far from the common environment of his peers and his job, he will be able to access unusual information that can solve the problem in unusual ways. It is an approach defended by Steve Jobs: “if you're gonna make connections which are innovative ... you have to not have the same bag of experiences as everyone else does” (JOBS, 1982). Sometimes the answer to that seemingly impossible problem lies in a meaningful experience of the past or even in an experience which left a mark on the brain because it seemed different, extraordinary or noteworthy, this is a very practical reason for developing the plurality of experiences. This phenomenon might have happened during the development of one of the most successful products of the 20<sup>th</sup> century, the iPod. At the time, Apple appeared to have a culture which promoted and elevated creativity, not only on the inside but also on the outside; it wanted to promote the image of an innovative company utilizing an advertising slogan such as “think different”. Thus, in 2001, the computer company entered the entirely diverse industry of music with a portal called iTunes, and as a complementary strategy, it launched a revolutionary music player and a team was entrusted with the task of designing the external appearance of this revolutionary player. It was a very complicated problem, and given the importance of this product to the company and the pressures involved, it had to be “just right”. A person, or team, looking for ideas for a futuristic design might resort to many strategies, maybe, among them, recall the image of something that looked like a futuristic design in a cartoon he watched five years before:

Figure 20: The Simpsons, 1996.



Figure 21: Apple's iPod, 2001.

Figure 20. Scene from the television show “The Simpsons”<sup>12</sup>. Source: Fox Films.Figure 21. The first design of Apple's iPod in 2001. Source: Engadget.<sup>13</sup>

The point here is not to imply that the designers at Apple copied iPod's design from this specific episode of the Simpsons, in an exemplary application of the famous adage “originality is the art of concealing your source” (O'TOOLE, 2014). It may have been a coincidence, or a process analogous to convergent evolution in biology: when a similar solution appears independently in different species to solve the same kinds of problems, such as different types of wings to fly and eyes to see. As a matter of fact, the device in the Simpsons' episode was not a music player but a futuristic intercom. The point here, which is relevant to the discussion of polymathy, is that the design of one of the most successful products of our era was available, however slightly different and used for a different product, to thousands or even millions of people for five years before either someone arrived at its idea independently or was inspired by it. Whichever the case, it entertains the

<sup>12</sup>The Simpsons, season 8, episode 5, “Bart After Dark”, aired on Fox network on November 24, 1996.

<sup>13</sup>Retrieved from <http://www.engadget.com/2011/10/23/10-years-ago-today-the-original-ipod-changed-music/>.

idea that an experience from a totally different area might prove extremely useful to one's main profession.

The development of a plurality of experiences also assists in the process of change and self-development. Herminia Ibarra, a researcher at INSEAD, recently published a book defending the importance of engaging in new, playful experiences with one's possible selves for the purpose of changing oneself effectively and as a tool of self-development:

The paradox of change is that the only way to alter the way we think is by doing the very things our habitual thinking keeps us from doing [...] New experiences not only change how you think [...] but also change who you become.

(IBARRA, 2015, p.5)

Here, plurality of experiences is mixed with other behaviors and abilities such as the courage to challenge one's assumptions and ideas (they will be treated shortly) in order to achieve one's goals of change and self-development. If the popular wisdom says that change is difficult, it may be because it has not been approached appropriately; possessing the capacity of engaging in new experiences and having developed a plurality of them may greatly facilitate the process of change when it becomes desirable or even necessary.

### *Different thinking styles encouragement*

Exercising different thinking styles is the development and encouragement of a plurality of thinking styles. It encompasses the idea that the plurality of thinking is beneficial to the individual and to the groups. First, because it generates a greater "mental repertoire" for the individual. Second, because it enhances person-to-person communication; by exercising a plurality of thinking styles it becomes easier to deal with and to understand people who tend to favor a diverse thinking style. Third, because it enhances intra- and extra-group communication; it assists in the creation of a shared cognition if the entities (persons, groups, departments, etc.) involved engage in exercising each other's favorite thinking style. Different authors proposed different models of thinking or cognitive styles,

Sternberg (1999), Kirton (2004) and Guilford (1957) among them. Whichever the approach chosen, the concept behind exercising different thinking styles as a polymathic leadership behavior in the organization is to add plurality in the minds of the individuals for better solutions and better communication. This behavior, however, should not be pressed upon individuals. There may be cases that some individuals are so committed to a specific cognitive style in which pushing him to think differently might be counterproductive; it may, for instance, undermine his capacity of reaching the profundity necessary to solve a difficult problem. One of the most important factors of exercising different thinking styles in leading a work group is fostering the collective ability of the group to attack problems through a plurality of angles. In this case, it is extremely important to balance the information and solicit inputs from all members of the group as well.

### *Perspective-taking*

Perspective-taking is the act of viewing a situation or understanding a concept from an alternate point-of-view. It involves mentally simulating the point-of-view of another's cognitive state. Perspective-taking is a tool which leads to many positive effects on organizations which are consonant with the idea of plurality and polymathy: it combats automatic expressions of racial bias (TODD *et al.*, 2011), it combats the denial of group discrimination (TODD, BODENHAUSEN, *et al.*, 2012), and it undermines stereotype maintenance processes (TODD, GALINSKY, *et al.*, 2012).

### **Profoundness stimulation**

Profoundness stimulation entails behaviors that encourage the development of factors related to the polymathic great dimension of “depth”. Profoundness stimulation is based on the idea that the attainment of deep knowledge and learnings as well as the living of meaningful experiences by the members of the group are essential to exchanges that are considered polymathic.

Profoundness stimulation, as well as plurality stimulation, has to be balanced. Any polymathic entity must accept that much of its knowledge will

remain shallow and many of its experiences will stay hollow due to natural restraints. An opposite thinking could have disastrous consequences. Unlike breadth, depth is not good in itself; unrestrained depth pursuit has different consequences from unrestrained breadth pursuit. To exemplify this, imagine we had two super-intelligent computers, one with an infinite drive for breadth and the other with an infinite drive for depth. While the former would ponder the consequences before conflicting with mankind (interfering with it would possibly mean a loss of plurality and would only be justified if more plurality could be generated by doing so), the latter might, for instance, decide to delve into the nature of *pi* and consume the whole universe in the effort to finding its final number (BOSTROM, 2014), a possibility already posited by serious researchers on artificial intelligence.

In an organizational context depth is the dimension which already receives most of the attention. Companies look for specialists and they even pay for the specialization of its important employees. In contrast, rare are the cases in which the companies pay the employees to diversify their interests; Google, with its famous policy of encouraging 20% of the work-time for the development of side projects, was an example. Nonetheless, polymathic leadership must not take profoundness for granted. Both leaders and followers must constantly engage in actions that lead to the sustainability and enhancement of the level of depth in the group and the organization. Some attitudes that are benign for the cultivation of depth are the exercise of thoroughness and perseverance.

Profoundness stimulation involves developing *thoroughness*, a dimension of polymathy as a *Weltanschauung* which refers to persisting in the face of difficulties until the achievement of long-term goals and is related to the concepts of “grit” and perseverance. Profoundness also means not being satisfied by overly simplistic answers to complex phenomenon and avoiding seeing the world through reductionistic lenses such as Manichaeism.

The role of perseverance and the importance to reject simplisms are discussed below.

### *Avoiding simplisms*

Simplism is oversimplifying things by ignoring complexity and complications. Simplisms are represented by some outlooks such as manichaeism, i.e. reducing the world to a struggle between good and evil. Their often conscious and deliberate ignorance of subtleties, complexity and complications, painting the world in “black and white”, is counterproductive to the development of a polymathy. While the world is very complex and some forms of simplification are needed in order to make sense of it, extreme forms of simplification lead to a limiting view of the world, thereby fostering undesirable behaviors and processes like groupthink, extra-group discrimination and prejudice, besides clouding more clear and sophisticated thinking.

### *Perseverance*

Perseverance is among the positive conative qualities that individuals can develop to assist in the achievement of difficult and lengthy goals. Perseverance entails continued effort to do or achieve something despite difficulties, failure, or opposition (MERRIAM-WEBSTER, 2015f). In the psychology literature, the similar concept of persistence has received considerable attention and enjoys having a well-developed measuring instrument available.

Persistence is a personality trait that refers to perseverance in spite of fatigue or frustration (CLONINGER *et al.*, 1993). It is measured by the Temperament and Character Inventory (TCI) and has four elements: (1) eagerness of effort; (2) work hardness; (3) ambition; and (4) perfectionism (CLONINGER *et al.*, 1994). Although persistence is described as a trait (CLONINGER *et al.*, 1993) and verified as heritable (HEATH *et al.*, 1994; GILLESPIE *et al.*, 2003), the quality of continuing despite of fatigue or frustration has all the features of being developable (see discussion on freedom versus determinism in section 3.4.2) and should be encouraged in a polymathic environment.

Perseverance is expected to be an important factor for the development of polymathy, especially concerning the great dimension of depth. In the quest for profoundness, one often has to endure a great period of effort with little or even no

external rewards. A famous example is Thomas Edison's quest for making a successful incandescent light bulb. It is said that he had experimented with thousands of models, all of them failures, before reaching a successful functional model. Perseverance is fundamental for goal achievement in these situations, especially when one cannot rely on a continuous positive reinforcement or feedback to assist in one's motivation.

Perseverance is also important for the achievement of a mental state in which the individual becomes completely absorbed in a task: *the flow state*, or the "holistic sensation that people feel when they act with total involvement" (CSIKSZENTMIHALYI, 2000, p. 36). The flow, or what the author calls "autotelic experience", is seen in the development of creativity, while learning with great interest, while acquiring skills and practicing for attaining mastery in a subject (CSIKSZENTMIHALYI, 2014). Nevertheless, the sensation of enjoyment and acting with total involvement is the product of a balance between the challenges undertaken and the person's capabilities; it means that if the challenge is perceived as too big the result is stress and anxiety rather than the flow. On the other hand, if the challenge is too small, the result will be boredom (CSIKSZENTMIHALYI, 2000). Perseverance is important when the perceived challenge is greater than one's perceived skills or capacities. It is very natural to feel stressed and anxious if the person is a novice and the task is too daunting; for instance, nobody would expect flow state for a pianist in his first public presentation just after three months of practice with the instrument. But if the same person persists on the practice of the instrument and persists on giving auditions despite the feelings of anxiety, this individual is likely to start experiencing the flow state and then form a positive spiral of development once the activity starts to be done with enjoyment rather than anxiety, worry or excessive stress. This pursuit is associated to the polymathic dimension of depth, which is related to the ideas of profoundness, intensity, completeness and thoroughness. Thus, qualities of perseverance and the stimulation of the flow state benefits members of the group at developing greater levels of depth, therefore empowering them to assist in the solution of problems faced by the group with their profound learnings (*mathemata*) and knowledge.

## Connectedness stimulation

Connectedness stimulation entails behaviors that encourage the development of factors related to the polymathic great dimension of “connectedness”. It is based on the idea that the capacity of associating and relating things is essential for polymathic systems. Connectedness, in the example of breadth and profoundness, must be approached with caution and some restraints. While threading and playing with new connections may lead to original and creative ideas, doing so without the systematic application of critique is an invitation to false conclusions and beliefs. It, once more, adds to the importance of observing balance for any polymathic endeavor.

In an organizational context, the stimulation of connectivity can lead to several outcomes and will enable the collective harnessing of capacities that are scattered through different minds in the group. Below are examples of practices which can foster connectedness, thus assisting in the development of a polymathic environment.

### *Exercising “thinking tools” related to connectedness*

Root-bernstein and Root-bernstein (2003) proposed thirteen thinking tools whereby imagination manifests itself. Some of them, namely analogizing, playing, transforming, synthesizing are especially helpful in order to develop one’s capacity of connectedness. Analogizing is “recognizing a functional likeness between two or more otherwise unlike things” (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003, p. 381). The exercising of this tool has obvious relations with connectedness, analogies brings different concepts together and broaden our perception. Playing is “the exercise of our minds, bodies, knowledge, and skills for the pure emotional joy of using them” (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003, p. 382). Playing frees the individual from constraints which may prevent him to experience new things and, possibly, form new connections (IBARRA, 2015). Playing is also related to the tool of transforming, whereby ideas are mentally manipulated and changed. Transforming is also a way of reaching connectedness once some perceived connections are necessary for only element to be transformed and



transmuted into another. Finally, synthesizing, i.e. “the combining of many ways of thinking into a synthetic knowing” (ROOT-BERNSTEIN and ROOT-BERNSTEIN, 2003, p.383) is also intimately related with connectedness, it trains this capacity and depends on it, the combination of many ways of thinking and different elements is one of the core properties of connectedness.

### *Exercising the integration across areas and departments*

One of the greatest hindrances of leadership in the organizational context is the difficulty of communication between different areas of the firm. Stimulating the integration across areas in the organization is fundamental in order to avoid the problem of schizoidism, in which there is a rupture between different parts of the company. This view is well grounded on the literature about organizational management and is the translation of the polymathic dimension of connectedness to the organizational environment. LEVINE *et al.* (2013), for instance, defended the importance of different types of integration and of shared cognition for organizational learning, while KARAHANNA *et al.* (2013) empirically showed how the development of shared language and cognition between areas lead the firm to positive results.

### *Building a sense of the whole in the organization*

Job fragmentation and specialization without a sense of the whole are also undesirable aspects in a polymathic point of view. The advent of organizational models such as Taylorism and Fordism led to an increase in productivity but often with the cost of a greater job fragmentation (MATTHEWS, 1996). An excessive job fragmentation has negative outcomes to the society and the individual (MARX *et al.*, 1972) and to organizations. In the organizational literature this discussion is not new, aiming to deal with problems generated by excessive fragmentation, loss of a sense of the whole and processes inflexibilities, PIORE and SABEL (1984) coined the term “flexible specialization”, i.e. competitive strategy whereby a firm develops multi-skilled employees and innovative executives in order to better respond and accommodate to a scenario of ceaseless change. Thus, building a sense of the whole is consonant with the idea that although specialization is valuable and

effective it has to be balanced with some dose of flexibility and, above all, a sense of what is happening in a wider view. It includes having a sense of the role of each task in the greater picture.

### **Ambidexterity development**

Ambidexterity development refers to behaviors and capacities concerning the dimension “ambidexterity” of polymathy as a worldview. From now on, the dimensions of polymathic leadership will mirror the dimensions of polymathy as a *Weltanschauung*. Thus, rather than focusing on the description of these dimensions, the focus will be their relevance in the context of polymathic leadership.

In a polymathic leadership context, developing the members’ ambidexterity, i.e. the capacity of using seemingly disparate or oppositional skills, stances or concepts equally well and in balance means empowering the group for the facilitation of exchanges and allowing the utilization of other polymathic behaviors that require the use of apparently oppositional stances, such as critical open-mindedness and challenging humility.

In an organizational environment, ambidexterity facilitates exchanges and communication; ambidexterity creates connectors, i.e. persons that can “speak multiple languages within the company”. As posed by the article of Karahanna *et al.* (2010), when an important team member is capable of navigating skillfully in different sectors of the company, he or she can better contribute to the organization’s performance.

### **Critical open-mindedness**

In the leadership context, critical open-mindedness operates in a similar way to the dimension of authentic leadership called balanced processing. Balanced processing is defined as the solicitation by the leader of sufficient opinions and viewpoints prior to making important decisions (AVOLIO *et al.*, 2007), leaders who utilize this tool are “inclined and able to consider multiple sides of an issue and multiple perspectives as they assess information in a relatively balanced manner” (AVOLIO and GARDNER, 2005). Balanced processing, seen through the

lenses of authentic leadership, is a way for the leader to stay authentic by avoiding the contamination of ego and self-esteem problems and by keeping his clarity and taking an objective evaluation (GARDNER *et al.*, 2005). In the lenses of polymathic leadership, critical open-mindedness is a tool to navigate effectively through the multitude of information maintaining clarity and a reasoned thinking involving critique. While balanced processing emerges from the singularity (the leader) soliciting plurality (other opinions and viewpoints), critical open-mindedness starts from the assumption that the polymathic leader is already immersed on a multitude of information and he has to apply some systematic thinking in order to sift the relevant information. Thus, critical open-mindedness is a conjugation of two factors: being open-minded, i.e. being receptive to new and different ideas; and applying critique, i.e. following a systematic and autonomous judgment as well as the practicing of doubt.

Critical open-mindedness can also be applied internally as a tool for a balanced self-assessment. It means the confrontation of different and sometimes ambiguous information and perceptions which one possesses about himself openly including things that might not be so desirable or agreeable (e.g. emotionally dangerous to one's self-esteem) but applying critique to them.

Critical open-mindedness involves the sub-element of relativization, which, in some circumstances, and if exercised with discernment, can offer great contributions for polymathic systems, as discussed below.

### *Relativization*

Relativizing means seeing something in comparison, relative to something else rather than absolute. Being absolute means being complete in itself, closed. Relativization is associated with the idea of open-mindedness and “thinking outside the box”, it means looking for different ways to see something when it appears to have none. Relativization is perspective-taking in a greater and wider sense. As in polymathic leadership members will often deal with very difficult problems the use of relativization can be instrumental to solve them, especially during the phases of the lifecycle of solving a problem in which the solution seems impossible, relativization may appear as a relief, a way to divert the mind from the difficulties

and carry it to other spheres, for instance, by making it smaller than it appears. Relativization is a way to escape being overwhelmed by success and being destroyed by failures. By relativizing, one sees these events as they are: just events among billions of other events. Once again, relativization without balance is not polymathic, for instance, alienating oneself from reality by the use of relativization is not the defended utilization of the tool.

### **Polymathic Confidence**

Polymathic confidence entails individual's conviction about one's abilities to mobilize the motivation, cognitive resources, and courses of action needed to successfully develop broad, deep and connected learnings and knowledge (see STAJKOVIC *et al.*, 1998).

In a polymathic leadership context, a functional polymathic group depends on the development of important psychological qualities related to confidence by the members of the group. The more members are confident that they possess the necessary capacity to deal with difficult and complex tasks that require the advancement to new levels of individual and group knowledge, the more empowered the group is to exercise polymathic endeavors. As a result, members that are confident about their capacity and the group's capacity of being polymathic will contribute to the group in deeper and broader ways, exercising positive and developmental influence within the whole group.

There are two important topics for the development of polymathic confidence, which will be addressed next: a positive and developmental approach to intelligence and the courage for undertaking serious self-development.

#### *Positive and developmental approach on intelligence*

Viewing a specific capacity such as intelligence as something fixed means believing that this characteristic is immutable and that it will remain always the same. Polymathy and polymathic leadership are intrinsically linked with the possibilities of adaptation and change; they are fundamental in order to deal with a VUCA world and to encompass a view of personal growth and self-development.

Thus, the belief that traits such as intelligence are immutable is in opposition with the idea of polymathy.

In the psychological literature, some authors have investigated the effects in the individual of conceiving intelligence as a fixed or developable. Mueller and Dweck (1998) devised a study to test the response of children praised for their intelligence. They found that those children cared more about appearing intelligent (performance) than really learning. When faced with failure, they also displayed less task persistence, less task enjoyment, more low-ability attributions, and worse task performance. Finally, children praised for intelligence described it as a fixed trait more often than children praised for hard work, who saw intelligence as a developable trait (MUELLER and DWECK, 1998). Thus, having a mindset of intelligence as a fixed and immutable trait is negative both to the ones attributed with the trait and to those not attributed with the trait. To the former it has the malicious consequence of removing the incentive of the person to try new things and “look like a fool” because he or she fears losing the attribution of being intelligent, see (BANDURA and DWECK, 1985; DWECK, 2000). To the latter it is discouraging. It leads to the possibly inaccurate mindset that he or she is not “cut out for the subject”. It can become a self-fulfilling prophecy, once negative emotions start being attached to that discipline, which leads to its avoidance and lack of interest. As a result, the person really becomes bad at the given subject (see MERTON, 1948; RYAN and DECI, 2000). Henceforth, a developmental view on intelligence, based on the possibility of its enhancement via effort and motivation rather the belief that traits as innate and immutable/fixed, is more suitable for the process of polymathic leadership and for the development of the capabilities of the members of the group.

### *Courage for self-development*

Courage is the ability to do something that is known to be difficult or dangerous; it is mental or moral strength to venture, persevere, and withstand danger, fear, or difficulty (MERRIAM-WEBSTER, 2015b). Courage, in special, intellectual courage, was approached in the discussion of the polymathic dimension of challenging humility. That context entailed the strength necessary to confront

unjustified views and authority. Here, courage is viewed in the context of facing our inner limitations.

A polymathic environment built within the group with the influence of polymathic leadership is especially suitable to deal with difficult and VUCA problems. It often requires deep and broad contributions from all members of the group, and thus self-development becomes central as it is expected that the groups and the individuals within it will have to advance to new levels of development in order to successfully rise above the challenges at hand.

Therefore, members of a polymathic group must often engage in the difficult process of *challenging one's own assumptions* and it requires courage. Also, changing oneself and trying new things is daunting. One has to suspend judgment and accept and be seen as a novice again, once again it takes *courage to look foolish to others* as it often involves difficult psychological issues of self-esteem.

The appointed leader, especially, needs courage. He or she must transcend some common and widespread heuristics of leadership, such as “the leader cannot show weakness”, or “the leader cannot express doubt”. In fact, not being afraid of showing temporary weakness due to being in the early development of a new skill and not being afraid of not having all the answers beforehand are great strengths of polymathic leadership. In the face of difficult problems, people tend to look for easier solutions. Polymathy involves fighting the mental sloth and having the strength to venture, persevere and withstand all the difficulties in order to advance to higher levels of the intellect and achieve desired change and transformation instead of giving in any answer because there was social pressure to do so.

### **Mathematical Empathy**

Mathematical empathy, i.e. seeking to deeply comprehend another person's ideas and the true meaning or purpose behind them, is fundamental for the practice of polymathic leadership. Polymathy leadership in the group often entails arranging a system in which the pieces of collective knowledge that are scattered in the heads of different people can work together and add up in tandem towards the

solution of the problems at hand. Thus, having the ability of comprehending ideas from another person's perspective, where they originally come from, is an invaluable asset for the polymathic development of the group and for rising above difficult problems.

Like polymathic confidence, it is expected that the more mathematical empathy that the members of the group display the more empowered the group will be to exercise polymathic endeavors.

### **Challenging humility**

Challenging Humility entails confronting people, systems and ideas, often established on some sort of authority, with intellectual humility. This behavior also involves the use of empathy, especially when confronting other people. Challenging humility can be addressed in two different contexts: concerning personal interactions and concerning challenging social concepts, systems and structures.

#### *Courage to confront others, especially authorities*

In the organizational environment it is sometimes necessary to change people's minds or to confront them. Changing others, like changing oneself, is a difficult task which will also require courage, especially when having to confront someone in a superior position (e.g. the boss or the appointed leader). If any member desires to foster a polymathic environment and, at a given circumstance, he or she has to confront somebody else's ideas or opinion, a way of doing it in consonance with polymathic values is via empathic confrontation. *Empathic confrontation* means authentically seeking understanding and seeing through the other person's frame of reference before confronting, prompting judgment or even dismissing an idea. As an analogy, if one considers that a person is driving into a dangerous direction, the course of action is to first align the vehicles together, having a glimpse of what is really going on the in other person's point of view and then, if suitable, steer away from this direction together. It is a totally different approach from bumping directly into the person, which would be the classical confrontation.

### *Courage to propose change*

Changing or challenging things, e.g. social systems and structures, might prove even more difficult than changing oneself or others. When the one proposing change and challenging the *status quo* is the appointed leader, a special degree of courage is demanded. The advocate of change must display courage to accept responsibility and face the consequences for eventual bad results or failures. Change implies risks, a true leader should not ask for change but place the responsibility upon others. Second, it takes courage to defy. Even though for some individuals specific systems may appear notably inefficient, defying them proves a much more difficult enterprise than perceiving its problems. Defying a system often implies confronting people who believe to be benefited by the current state of affairs. Even those who are neutral may oppose change since it takes effort and disturbs things that are in some sense already “working”. Another possible hindrance to change might be tradition; sometimes things are a certain way simply because of tradition.

While seeking to change things it is fundamental to balance challenging with humility. As with empathic confrontation, in order to change things one must first authentically seek a deep understanding of the given system or structure, and its reasons and history before challenging or dismissing it as a bad system/structure. Changing a system or structure without heedful comprehension of it often leads to the creation of more problems instead of workable solutions. What is unacceptable in a polymathic view is the continuation of inefficient systems just because of tradition or authority. It is a duty of the polymathic leader to be courageous and stand up for defending more intelligent and polymathic-friendly systems and structures, grounded on systematic use of reason, substituting less efficient systems based on ignorance, blind belief, tradition *per se* or authority.

### **Unbridled relations**

In a polymathic leadership context, members of the group must be free to pursue their interests without pressure for submission or conformity. This idea is consonant with the polymathic value of plurality. The absence of “bridles” is a



necessary condition for polymathy in the group. A group in which the free thought, the free pursuit of one's interests and the free expression of one's ideas are subjugated is in opposition with the idea of polymathy. Besides being related to the very core values of polymathy, unbridled relations can be useful for work groups dealing with difficult VUCA problems. The variety of experiences and interests in the group, encouraged by a polymathic worldview, may assist in the development of an array of different competencies, which can be harnessed and directed by the leader(s) and by mindful members while dealing with these kinds of problems.

### **Transcendancy**

Polymathic leadership, in its very definition, entails positive transformations and contributions to society. For that, it is often necessary for the group to rise above, go beyond and elevate the current state of affairs.

Ultimately, the role of polymathic leadership is to encourage, inspire and assist the group in achieving this new level, which entails overcoming difficulties and exercising the group's full potential through polymathic endeavors.

#### **4.2.2 Operationalizing polymathic leadership**

The objective of this section is to discuss some relevant issues regarding the operationalization and practice of polymathic leadership. The topics addressed are the importance of balance in many of the polymathic behaviors presented before and the specific roles of the leader under the lenses of polymathic leadership.

##### **Importance of balance**

Balance in general is a primordial concept for polymathic leadership. In fact, it is impossible to dissociate balance from polymathy. For polymathy, the three great dimensions must be balanced by principle. In a group, it is acceptable (and even encouraged) that some members may have some unbalanced internal aspects (e.g. some are more inclined towards being a specialist, disregarding breadth a little, while others might be inclined towards many interests, sometimes not developing the necessary depth), the system as a whole should seek balance in order to be polymathic.

For instance, in a polymathic organization, there might be a team of extremely technically-oriented individuals, maybe also commanded by a technical leader. However, inside the group, there should be at least one element who has also developed the capacity to bridge areas effectively (see ambidexterity), thus making the whole group more able to effectively communicate to other people in the organization the value of what they are doing. Meanwhile, members of the other sectors, who are occupied in the various intermediate processes of enabling the products originated by the technical team to reach its audience, bearing in mind the necessity of sustainable profit, may sometimes be alienated from the productive process. Thus, it would be equally advisable to have at least one element inside this group who has also developed a capacity communicate technically, thus improving the communication between the areas the other way around. A company as such would be much more balanced, connected and polymathic, even though most of its elements are specialists rather than polymaths in the strict sense of the term. The

precise placement of connective elements in the organization made the whole system polymathic instead of a collection of schizoid groups.

Still in the organizational context, the early Apple Inc. appeared to be a balanced company, with Steve Jobs representing the vision, entrepreneurship and having an extraordinary sense of connectedness (breadth and connectedness):

I decided to take a calligraphy class to learn how to do this. I learned about serif and sans serif typefaces, about varying the amount of space between different letter combinations, about what makes great typography great. It was beautiful, historical, artistically subtle in a way that science can't capture, and I found it fascinating. None of this had even a hope of any practical application in my life. But 10 years later, when we were designing the first Macintosh computer, it all came back to me. And we designed it all into the Mac. It was the first computer with beautiful typography.

(JOBS, 2005)

Steve Wozniak, on the other hand, represented and defended the utmost importance of deep technical skills (depth):

When you start a company, you can think what the revenues are gonna be, how much it's gonna be worth to shareholders, but you always need a technical element, you need somebody who knows how to do it and build the things, you need the scientists.

(WOZNIAK apud MAGAN, 2012)

At the personal level, just as at the organizational or group level, balance is a vital element of polymathy. Polymathy advocates the development of sometimes conflicting components (depth and breadth), thus it requires the constant making of difficult decisions. Often times, it is not possible to conjugate all the great dimensions of polymathy. In such cases, it is necessary to favor one dimension over another. Thus, the heeding of balance and application of critique are essential.

The use of balance is also necessary to avoid engaging in automatic behaviors that may lead to an unbalanced position. Take as an example the balance of apparent oppositional attitudes: respecting and playing. If the group heuristically decides that everything should be utterly respected, this might lead to a situation in

which people fail to use playfulness. As discussed before, playing may be instrumental in seeing things in a different way and making new connections. Thus, a not very thoughtful decision undermined the group's capacity by breaking the balance between playfulness and respect.

In sum, the heeding of balance must be pervasive for polymathy and polymathic leadership, in special. The neglect of balance may easily lead to anti-polymathic conditions.

### **Roles of the polymathic leader**

Although polymathic leadership is not a leader-centric approach, the role and importance of leaders should not be diminished. In this section, I propose what the main roles of the polymathic leader should be, taking into consideration the ultimate goals of polymathic leadership, which are fostering polymathic systems and making positive transformations and contributions to society. Thus, I propose the following four items are the main roles of the polymathic leader:

- Be a driver of a vision and goals that will engage the followers.
- Zeal for a group environment in which behaviors associated with a polymathic worldview are always present, encouraged and fostered.
- Act as a mediator and arbiter, and offer the necessary direction and discernment when the group processes deviate from the optimum and are leading the group towards negative results and anti-polymathic conditions.
- Act in the group so as the pieces of collective knowledge that are scattered in the heads of different people can add up in tandem towards the solution of the problems at hand.

The polymathic leader should not be posed as the “owner” of the group, be it at an intellectual, emotional or influential sphere. The polymathic leader should not be posed as a figure to inspire awe, as if endowed by special “divine” attributes. On the opposite, the polymathic leader should be seen as somebody at the same

level, he or she is just a person who is occupying a specific position and exercises a specific role in the group, with its rewards, risks and pressures.

The polymathic leader should expect and welcome challenges to his or her ideas, as long as members also heed the utilization of intellectual humility. Most of times the leader will act as a mediator, facilitator and as a “thermostat” of the social exchanges happening in the group. Whenever the group or certain members fall out of balance, the leader must take action to keep the system as fluid and as polymathic as possible.

The leader, especially in an entrepreneurial context, must carry a strong drive, direction and sense of objectives, but should never use his power to submit the voice and intellect of the group. For polymathic leadership, the followers must willingly choose to follow somebody’s leadership because they trust in this leader and they believe that being part of this group is beneficial to them. The leader is expected to sustainably lead utilizing polymathic behaviors, which, in turn, provide the followers with opportunities for self-development and rewards the individual for being part of a group that achieves difficult objectives that are agreed upon and are consonant with the ideas of polymathy as a worldview.

Polymathic leadership should encourage a realistic and mature behavior, which does not mean dryness or emotionless. A mature view entails being aware of and recognizing the various aspects of human nature. Polymathic leadership should encourage any human expression that is not blatantly dissonant from the values of polymathy. Again, it is part of the polymathic leader’s responsibility to act as a mediator and arbiter and tune down some behaviors when they start to affect the capacity of the group to achieve its goals and work as a polymathic system.

#### **4.2.3 Practical examples of polymathic behaviors and attitudes**

##### **Illustration 1**

This is the first illustration of how the behaviors of polymathic leadership can be implemented. In this fictional conversation a member starts with a real assertion taken from (ZAKARIA, 2015) and then the members of the group engage each other advancing to higher levels of depth, breadth and connectedness of

knowledge utilizing some components of polymathic leadership (they will be indicated in brackets, in italics).

Four members are discussing the respective strengths of liberal arts education and STEM (science, technology, engineering and mathematics) education for the development of creativity. Member 1 starts the discussion asserting that too much STEM-orientation can be detrimental to creativity and he starts giving examples of Asian countries:

Douglas: "Asian countries like Japan and South Korea have benefitted enormously from having skilled workforces. But technical chops are just one ingredient needed for innovation and economic success. America overcomes its disadvantage — a less-technically-trained workforce — with other advantages such as creativity, critical thinking and an optimistic outlook. A country like Japan, by contrast, can't do as much with its well-trained workers because it lacks many of the factors that produce continuous innovation (ZAKARIA, 2015)."

Robert: I view it differently. I think Japanese are rather creative [*perspective-taking*].

Karen: I do too. For instance, I love video games. Almost all of them are Japanese, and I can tell you, they are extremely creative [*experiential polymathy*]. In fact, did you know that nowadays the video game industry is bigger than Hollywood? [*broadening knowledge: philosophical polymathy*]

Robert (thinking to himself): Maybe what Douglas meant is that Japanese culture is stricter than American culture and, because of that, it may undermine creativity... [*mathematical empathy*]

Robert: Douglas, what do you mean by "can't do as much"? Do you know that Japan has more patents per capita than the United States? [*empathic confrontation; thoroughness*]

Douglas: No. In fact, I really hadn't thought this way. So, let's check this data and, Karen, we still have to see if the games you mentioned are really creative or just newly fashioned representations of old tropes! [*critical open-mindedness*]

Karen: You will surprise yourself! [*stimulating experiential polymathy*]

Nadia: Well, it is a complex matter for sure, maybe a possible way to approach this systematically would be to carefully analyze the school curricula of both countries and then cross this data with the information about patents? [*exercising intuitive tools: synthesizing*]

In this illustration, I purposely did not declare who was the appointed leader of this group. Polymathic leadership is created by leaders and members together. Successful polymathic leadership passes through the engagement of the members of the group in a polymathic exchange, creating a polymathic environment. When this occurs, members and appointed leaders see each other at the same level, influencing and being influenced with the common purpose of advancing to higher levels of depth, breadth and connectedness of knowledge, competences and creativity, and achieving together beneficial change and transformation.

## Illustration 2

In this illustration, the company had just implemented a new E.R.P. (Enterprise Resource Planning) system, which affected the way that many employees do their jobs. Brian works? at one of the company's warehouses. His job is to receive goods from suppliers, inspect them, and direct them to a given bin location in the warehouse. He did not need to work with computers before, and now he has to cross-check each delivery with its the respective purchase order:

Brian (feeling helpless and desperate): I hate the new system that the company installed. I completely changed the way I do my job!

John: Oh yeah, there has been a lot of changes lately! [*empathy*] But, tell me, what has been troublesome lately?

Brian: Now I have to cross-check every goods receipt with the purchase orders and every receipt takes twice the time. Besides that the system is difficult to navigate.

John: Do you remember how much trouble we have had with returns? And the time lost locating and separating the returned goods from their location? *[empathic confrontation]*

Brian: Yeah, that was messy.

John: Did you check this screen here? It demonstrates all the relations between documents. Do you see that the goods receipt number 05367 is related to purchase order 05685? Also, Rose in the financial sector can track the invoices from the supplier related to this goods receipt, and Cathy from accounts payable can track that the all the accounts related to that shipment. Isn't it a much more integrated process now? *[technical knowledge: depth; building a sense of the whole: connectedness]*

Brian: Hummm, that's why the manager was so enthusiastic about this new system. I can see how it will benefit the whole process *[empathy; perspective-taking; open-mindedness]*. However, it is still a bit difficult to use...

John: Yes, it is in the beginning. But keep on, if you need we can provide you a test version and some time for you to practice. Explore the system and keep practicing for a few days and you will see the difficulties disappear. *[thoroughness; perseverance]*

Brian: I guess it will be no problem; we have passed through much worse!

Sometimes, many problems can be avoided with a few minutes of effective and meaningful communication, following the principles of polymathic leadership. In the case above, Brian's job was in jeopardy. Brian was hired, trained and developed a relationship with the firm. Dismissing him due to an alleged technology non-adaptation would mean a loss of money to the company and, possibly, a loss of a competent resource.



In this illustration, valuable knowledge is transmitted from the leader to the follower and a sense of the whole is given. There is also the encouragement of perspective taking and persistence. Although the situation could have led to a heated discussion, it did not happen. The polymathic leader assessed the situation correctly and saw what kinds of barriers are impeding people to advance to higher levels of knowledge and skills. He also acted on forms of removing these barriers.

## **Conclusion**

The set of dimensions and elements of polymathic leadership presented in this section, while extensive is not exhaustive. The simple and small illustration above served to demonstrate how many elements can be applied in a very short social encounter. Polymathic leadership is a new theory and, thus, all the propositions presented are still to be tested and validated empirically. Nevertheless, this initial model aims to cover the core ideas of what polymathic leadership is and offer a perspective on how leaders and members should behave and act under this approach.

### 4.3. POLYMATHIC LEADERSHIP AND OTHER APPROACHES ON LEADERSHIP

The objective of this section is to compare polymathic leadership with two other types of leadership that are part of the so-called approach of “new leadership”: transformational and authentic leadership. The choice of these two perspectives is due to their relevance in the leadership literature and because they apparently have some similarities with polymathic leadership, which will be discussed and explored in this section.

#### 4.3.1 Transformational Leadership

Transformational leadership (sometimes referred to as charismatic leadership) is one of the most relevant approaches of the so-called “new leadership” (DAY and ANTONAKIS, 2011; NORTHOUSE, 2013). Some different approaches were made to address transformational and charismatic leadership, in this work I review three of the most important ones.

According to Day and Antonakis (2011), House (1977) was the first author to present an integrated theoretical framework and testable proposition to explain the behavior of charismatic leaders. House’s perspective puts strong emphasis on the skills and individual characteristics of the leader, charismatic leaders are people “who by force of their personal abilities are capable of having profound and extraordinary effects on followers” (HOUSE, 1977, p. 189). This view fits the leadership approach of the “great person”, as the leader, endowed with especial attributes, is seen a kind of savior, capable of solving complex problems: “because of other ‘gifts’ attributed to the leader, such as extraordinary competence, the followers believe that the leader will bring about social change and will thus deliver them from their plight” (House, 1977, p. 204).

Burns (2012) is one of the most influential authors of the theory of transformational leadership. His work serves as the foundation for the later development of the theory by Bass and Avolio (1997). Burns (2012) sought to theorize about the underpinnings of leader/follower interaction addressing the

relationship between individual power, individual purpose, and the quality of leader/follower relations.

According to Burns (2012), power is utilized by transformational leaders to improve communication with followers and understand their goals and needs; purpose is the desire of the leader to help followers reach new personal and professional heights; and leaders should display inspirational and uplifting behavior, and engage in highly a motivational relationship with followers.

Burns was especially preoccupied with the differentiation of manipulation and leadership. Burns sees manipulation as a nefarious process whereby leaders and followers become locked in a “symbiotic maintenance of each other’s lowers needs”, whereas transformational leadership is ethical, true and is an intrinsically developmental process aiming at higher-order aspirations of leaders and followers. He ends his work with the following statement: “That people can be lifted into their better selves is the secret of transforming leadership and the moral and practical theme of this book” (BURNS, 2012, p. 462)

Bass and Avolio (1997) utilized Burns (2012) work to advance the theory of transformational leadership. They proposed a framework for the construct with initially four dimensions, which later became five because the initial dimension of idealized influence (also known as charisma) was split into two components. Thus, the five dimensions of transformational leadership became: (1) attributional idealized influence, (2) behavioral idealized influence, (3) individualized consideration, (4) inspirational motivation, and (5) intellectual stimulation.

Attributional idealized influence refers to attributions of the leader through the follower’s perceptions. For instance, the leader’s attribution of being selfless and respectful for others depends on the perception of the followers as so (ANTONAKIS, 2012).

Behavioral idealized influence refers to specific behaviors of the leader that followers can observe directly, such as the encouragement of followers to achieve defined goals through the existence of a common vision, mission, and set of ideals (ANTONAKIS, 2012).

Individualized consideration refers to the attendance of the individual needs of followers. It involves serving as a mentor and coach, counseling followers,

maintaining frequent contact with them, and helping them to self-actualize (ANTONAKIS, 2012).

Inspirational motivation refers to raising followers' expectations and confidence that ambitious goals that might seem unreachable can be achieved. The leader serves as an inspiration and a communicator of confidence in the attainment of such goals. It involves the development of meaning and a strong team environment, and the provision of challenging work (BASS, 1985; ANTONAKIS, 2012).

Intellectual stimulation refers to the degree to which the leader challenges assumptions, solicits followers' ideas, encourages and stimulates creativity, and nurtures independent thinking. Bass (1985) poses that the employment of intellectual stimulation radically alters followers' conceptualization, comprehension, and discernment of problems they face. According to Antonakis (2012), intellectual stimulation involves "challenging follower assumptions, generalizations, and stereotypes and stimulating followers to seek ways of improving current performance" (p. 267).

### **Comparison with polymathic leadership**

In order to compare both constructs, I will utilize as a framework mainly the work of Burns (2012) and Bass and Avolio's (1997) five dimensions of Transformational Leadership (TL).

#### *Intellectual stimulation*

Among the dimensions of TL discussed above, intellectual stimulation presents the most conceptual affinity with polymathic leadership. Some descriptions of the behavior of intellectual stimulation are very similar to what was discussed in the topics of polymathic leadership. According to Bono and Judge (2004, p.901), intellectual stimulation refers to "leaders who challenge organizational norms, encourage divergent thinking, and who push followers to develop innovative strategies". Intellectual stimulation also involves the

encouragement and soliciting of creative ideas from the followers by their leaders, however it is not precise in stating how the followers must achieve it:

Transformational leaders stimulate their followers' efforts to be innovative and creative by questioning assumptions, reframing problems, and approaching old situations in new ways. Creativity is encouraged. There is no public criticism of individual members' mistakes. New ideas and creative problem solutions are solicited from followers, who are included in the process of addressing problems and finding solutions. Followers are encouraged to try new approaches, and their ideas are not criticized because they differ from the leader's ideas.

(BASS and AVOLIO, 1994, p.3)

Polymathic leadership has the merit of proposing that the expansion of a group's collective intellect and the performing of creative endeavors are done through the development of the polymathic dimensions of depth, breadth and connectedness, via specific behaviors that constitute the dimensions of polymathy as a worldview. Polymathy-fostering leaders never solicit "creativity" from their group. Instead, they foster meaningful exchanges that encompass depth and breadth, and they encourage polymathic pursuits by the followers. The sustained practice of these behaviors is expected to ultimately lead the group to more creative and innovative ideas.

An interesting issue about intellectual stimulation is its feed-forward multiplier effect, as observed in the study by Barling *et al.* (1996). The authors found that when leaders were trained to be more intellectually stimulating, their followers also showed significantly higher ratings for intellectual stimulation. This "contamination" effect is very important to disseminate a good practice throughout the group.

### *Idealized influence*

Idealized influence, also known as charisma, is a fundamental dimension of transformational leadership. However, charisma is not a focal component of polymathic leadership. Here it is valid to draw a distinction between the two facets

of idealized influence: attributional and behavioral: while the former refers to the manner the leader is seen by the followers (e.g. as charismatic, powerful and confident) and if the followers would like to be associated with him or her, the latter is focused on how the leader communicates values, beliefs and a sense of mission (BASS and AVOLIO, 1997). For polymathic leadership the latter aspect is much more important than the former. As seen, it is among the polymathic leader's role to direct the vision and promote systems of values and beliefs. Still, polymathic leadership is not centered at the capacity of the leader in acting like a "personality magnet", as charisma often times implies. Although polymathic leaders can serve as role models for specific behaviors and can be attributed with desirable features by the followers, polymathic leadership is centered on the capacity of influencing and encouraging the creation and the sustainability of polymathic systems, which can be done by leaders with different personalities and different levels of charisma.

#### *Inspirational motivation*

In the example of the behavioral dimension of idealized influence, inspirational motivation is important but is not a focal component of polymathic leadership. The difference is, again, the centralization on the leader's importance. As discussed in previous sections, self-development and confidence development are among the dimensions of polymathic leadership. Nonetheless, the perspective is different. The leader must be responsible for a system that is conducive for the member's development, however, the ultimate inspiration and motivation does not lie in external models but in the achievement of a polymathic *Zustand*, whereby individuals and groups can rise above, go beyond and elevate the current state of affairs, making positive transformations and contributions to society.

#### *Individualized consideration*

Following the same rationale for the other dimensions, individualized consideration is important but is not a focal component of polymathic leadership. In a polymathic leadership perspective, aspects of individualized influence, such as serving as a mentor and coach, and counseling followers should be a natural

occurrence in a polymathic system. It does not necessarily come from the leader. In fact, as the appointed leader in an organization spends most of the time at the strategy level (see KATZ, 1974), it should be expected the leader's seeking technical counseling from followers more often than acting as a counselor.

### *Conclusion*

Polymathic and transformational leadership have many characteristics in common. However, transformational leadership will not necessarily lead to a polymathic worldview in the group and to contributions that heed all the three great dimensions of breadth, depth and connectedness. Conversely, not all polymathic leaders will display charismatic characteristics. However, all polymathic leaders must be transformational, in the polymathic sense embedded by the dimension of transcendency, which includes the observation of the three great dimensions of polymathy.

#### **4.3.2 Authentic Leadership**

The construct of authentic leadership (henceforth AL), as the name implies, is based on the concept of authenticity. According to Gardner (*et al.* 2011), the concept of authenticity started to appear in theorizations of leadership in the 60s, with various authors with different perspectives on how to integrate these concepts.

According to Gardner and colleagues (2001), the constructs of leadership authenticity, as well as leadership inauthenticity, only gained formal definition and operationalization in the 80s, with the work of Henderson and Hoy (1983). In their view, leadership authenticity would depend on the degree of three components: (1) acceptance of personal and organizational responsibility for actions, outcomes and mistakes; (2) the non-manipulation of subordinates; and (3) the salience of the self over role requirements. Authentic leaders would score high on all these three factors, while a low score in them would indicate an inauthentic style of leadership.

Along the years, AL evolved into a complex multidisciplinary construct, especially concerning to the integration of three specific bodies of knowledge: leadership, ethics and the positive school of organizational behavior (LUTHANS, 2002; AVOLIO and GARDNER, 2005; COOPER *et al.*, 2005; GARDNER *et al.*, 2005).

The construct of AL is still in the process of development today, there is not a consensual definition of it accepted by the entire academia. Nonetheless, Shamir and Eilam (2005) posed that some of the proposed elements for AL are shared by various scholars in the field. Walumbwa *et al.* (2008), went further and sought to consolidate the construct of AL through an extensive review of the literature. They posed that the definitions of AL tend to converge toward some central dimensions. In the same study, they presented the following definition of authentic leadership:

[Authentic leadership is] a pattern of leader behavior that draws upon and promotes both positive psychological capacities and a positive ethical climate, to foster greater self-awareness, an internalized moral perspective, balanced processing of information, and relational transparency on the part of leaders working with followers, fostering positive self-development.

(WALUMBWA *et al.*, 2008, p. 94)

In the perspective of Walumbwa and colleagues (2008), AL is a multidimensional construct composed by four subjective dimensions: (1) self-awareness, (2) relational transparency, (3) internalized moral perspective, and (4) balanced processing. These dimensions can be assessed via the Authentic Leadership Questionnaire (ALQ).

Self-awareness refers to the awareness and understanding of the nature of one's core values, identity, emotions, motives. It is the dimension whereby a person can judge reality and establish moral judgments of performed acts. It involves the comprehension of one's strengths and weaknesses and the comprehension of how the person's *self* impact others (KERNIS, 2003). Sample items of this dimension in the Authentic Leadership Questionnaire are:

- Seeks feedback to improve interactions with others.



- Accurately describes how others view his or her capabilities.

Relational transparency refers to the truthful representation of oneself to others, in opposition of displaying oneself in a false or distorted way. It involves expressing thoughts and feelings openly (KERNIS, 2003). The employment of relational transparency promotes mutual respect, confidence, and credibility (GARDNER *et al.*, 2005). Sample items of this dimension in the Authentic Leadership Questionnaire are:

- Says exactly what he or she means.
- Is willing to admit mistakes when they are made.

Internalized moral perspective refers to a positive ethical foundation, oriented by internal moral and ethical standards of the person that surmount outside pressures. Thus it encompasses the alignment of the leader's values and beliefs with his actions over time (AVOLIO and GARDNER, 2005). This dimension is directly based on the individual's self-regulation (RYAN and DECI, 2000). Sample items of this dimension in the Authentic Leadership Questionnaire are:

- Demonstrates beliefs that are consistent with actions.
- Makes decisions based on his/her core beliefs.

Balanced processing (sometimes balanced processing of information) refers to the leader's soliciting of different sources of relevant information, alternative viewpoints and their fair-minded consideration. The solicited viewpoints must encompass not only the ones favorable to the beliefs and positions of the decision-maker but also, and especially, the ones that are in opposition to them (GARDNER *et al.*, 2005). The employment of this behavior is expected to make the decision less susceptible to distortions and biases. Sample items of this dimension in the Authentic Leadership Questionnaire are:

- Solicits views that challenge his or her deeply held positions.
- Listens carefully to different points of view before coming to conclusions.

### **Comparison with Polymathic Leadership**

For the comparison of authentic leadership and polymathic leadership, I will follow the same structure as the previous section, creating an individual topic for each dimension.

### *Self-awareness*

Self-awareness is fundamental for polymathic leadership. It did not receive a dimension in the model because self-awareness is seen as a kind of critique to oneself, which places it under the polymathic dimension of critical open-mindedness. Another dimension that covers the topic of awareness, but regarding to others, is mathematical empathy. In this case it goes beyond awareness, as empathy entails not only comprehending but the exercise of transposing oneself to another person's perspective.

### *Relational transparency*

Relational transparency is behind the core ideas of authenticity. It is very important for polymathic leadership once it entails sustainable, meaningful relationships. Without authenticity and transparency it is difficult to build the level of relationship necessary for the profoundness necessary for polymathic exchanges. Thus, it is possible to pose that polymathic leadership implies relational transparency.

### *Internalized moral perspective*

Internal moral and ethical standards of the person that surmount outside pressures, i.e. internalized moral perspective, are expected to be present in the polymathic leadership context. For instance, the dimension of unbridledness in the individual depends on an inner source of morals and values that can resist pressures for subjugation. There is a vital issue, though, which is that polymathy already entails values. Thus, for polymathic leadership the internalized values must be consonant with polymathy as a *Weltanschauung*.

### *Balanced processing*

Soliciting different sources of relevant information, asking for views that may challenge the leader's deeply held positions, and listening carefully to different points of view before coming to conclusions are fundamental behaviors of polymathic leadership. As discussed, the concept of balance overall permeates the models of polymathy as a worldview and polymathic leadership. Many of the behaviors outlined in the AL dimension of balanced processing also appear in dimensions of polymathic leadership, just the organization of the construct was different. For instance, soliciting different points of view is related to the polymathic leadership dimension of plurality stimulation, whereas soliciting views that challenge the leader's held positions is related to the behavior of challenging humility. Therefore, it is possible to pose that balanced processing is a focal element of both approaches.

### *Conclusion*

Polymathic leadership has even more elements in common with authentic leadership than with transformational leadership. Nonetheless, the same factors that work to differentiate TL from PL are also present here. As posed before, polymathic leadership is centered on the capacity of influencing and encouraging the creation and the sustainability of polymathic systems. The difference from TL is that it can be done without a charismatic leader, but it appears that it is not possible to be achieved without authenticity. Thus, it is very likely that polymathic leadership should entail authentic behaviors. Although they are not the primordial focus of the model, the model proposed by polymathic leadership might not be feasible without authenticity.

## 5. CONCLUSION

In 1945, the psychologist Kurt Lewin stated the celebrated sentence: “Nothing is as practical as a good theory” (LEWIN, 1945, p.129). Unfortunately, it often referenced apart from original context. In that paper, the author describes the necessity to clarify “day by day” social problems with scientific rigor and its criticality in the development of our society, also he celebrates the advances that were taking place in the field of social science.

Lewin pointed out to the importance of strong theoretical foundations for social sciences. A view reiterated by posterior scholars such as Andrew de Ven: “Good theory is practical precisely because it advances knowledge in a scientific discipline, guides research toward crucial questions, and enlightens the profession of management” (VEN, 1989).

What is intended by postulating theory in this work resonates with the ideas of Lewin and De Ven. A model or theory for polymathy and polymathic leadership emerge in an era of new problems and challenges with a new level of complexity and urgency. For instance, the problem of building a very large bridge over a river required, in the past, just the knowledge of making steel and bridge building. Nowadays, in order to build a bridge, one has to take into account social, humanistic, environmental and economic aspects which were not so relevant in the past, besides the old technical problems, which are not the greatest challenge anymore. In 1874, when Eads Bridge was built to connect the east and west of the United States, crossing over the Mississippi River, at least 77 workers suffered severe damage or death due to Caisson disease, a type of decompression sickness. It is an example of how the rules of that time were different from what is acceptable today. Henceforth, as the views and social systems change from time to time, the theories also need to be renewed in order to accommodate new realities, which is a very practical aspect of theories.

Today’s challenges call for a more comprehensive, interconnected and critical type of leadership. As discussed before this call is not new, but despite posited by many authors, we are still in the search for better models to answer these challenges. AVOLIO (2010), while reflecting on the challenges for the future of the

field of leadership studies, came very close to the idea of polymathy (and polymathic leadership) which is encompassed in this work:

Today leadership research is primarily conducted by psychologists, sociologists, historians, management theorists, political scientists, educators, ethicists, philosophers, and anthropologists. I have no doubt that over the next fifty years critical additions to the leadership research team will involve engineers, biologists, geneticists, and chemists. A more holistic approach to human development is on the horizon, and leadership development has traditionally trailed only a short distance behind the science of human development.

(AVOLIO, 2010, p. 747)

Polymathy entails developing the capacity of solving problems and manipulating the environment integrating and interconnecting multiple bodies of knowledge, learnings, experiences, skills and competencies. Polymathy treasures the gift of being able to make sense of the world and the knowledge and legacy we are able to build from it. The framework of polymathy can offer contributions by fostering our capacity of connectivity, by understanding and promoting plurality of thought, and by treasuring the pursuit of knowledge without pressure for submission. It is a systems view for the development of an entity as closely as possible to a fully *gebildete* status. It means that polymathy is not only a theory of accommodating to change, it is a theory of creating change. Both for polymathy and *Bildung* “the mere appropriation of the stores of knowledge, the interpretations and the rules of a present cultural form of life” (PEUKERT, 2002) are not enough, the *gebildete* and polymathic entity must develop the ability to “go beyond the present state of affairs and to transform the structures and prevailing rules of this form of life, should it in any way endanger itself” (PEUKERT, 2002). A full-range theory of polymathy, like *Bildung*, must incorporate a praxeology (a theory of actions) and a teleology (a theory for explaining ends or purposes). It means that polymathy and polymathic leadership encompass not only the actions of how to deal with complex problems and a changing environment, but they also carry a purpose; expanding humankind capabilities by advancing together (not only as groups of an organization, but rather as groups within a very large environment that we all share: the planet) to higher levels of depth, breadth and connectedness of

knowledge, experiences, competences and creativity, in order to solve complex problems and achieve together positive change and transformation.

Polymathy and polymathic leadership have addressed discussions related to the role of traits (see STOGDILL, 1948; KIRKPATRICK and LOCKE, 1991; CARUSO and WOLFE, 2004) and skills (see KATZ, 1974), it also brought issues about the nature of the relationship between leaders and followers (see COLELLA and VARMA, 2001), and the approaches of the so-called “new leadership theories”(NORTHOUSE, 2013): transformational leadership (BASS, 1985; BASS and RIGGIO, 2006), charismatic leadership (CONGER *et al.*, 2000), and authentic leadership (AVOLIO and GARDNER, 2005; GARDNER *et al.*, 2005). It has also drawn upon recent discussions of emotional intelligence (see DRUSKAT and WOLFF, 2001; CARUSO and WOLFE, 2004; GOLEMAN, 2006), and leadership and complexity (see OSBORN *et al.*, 2002; SCHNEIDER and SOMERS, 2006; UHL-BIEN *et al.*, 2007).

In sum, based on a list of five items that a theory should cover (PILIAVIN, 2005), this work intended to:

- Help classify polymathy: its nature, processes, and relationships;
- Help understand how and why the already observed, but not academically structuralized, phenomenon of polymathy occurs;
- Help predict some possible relationships between antecedents and outcomes of polymathy and polymathic leadership;
- Serve as a basis for action. “There is nothing as practical as a good theory”.

The fifth item of the list is “guide research in useful directions”, which is the last topic of this work.

### **Future studies and developments**

As posed before, polymathic leadership is a new theory and, thus, all the propositions presented are still to be tested and validated empirically. The focus of this work was to introduce an initial model, which aimed at covering the core ideas

about the construct and offering a perspective on how this construct could be operationalized. Anteceding polymathic leadership is polymathy itself. A construct that, as far as my exploration could reach, had never been the main focus of an academic work and that had never been articulated with other constructs of the literature in a deep, academic sense. Thus, I propose that the next steps in the development of a theory of polymathy and polymathic leadership should focus on:

- The advancement of the theoretical models of polymathy and polymathic leadership.
- The advancement of the theoretical propositions and hypotheses.
- The elaboration of an instrument to measure polymathy.
- The elaboration of an instrument to measure polymathic leadership.

## 6. BIBLIOGRAPHICAL REFERENCES

AMABILE, T. M. A model of creativity and innovation in organizations. **Research in organizational behavior**, v. 10, n. 1, p. 123-167, 1988.

AMABILE, T. M. Creativity and Innovation in Organizations. **Harvard Business School**, 1996.

AMABILE, T. M. The social psychology of creativity: A componential conceptualization. **Journal of personality and social psychology**, v. 45, n. 2, p. 357, 1983. ISSN 1939-1315.

ANNAN, K. **The New World Disorder: Challenges for the UN in the 21st Century 2014**.

ANTONAKIS, J. Transformational and Charismatic Leadership. In: ANTONAKIS, J. (Ed.). **The Nature of Leadership**, 2012.

ATKINSON, R. et al. **Worse Than the Great Depression: What Experts Are Missing About American Manufacturing Decline**. Information Technology and Innovation Foundation (ITIF) March, 2012.

AVOLIO, B. J. Pursuing authentic leadership development. **Handbook of leadership theory and practice**, p. 739-768, 2010.

AVOLIO, B. J.; GARDNER, W. L. Authentic leadership development: Getting to the root of positive forms of leadership. **The leadership quarterly**, v. 16, n. 3, p. 315-338, 2005. ISSN 1048-9843.

AVOLIO, B. J.; GARDNER, W. L.; WALUMBWA, F. O. Authentic leadership questionnaire. **Gallup Leadership Institute**. Retrieved with permission from <http://www.mindgarden.com>, 2007. Accessed: 2014-10-18.



BANDURA, A. **Self-efficacy: The exercise of control.** Macmillan, 1997. ISBN 0716728508.

BANDURA, M.; DWECK, C. The relationship of conceptions of intelligence and achievement goals to achievement-related cognition, affect and behavior. **Unpublished manuscript, Harvard University**, 1985.

BARLING, J.; WEBER, T.; KELLOWAY, E. K. Effects of transformational leadership training on attitudinal and financial outcomes: A field experiment. **Journal of Applied Psychology**, US, v. 81, n. 6, p. 827-832, 1996. ISSN 1939-1854(Electronic);0021-9010(Print).

BASS, B. M. **Leadership and Performance Beyond Expectations.** Free Press, 1985. ISBN 9780029018101.

BASS, B. M.; AVOLIO, B. J. **Improving Organizational Effectiveness Through Transformational Leadership.** SAGE Publications, 1994. ISBN 9780803952362.

BASS, B. M.; AVOLIO, B. J. **Full range leadership development: Manual for the Multifactor Leadership Questionnaire.** Mind Garden Palo Alto, CA, 1997.

BASS, B. M.; BASS, R. **The Bass handbook of leadership: Theory, research, and managerial applications.** Simon and Schuster, 2009. ISBN 1416545786.

BASS, B. M.; RIGGIO, R. E. **Transformational Leadership.** Taylor & Francis, 2006. ISBN 9781135618889.

BAUMOL, W.; BLINDER, A. **Economics: Principles and Policy.** Cengage Learning, 2011. ISBN 9780538453677.

BEGHETTO, R. A.; KAUFMAN, J. C. Toward a broader conception of creativity: A case for "mini-c" creativity. **Psychology of Aesthetics, Creativity, and the Arts**, v. 1, n. 2, p. 73, 2007. ISSN 1931-390X.

BENNETT, N.; LEMOINE, G. J. What VUCA Really Means for You. **Harvard Business Review**, v. 92, n. 1/2, p. 27-27, 2014. ISSN 00178012. Retrieved from: <http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=93302155&lang=pt-br&site=ehost-live> >. Accessed: 2015-01-02.

BINET, A. **L'étude expérimentale de l'intelligence**. Editions L'Harmattan, 2004. ISBN 2296381332.

BONO, J. E.; JUDGE, T. A. Personality and Transformational and Transactional Leadership: A Meta-Analysis. **Journal of Applied Psychology**, US, v. 89, n. 5, p. 901-910, 2004. ISSN 1939-1854(Electronic);0021-9010(Print).

BOSTROM, N. **How long before superintelligence?** Linguistic and Philosophical Investigations, 2006. Retrieved from: <http://www.nickbostrom.com/superintelligence.html> >. Accessed: 2015-02-17.

\_\_\_\_\_. **Superintelligence: Paths, Dangers, Strategies**. Oxford University Press, 2014. ISBN 9780199678112.

BOTEACH, S. **Honoring the Child Spirit: Inspiration and Learning from Our Children**. Vanguard Press, 2011. ISBN 9781593156541.

BOYATZIS, R. E.; ROCHFORD, K.; JACK, A. I. Antagonistic Neural Networks Underlying Differentiated Leadership Roles. **Frontiers in Human Neuroscience**, v. 8, 2014-March-4 2014. ISSN 1662-5161. Retrieved from: [http://www.frontiersin.org/Journal/Abstract.aspx?s=537&name=human\\_ne](http://www.frontiersin.org/Journal/Abstract.aspx?s=537&name=human_ne)

uroscience&ART DOI=10.3389/fnhum.2014.00114 >. Accessed: 2015-02-17.

BOYCE, C. J.; WOOD, A. M.; POWDTHAVEE, N. Is personality fixed? Personality changes as much as “variable” economic factors and more strongly predicts changes to life satisfaction. **Social Indicators Research**, v. 111, n. 1, p. 287-305, 2013. ISSN 0303-8300.

BRITANNICA, E. Renaissance man. **Encyclopædia Britannica**, 2015. Retrieved from: <  
<http://global.britannica.com/EBchecked/topic/497891/Renaissance-man> >. Accessed: 2014-10-26.

BROADY-PRESTON, J. The information professional of the future: polymath or dinosaur? **Library Management**, v. 31, n. 1/2, p. 66-78, 2010. ISSN 0143-5124.

BRODERICK, D. **Ferocious Minds: Polymathy and the New Enlightenment**. Borgo Press, 2005. ISBN 9780809544738.

BRYMAN, A. **Charisma and leadership in organizations**. Sage Pubns, 1992. ISBN 0803983174.

BURKE, P. **A Social History of Knowledge II: From the Encyclopaedia to Wikipedia**. John Wiley & Sons, 2014. ISBN 0745675700.

BURKE, C. S.; DIAZGRANADOS, D.; SALAS, E. Team leadership: A review and look ahead. **The SAGE Handbook of Leadership**. Los Angeles, Calif: Sage. S, p. 338-351, 2011.

BURNS, J. M. G. **Leadership**. Open Road Media, 2012. ISBN 9781453245170.

BYRNE, R. W.; WHITEN, A. Machiavellian Intelligence: Social Expertise And The Evolution Of Intellect In Monkeys, Apes, And Humans (Oxford Science. 1989.

CANDY, P. C. **Self-Direction for Lifelong Learning. A Comprehensive Guide to Theory and Practice.** ERIC, 1991. ISBN 1555423035.

CARR, E. The last days of the polymath. **Intelligent Life Magazine, Autumn, 2009.**

CARROLL, J. B. **Human cognitive abilities: A survey of factor-analytic studies.** Cambridge University Press, 1993. ISBN 0521387124.

CARROLL, J. B. The three-stratum theory of cognitive abilities. In: FLANAGAN, D. P.;GENSHAFT, J. L., *et al* (Ed.). **Contemporary intellectual assessment: Theories, tests, and issues.** New York, NY, US: Guilford Press, 1997. p.122-130. ISBN 1-57230-147-3 (Hardcover).

CARUSO, D. R.; WOLFE, C. J. Emotional intelligence and leadership development. **Leader development for transforming organizations: Growing leaders for tomorrow**, p. 237-263, 2004.

CASPI, A.; ROBERTS, B. W. Personality development across the life course: The argument for change and continuity. **Psychological Inquiry**, v. 12, n. 2, p. 49-66, 2001. ISSN 1047-840X.

CAVELL, S. **Must We Mean What We Say?: A Book of Essays.** Cambridge University Press, 2002. ISBN 9780521529198.

CHERNOW, R. **Titan: The Life of John D. Rockefeller, Sr.** Knopf Doubleday Publishing Group, 2007. ISBN 9780307429773.

CHRISOMALIS, S. **Dictionary of Obscure Words.** 2015

CIULLA, J. B. **Ethics, the heart of leadership**. Greenwood Publishing Group, 2004. ISBN 0275982483.

CLONINGER, C. R.; SVRAKIC, D. M.; PRZYBECK, T. R. A psychobiological model of temperament and character. **Archives of general psychiatry**, v. 50, n. 12, p. 975-990, 1993. ISSN 0003-990X.

\_\_\_\_\_. **The Temperament and Character Inventory (TCI): A guide to its development and use**. center for psychobiology of personality, Washington University St. Louis, MO, 1994. ISBN 0964291703.

COHEN, S. G.; BAILEY, D. E. What makes teams work: Group effectiveness research from the shop floor to the executive suite. **Journal of Management**, v. 23, n. 3, p. 239-290, // 1997. ISSN 0149-2063. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0149206397900349> Accessed: 2015-03-31.

COLELLA, A.; VARMA, A. The impact of subordinate disability on leader-member exchange relationships. **Academy of Management Journal**, v. 44, n. 2, p. 304-315, 2001. ISSN 0001-4273.

CONGER, J. A.; KANUNGO, R. N.; MENON, S. T. Charismatic Leadership and Follower Effects. **Journal of Organizational Behavior**, v. 21, n. 7, p. 747-767, 2000. ISSN 08943796. Retrieved from: <http://www.jstor.org/stable/3100311> Accessed: 2015-03-30.

COOPER, C. D.; SCANDURA, T. A.; SCHRIESHEIM, C. A. Looking forward but learning from our past: Potential challenges to developing authentic leadership theory and authentic leaders. **The Leadership Quarterly**, v. 16, n. 3, p. 475-493, 2005. ISSN 1048-9843.

CSIKSZENTMIHALYI, M. **Beyond boredom and anxiety**. Jossey-Bass, 2000. ISBN 0787951404.

CSIKSZENTMIHALYI, M. 16 Implications of a Systems Perspective for the Study of Creativity. **Handbook of creativity**, p. 313, 1999. ISSN 0521576040.

CSIKSZENTMIHALYI, M.; WOLFE, R. New conceptions and research approaches to creativity: Implications of a systems perspective for creativity in education. In: (Ed.). **The Systems Model of Creativity**: Springer, 2014. p.161-184. ISBN 9401790841.

\_\_\_\_\_. **Flow**. Springer, 2014. ISBN 9401790876.

DABARS, W. B.; UNIVERSITY OF CALIFORNIA, L. A. **Disciplinary and Interdisciplinarity: Rhetoric and Context in the American Research University**. University of California, Los Angeles, 2008. ISBN 9781109022247.

DAFT, R. **The Leadership Experience**. Cengage Learning, 2007. ISBN 9780324539684.

DAMPIER, W.; COHEN, I. B. **A History of Science and Its Relations with Philosophy and Religion**. Cambridge University Press, 1948. ISBN 9780521093668.

DAVIS, R.; SHROBE, H.; SZOLOVITS, P. What is a knowledge representation? **AI magazine**, v. 14, n. 1, p. 17, 1993. ISSN 0738-4602.

DAY, D. V.; ANTONAKIS, J. **The nature of leadership**. Sage, 2011. ISBN 1412980208.

DAY, D.V.; ANTONAKIS, J. Leadership: Past, present, and future. **The nature of leadership**, p. 3-25, 2012.

\_\_\_\_\_. The Future of Leadership. In: LEONARD, H. S.; LEWIS, R., *et al* (Ed.). **The Wiley-Blackwell Handbook of the Psychology of Leadership, Change, and Organizational Development**: Wiley-Blackwell, 2013. p.221-236. ISBN 111997657X; 9781119976578.

DEN HARTOG, D. N.; DICKSON, M. W. Leadership and culture. In: ANTONAKIS, J.; CIANCIOLO, A. T., *et al* (Ed.). **The nature of leadership**. Thousand Oaks, CA, US: Sage Publications, Inc, 2004. p.249-278. ISBN 0-7619-2714-X (Hardcover); 0-7619-2715-8 (Paperback).

DESANCTIS, G.; POOLE, M. S. Capturing the complexity in advanced technology use: Adaptive structuration theory. **Organization science**, v. 5, n. 2, p. 121-147, 1994. ISSN 1047-7039.

DESANCTIS, G.; POOLE, M. S. Transitions in teamwork in new organizational forms. **Advances in group processes**, v. 14, n. 1, p. 57-176, 1997.

DEVINE, D. J. *et al*. Teams in organizations prevalence, characteristics, and effectiveness. **Small Group Research**, v. 30, n. 6, p. 678-711, 1999. ISSN 1046-4964.

DOMJAN, M. **The Principles of Learning and Behavior**. Cengage Learning, 2014. ISBN 9781305142671.

DOUKAS, G. **PIERRE BOAISTUAU (c. 1517-1566) AND THE EMPLOYMENT OF HUMANISM IN MID SIXTEENTH-CENTURY FRANCE**. 2011. (Doctor). University of Birmingham Research Archive

DRUCKER, P. F.; DRUCKER, P. F. **Post-capitalist society**. Routledge, 1993. ISBN 0750620250.

DRUSKAT, V. U.; WOLFF, S. B. Building the Emotional Intelligence of Groups. **Harvard Business Review**, v. 79, n. 3, p. 80-90, 2001. ISSN

00178012. Retrieved from: <  
<http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=4147417&lang=pt-br&site=ehost-live> >. Accessed: 2015-01-10.

DUCKWORTH, A. L. et al. Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, US, v. 92, n. 6, p. 1087-1101, 2007. ISSN 1939-1315(Electronic);0022-3514(Print).

DUNCAN, R. B. The ambidextrous organization: Designing dual structures for innovation. *The management of organization*, v. 1, p. 167-188, 1976.

DWECK, C. S. **Self-theories: Their Role in Motivation, Personality, and Development**. Psychology Press, 2000. ISBN 9781841690247.

EISENSTEIN, E. L. **The printing revolution in early modern Europe**. Cambridge University Press, 2005. ISBN 0521845432.

ENGLER, B. **Personality Theories**. Cengage Learning, 2013. ISBN 9781285088808.

FADEL, C.; BOSCH, C. **Polymathy, Interdisciplinarity, and "The World in Ten Curves"**. 2014-03-17 2013. Retrieved from: <  
<https://prezi.com/loa3314gtzj7/polymathy-interdisciplinarity-and-the-world-in-ten-curves/> >. Accessed: 2015-02-15.

FAIRFIELD, P. et al. **John Dewey and Continental Philosophy**. Southern Illinois University Press, 2010. ISBN 9780809385850.

FAUCONNIER, G.; TURNER, M. **The way we think: Conceptual blending and the mind's hidden complexities**. Basic Books, 2008. ISBN 0786725575.

FELLENZ, M. R. Forming the Professional Self: Bildung and the ontological perspective on professional education and development. **Educational**



**Philosophy and Theory**, p. 1-17, 2015. ISSN 0013-1857. Retrieved from: < <http://dx.doi.org/10.1080/00131857.2015.1006161> >. Accessed: 2015-03-15.

GARDNER, H. **Frames of mind: The theory of multiple intelligences**. Basic books, 1985. ISBN 0465025099.

GARDNER, W. L. et al. "Can you see the real me?" A self-based model of authentic leader and follower development. **The Leadership Quarterly**, v. 16, n. 3, p. 343-372, 6// 2005. ISSN 1048-9843. Retrieved from: < <http://www.sciencedirect.com/science/article/pii/S1048984305000275> >. Accessed: 2015-02-08.

GARDNER, W. L. et al. Authentic leadership: A review of the literature and research agenda. **The Leadership Quarterly**, v. 22, n. 6, p. 1120-1145, 2011. ISSN 10489843.

GENOVESE, M. A. **Building Tomorrow's Leaders Today: On Becoming a Polymath Leader**. Taylor & Francis, 2013. ISBN 9781317930921.

GIBBS, B. Autonomy and authority in education. **Journal of Philosophy of Education**, v. 13, n. 1, p. 119-132, 1979. ISSN 1467-9752.

GIDDENS, A. **The constitution of society: Outline of the theory of structuration**. Univ of California Press, 1984. ISBN 0520052927.

GIDDENS, A. **New Rules of Sociological Method: A Positive Critique of Interpretative Sociologies**. Wiley, 2013. ISBN 9780745677156.

GIDDENS, A.; TURNER, J. H. **Social Theory Today**. Stanford University Press, 1988. ISBN 9780804715140.

GILLESPIE, N. A. et al. The genetic and environmental relationship between Cloninger's dimensions of temperament and character.

**Personality and Individual Differences**, v. 35, n. 8, p. 1931-1946, 2003. ISSN 0191-8869.

GIST, M. E.; LOCKE, E. A.; TAYLOR, M. S. Organizational behavior: Group structure, process, and effectiveness. **Journal of Management**, v. 13, n. 2, p. 237-257, 1987. ISSN 0149-2063.

GOLDBERG, L. R. An alternative" description of personality": the big-five factor structure. **Journal of personality and social psychology**, v. 59, n. 6, p. 1216, 1990. ISSN 1939-1315.

\_\_\_\_\_. The structure of phenotypic personality traits. **American psychologist**, v. 48, n. 1, p. 26, 1993. ISSN 1935-990X.

GOLDHABER, D. **The Nature-Nurture Debates: Bridging the Gap**. Cambridge University Press, 2012. ISBN 9780521148795.

GOLEMAN, D. **Emotional intelligence**. Random House LLC, 2006. ISBN 055380491X.

GOLEMAN, D.; BOYATZIS, R.; MCKEE, A. **Primal Leadership: Unleashing the Power of Emotional Intelligence**. Harvard Business Press, 2013. ISBN 1422168034.

GOODMAN, H. L. Chinese Polymaths, 100—300 AD: The Tung-kuan, Taoist Dissent, and Technical Skills. **Asia Major**, p. 101-174, 2005. ISSN 0004-4482.

GOTTFREDSON, L. S. Mainstream science on intelligence: An editorial with 52 signatories, history, and bibliography. **Intelligence**, v. 24, n. 1, p. 13-23, 1997. ISSN 0160-2896.

GRAY, J. R.; BRAVER, T. S.; RAICHLE, M. E. Integration of emotion and cognition in the lateral prefrontal cortex. **Proceedings of the National Academy of Sciences**, v. 99, n. 6, p. 4115-4120, 2002. ISSN 0027-8424.

GOULD, S. J. **I Have Landed: Splashes and Reflections in Natural History**. Random House, 2003.

GUILFORD, J. P. Creative abilities in the arts. **Psychological Review**, US, v. 64, n. 2, p. 110-118, 1957. ISSN 1939-1471(Electronic);0033-295X(Print).

HARDCASTLE, A. **How To Be A Renaissance Man**. Amazon Kindle, 2014.

HARPER, D. The Online Etymology Dictionary. December 1st, 2014 2014. Retrieved from: [http://www.etymonline.com/index.php?term=polymath&allowed\\_in\\_frame=0](http://www.etymonline.com/index.php?term=polymath&allowed_in_frame=0) >. Accessed: December 1st, 2014.

HARPER, E. George Gamow: Scientific amateur and polymath. **Physics in Perspective**, v. 3, n. 3, p. 335-372, 2001. ISSN 1422-6944.

HAYES, N. **Foundations of Psychology**. Thomson Learning, 2000. ISBN 9781861525895.

HAWKINS, J.; BLAKESLEE, S. **On intelligence**. Macmillan, 2007. ISBN 1429900458.

HEATH, A. C.; CLONINGER, C. R.; MARTIN, N. Testing a model for the genetic structure of personality: a comparison of the personality systems of Cloninger and Eysenck. **Journal of personality and social psychology**, v. 66, n. 4, p. 762, 1994. ISSN 1939-1315.

HENDERSON, J. E.; HOY, W. K. Leader authenticity: The development and test of an operational measure. **Educational & Psychological Research**, 1983. ISSN 0279-0688.

HOCKEY, T. et al. **Biographical Encyclopedia of Astronomers**. Springer, 2007. ISBN 9780387304007.

HOFSTEDE, G.; HOFSTEDE, G. J.; MINKOV, M. **Cultures and Organizations: Software of the Mind, Third Edition**. McGraw-Hill Education, 2010. ISBN 9780071770156.

HOLLOWAY, Z. R. **Are you a Polymath?** CuriousHumans, 2014. Retrieved from: < <http://www.curioushumans.net/are-you-a-polymath/> >. Accessed: 2015-03-11.

HOUSE, R. J. **A 1976 theory of charismatic leadership**. Faculty of Management Studies, University of Toronto, 1977.

HUITT, W.; CAIN, S. An overview of the conative domain. **Educational Psychology Interactive**, p. 1-20, 2005.

HUNT, E. **Human Intelligence**. Cambridge University Press, 2010. ISBN 9781139495110.

HUNT, T. **1st IRB Barcelona POSTDOC DAY**. Barcelona, Spain 2014.

IBARRA, H. **Act Like a Leader, Think Like a Leader**. Perseus Distribution Services, 2015. ISBN 9781422184127.

INSTANT-SERIES, T. **Jack of All Trades: How to Master All Sorts of Skills in Short Amount of Time and Be a Modern Renaissance Person**. Instant-Series, 2015.

JARVIS, P. **Towards a Comprehensive Theory of Human Learning.** Taylor & Francis, 2012. ISBN 9781134254842.

JOBS, S. **Speech to the Academy of Achievement:** Academy of Achievement 1982.

\_\_\_\_\_. **Stanford Commencement Speech:** Stanford 2005.

JOHANSEN, B.; JOHANSEN, R. **Get There Early: Sensing the Future to Compete in the Present.** Berrett-Koehler Publishers, 2007. ISBN 9781576755310.

JOSEPH, M.; MCGLINN, M. **The Trivium: The Liberal Arts of Logic, Grammar, and Rhetoric.** Paul Dry Books, 2002. ISBN 9781589882737.

KARAHANNA, E.; KARAHANNA, E.; PRESTON, D. S. The Effect of Social Capital of the Relationship Between the CIO and Top Management Team on Firm Performance. **Journal of management information systems**, v. 30, n. 1, p. 15-55, 2013. ISSN 0742-1222.

KATZ, R. L. **Skills of an effective administrator.** Harvard Business Press, 1974. ISBN 1422147894.

KAUFMAN, J. C.; BEGHETTO, R. A. Beyond big and little: The four c model of creativity. **Review of General Psychology**, US, v. 13, n. 1, p. 1-12, 2009. ISSN 1939-1552(Electronic);1089-2680(Print).

KAUFMAN, J. C. et al. Creativity polymathy: What Benjamin Franklin can teach your kindergartener. **Learning and Individual Differences**, v. 20, n. 4, p. 380-387, 2010. ISSN 1041-6080.

KAUFMANN, A.; TÖDTLING, F. Science–industry interaction in the process of innovation: the importance of boundary-crossing between systems. **Research policy**, v. 30, n. 5, p. 791-804, 2001. ISSN 0048-7333.

KERNIS, M. H. Toward a conceptualization of optimal self-esteem. **Psychological inquiry**, v. 14, n. 1, p. 1-26, 2003. ISSN 1047-840X.

KILMISTER, C. W. **Schrödinger, centenary celebration of a polymath**. CUP Archive, 1987. ISBN 0521340179.

KIRKPATRICK, S. A.; LOCKE, E. A. Leadership\_Do Traits Matter. **Academy of Management Executive**, v. 5, n. 2, 1991.

KIRTON, J. **Adaption-Innovation: In the Context of Diversity and Change**. Taylor & Francis, 2004. ISBN 9781134427031.

KOESTLER, A. **The act of creation: A study of the conscious and unconscious in science and art**. Dell Publishing Company, 1967.

KOLBE, K. **The conative connection: Uncovering the link between who you are and how you perform**. Addison-Wesley Longman, 1990. ISBN 0201517957.

KOLTKO-RIVERA, M. E. The Psychology of Worldviews. **Review of General Psychology**, v. 8, n. 1, p. 3-58, 2004. ISSN 1089-2680.

KOTTER, J. P. What Leaders really do. **Harvard Business Review**, 1990.

KOTTER, J. P. **Force For Change: How Leadership Differs from Management**. Free Press, 2008. ISBN 9781439135990.

KOZLOWSKI, S. W.; BELL, B. S. Work groups and teams in organizations: Review Update. In: SCHMITT, N. e HIGHHOUSE, S. (Ed.). **Handbook of psychology: Vol. 12**. Industrial and organizational psychology. 2nd. Hoboken, NJ: Wiley, v.Vol. 12, 2013. p.412-469. ISBN 0471264385.

KOZLOWSKI, S. W.; ILGEN, D. R. Enhancing the effectiveness of work groups and teams. **Psychological science in the public interest**, v. 7, n. 3, p. 77-124, 2006. ISSN 1529-1006.

KUHN, T. S. **The Copernican Revolution: Planetary Astronomy in the Development of Western Thought**. Harvard University Press, 1957. ISBN 9780674171039.

LACEY, T. **What is a polymath?** , 1999. Retrieved from: < <http://www.angelfire.com/fl/polymathsociety/whatis.html> >. Accessed: 2015-03-11.

LAW, K. S.; WONG, C.-S.; MOBLEY, W. M. Toward a taxonomy of multidimensional constructs. **Academy of management review**, v. 23, n. 4, p. 741-755, 1998. ISSN 0363-7425.

LEPINE, J. A. et al. A meta-analysis of teamwork processes: Tests of a multidimensional model and relationships with team effectiveness criteria. **Personnel psychology**, v. 61, n. 2, p. 273-307, 2008. ISSN 0031-5826.

LEVINE, J. M.; THOMPSON, L. L.; MESSICK, D. M. **Shared Cognition in Organizations: The Management of Knowledge**. Taylor & Francis, 2013. ISBN 9781134997367.

LEWIN, K. The research center for group dynamics at Massachusetts Institute of Technology. **Sociometry**, p. 126-136, 1945. ISSN 0038-0431.

LIEBERMAN, D. A. **Human Learning and Memory**. Cambridge University Press, 2011. ISBN 9781139502535.

LITMAN, J. Curiosity and the pleasures of learning: Wanting and liking new information. **Cognition & emotion**, v. 19, n. 6, p. 793-814, 2005. ISSN 0269-9931.

LOBENSTINE, M. **The Renaissance Soul: How to Make Your Passions Your Life--a Creative and Practical Guide.** Experiment, 2013. ISBN 9781615190928.

LONGMAN. **Polymath.** Longman. 2015

LUK, C. L.; BOND, M. H. Personality variation and values endorsement in Chinese university students. **Personality and Individual Differences**, v. 14, n. 3, p. 429-437, 1993. ISSN 0191-8869.

LUTHANS, F. The need for and meaning of positive organizational behavior. **Journal of organizational behavior**, v. 23, n. 6, p. 695-706, 2002. ISSN 1099-1379.

LUTHANS, F. et al. Psychological capital development: toward a micro-intervention. **Journal of Organizational Behavior**, v. 27, n. 3, p. 387-393, 2006. ISSN 0894-3796

LUTHANS, F.; LUTHANS, K. W.; LUTHANS, B. C. Positive psychological capital: beyond human and social capital. **Business Horizons**, v. 47, n. 1, p. 45-50, 2004. ISSN 00076813.

MACKAY, C. The tulipomania. In: (Ed.). **Extraordinary popular delusions and the madness of crowds.** Noonday Press: Noonday Press, 1932. p.89-97.

MAGAN, R. **A New War Begins.** The Men Who Built America 2012.

MARINO, A. **The Biography of "the Idea of Literature": From Antiquity to the Baroque.** State University of New York Press, 1996. ISBN 9780791428948.

MARROU, H. I. **A History of Education in Antiquity.** University of Wisconsin Press, 1956. ISBN 9780299088149.



MARX, K.; ENGELS, F.; ARTHUR, C. J. **The German Ideology**. International Publishers, 1972. ISBN 9780717803026.

MATTHEWS, G.; DEARY, I. J.; WHITEMAN, M. C. **Personality Traits**. Cambridge University Press, 2009. ISBN 9780521887786.

MATTHEWS, R. A. **Fordism, Flexibility, and Regional Productivity Growth**. Garland Pub., 1996. ISBN 9780815327363.

MCCRAE, R. R. Creativity, divergent thinking, and openness to experience. **Journal of Personality and Social Psychology**, US, v. 52, n. 6, p. 1258-1265, 1987. ISSN 1939-1315(Electronic);0022-3514(Print).

MCGREW, K. S. CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. **Intelligence**, v. 37, n. 1, p. 1-10, 2009. ISSN 0160-2896. Retrieved from: <http://www.sciencedirect.com/science/article/pii/S0160289608000986> Accessed: 2015-03-23.

MERRIAM-WEBSTER. **Ambidextrous**. Encyclopaedia Britannica. 2015a

\_\_\_\_\_. **Connect**. Encyclopaedia Britannica. 2015b

\_\_\_\_\_. **Courage**. Encyclopaedia Britannica. 2015b

\_\_\_\_\_. **Dilettante**. Encyclopaedia Britannica. 2015c

\_\_\_\_\_. **Perseverance**. Encyclopaedia Britannica. 2015d

\_\_\_\_\_. **Polymath**. Encyclopaedia Britannica. 2015e

\_\_\_\_\_. **Problem**. Encyclopaedia Britannica. 2015f

MERTON, R. K. The self-fulfilling prophecy. **The Antioch Review**, p. 193-210, 1948. ISSN 0003-5769.

MIAN, A.; SUFI, A. **House of Debt: How They (and You) Caused the Great Recession, and How We Can Prevent It from Happening Again**. University of Chicago Press, 2015. ISBN 9780226277509.

MILES, R. E. et al. Organizational Strategy, Structure, and Process. **Academy of Management Review**, v. 3, n. 3, p. 546-562, 1978. ISSN 03637425. Retrieved from: <  
<http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=4305755&lang=pt-br&site=ehost-live> >. Accessed: 2015-01-21.

MIRCHANDANI, V. **The New Polymath: Profiles in Compound-Technology Innovations**. Wiley, 2010. ISBN 9780470768457.

MISCHEL, W.; SHODA, Y.; AYDUK, O. **Introduction to Personality: Toward an Integrative Science of the Person, 8th Edition**. Wiley Global Education, 2007. ISBN 9781118312018.

MOON, H. The Two Faces of Conscientiousness: Duty and Achievement Striving in Escalation of Commitment Dilemmas. **Journal of Applied Psychology**, v. 86, n. 3, p. 533-540, 2001. ISSN 00219010. Retrieved from: <  
<http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=12128456&lang=pt-br&site=ehost-live> >. Accessed: 2015-03-07.

MOUNTCASTLE, V. B. The columnar organization of the neocortex. **Brain**, v. 120, n. 4, p. 701-722, 1997. ISSN 0006-8950.

MUELLER, C. M.; DWECK, C. S. Praise for intelligence can undermine children's motivation and performance. **Journal of personality and social psychology**, v. 75, n. 1, p. 33, 1998. ISSN 1939-1315.

NIU, W.; STERNBERG, R. J. The philosophical roots of Western and Eastern conceptions of creativity. **Journal of Theoretical and Philosophical Psychology**, v. 26, n. 1-2, p. 18, 2006. ISSN 2151-3341.

NORTHHOUSE, P. G. **Leadership: Theory and Practice**. Sixth. New York: SAGE Publications, 2013.

NYE, E. R.; GIBSON, M. E. **Ronald Ross: malariologist and polymath: a biography**. Macmillan Press Ltd., 1997. ISBN 033362551X.

OLSON, J. S. **Encyclopedia of the Industrial Revolution in America**. Greenwood Press, 2002. ISBN 9780313308307.

OLVER, J. M.; MOORADIAN, T. A. Personality traits and personal values: a conceptual and empirical integration. **Personality and individual differences**, v. 35, n. 1, p. 109-125, 2003. ISSN 0191-8869.

OSBORN, R. N.; HUNT, J. G.; JAUCH, L. R. Toward a contextual theory of leadership. **The Leadership Quarterly**, v. 13, 2002.

OXFORD. **Polymath**. Oxford University Press. 2015

PARKS-LEDUC, L.; FELDMAN, G.; BARDI, A. Personality Traits and Personal Values A Meta-Analysis. **Personality and Social Psychology Review**, p. 1088868314538548, 2014. ISSN 1088-8683.

PAUL, R. W.; BINKER, A. **Critical thinking: What every person needs to survive in a rapidly changing world**. ERIC, 1990. ISBN 0944583040.

PERRINE, N. E.; BRODERSEN, R. Artistic and scientific creative behavior: Openness and the mediating role of interests. **The Journal of Creative Behavior**, v. 39, n. 4, p. 217-236, 2005. ISSN 2162-6057.

PETERSON, C.; SELIGMAN, M. E. **Character strengths and virtues: A handbook and classification**. Oxford University Press, 2004. ISBN 0199883246.

PEUKERT, H. Beyond the Present State of Affairs: Bildung and the Search for Orientation in Rapidly Transforming Societies. **Journal of Philosophy of Education**, v. 36, n. 3, p. 421-435, 2002. ISSN 1467-9752. Retrieved from: < <http://dx.doi.org/10.1111/1467-9752.00285> >. Accessed: 2015-01-09.

PIKETTY, T.; GOLDHAMMER, A. **Capital in the Twenty First Century**. Harvard University Press, 2014. ISBN 9780674430006.

PILIAVIN, J. **Theory in Social Science**. 2005. Retrieved from: < <http://www.ssc.wisc.edu/~jpiliavi/357/theory.white.pdf> >. Accessed: 2015-08-01.

PIORE, M. J.; SABEL, C. F. **The second industrial divide: possibilities for prosperity**. Basic Books, 1984. ISBN 9780465075638.

PLOMIN, R. **Genetics and experience: The interplay between nature and nurture**. Thousand Oaks, CA, US: Sage Publications, Inc, 1994. xvi, 189 ISBN 0-8039-5420-4 (Hardcover); 0-8039-5421-2 (Paperback).

RAELIN, J. Does Action Learning Promote Collaborative Leadership? **Academy of Management Learning & Education**, v. 5, n. 2, p. 152-168, 2006. ISSN 1537260X. Retrieved from: < <http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=21253780&lang=pt-br&site=ehost-live> >. Accessed: 2015-03-03.

REICH, R. B. **Supercapitalism**. Knopf Doubleday Publishing Group, 2007. ISBN 9780307267856.

REITAN, R. M.; WOLFSON, D. Conation: A Neglected Aspect of Neuropsychological Functioning. **Archives of Clinical Neuropsychology**, v. 15, n. 5, p. 443-453, 7// 2000. ISSN 0887-6177. Retrieved from: < <http://www.sciencedirect.com/science/article/pii/S0887617799000438> >. Accessed: 2015-03-03.

RIDLEY, M. **Nature Via Nurture: Genes, Experience, and What Makes Us Human**. Fourth Estate, 2006. ISBN 9780007240821. Retrieved from: < <https://books.google.com.br/books?id=-vS4fy9mZe4C> >. Accessed: 2015-03-03.

RIGGS, E. G. Conation: cultivating the will to succeed among middle and high school students. **Forum on Public Policy: A Journal of the Oxford Round Table**, 2007. ISSN 1556763X.

RIGGS, W. Open-Mindedness. **Metaphilosophy**, v. 41, n. 1-2, p. 172-188, 2010. ISSN 1467-9973.

ROBIN, L. **Greek Thought and the Origins of the Scientific Spirit**. Taylor & Francis, 2013. ISBN 9781136196713.

ROBINSON, A. **The last man who knew everything: Thomas Young, the anonymous polymath who proved Newton wrong, explained how we see, cured the sick, and deciphered the Rosetta stone, among other feats of genius**. Oneworld, 2006. ISBN 1851684948.

ROBINSON, A. **The rise of the cultural polymath**. 2010

ROCCAS, S. et al. The big five personality factors and personal values. **Personality and social psychology bulletin**, v. 28, n. 6, p. 789-801, 2002. ISSN 0146-1672.

ROOT-BERNSTEIN, R. Multiple Giftedness in Adults: The Case of Polymaths. In: (Ed.). **International Handbook on Giftedness**: Springer, 2009. p.853-870. ISBN 1402061617.

ROOT-BERNSTEIN, R. et al. Arts foster scientific success: Avocations of Nobel, National Academy, Royal Society, and Sigma Xi members. **Journal of Psychology of Science and Technology**, n. 1, p. 51-63, 2008. ISSN 1939-7054.

ROOT-BERNSTEIN, R.; ROOT-BERNSTEIN, M. Intuitive tools for innovative thinking. **The international handbook on innovation**, p. 377-387, 2003.

\_\_\_\_\_. Artistic Scientists and Scientific Artists: The Link Between Polymathy and Creativity. In: STERNBERG, R. J.; GRIGORENKO, E. L., *et al* (Ed.). **Creativity: From potential to realization**. Washington, DC, US: American Psychological Association, 2004. p.127-151. ISBN 1-59147-120-6 (Hardcover).

ROOT-BERNSTEIN, R.; SHAVININA, L. The art of innovation: Polymaths and the universality of the creative process. **International handbook of innovation**, p. 267-278, 2003.

ROOT-BERNSTEIN, R. S. **The sciences and arts share a common creative aesthetic**. Springer, 1997. ISBN 0792347633.

ROOT-BERNSTEIN, R. S.; BERNSTEIN, M.; GARNIER, H. Correlations between avocations, scientific style, work habits, and professional impact of scientists. **Creativity Research Journal**, v. 8, n. 2, p. 115-137, 1995. ISSN 1040-0419.

ROOT-BERNSTEIN, R. S.; ROOT-BERNSTEIN, M. M. **Sparks of genius: The thirteen thinking tools of the world's most creative people**. Houghton Mifflin Harcourt, 2013. ISBN 0547525893.

ROSENER, J. B. Ways Women Lead. **Harvard Business Review**, 1990.

ROSS, C. E. "Trying all things": romantic polymaths, social factors, and the legacies of a rhetorical education. **Texas Studies in Literature and Language**, v. 53, p. 401+, 2011 Winter // 2011. ISSN 00404691. Retrieved from: <

<http://go.galegroup.com/ps/i.do?id=GALE%7CA274116264&v=2.1&u=cap&it=r&p=AONE&sw=w&asid=b853a73548f8828d436b753b30eccfb9> >.

Accessed: 2015-03-07.

RUNCO, M. A. Creativity. **Annual Review of Psychology**, v. 55, n. 1, p. 657-687, 2004. ISSN 00664308. Retrieved from: <  
<http://search.ebscohost.com/login.aspx?direct=true&db=afh&AN=12005206&lang=pt-br&site=ehost-live> >. Accessed: 2015-06-03.

RUNCO, E.-I.-C. M. A.; STEVEN, R. P. **Divergent Thinking**: 400-403 p. 2011.

RYAN, R. M.; DECI, E. L. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. **American psychologist**, v. 55, n. 1, p. 68, 2000. ISSN 1557987041.

SAGAN, C. **Dragons of Eden: Speculations on the evolution of human intelligence**. Random House LLC, 2012. ISBN 0307801004.

SALOVEY, P.; MAYER, J. D. Emotional intelligence. **Imagination, cognition and personality**, v. 9, n. 3, p. 185-211, 1990. ISSN 0276-2366.

SAMOVAR, L. et al. **Intercultural communication: A reader**. Cengage Learning, 2014. ISBN 1285965981.

SANDRINE. **Are You a Polymath? 10 Ideas for Multi-Interest People**. 2014

SCHEIN, E. H. Defining Organizational Culture. In: SCHEIN, E. H. (Ed.). **Organizational Culture and Leadership**. 2nd. San Francisco: Jossey-Bass, 1992.

SCHNEIDER, M.; SOMERS, M. Organizations as complex adaptive systems: Implications of Complexity Theory for leadership research. **The Leadership Quarterly**, v. 17, n. 4, p. 351-365, 2006. ISSN 10489843.

SCHWARTZ, S. H. Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. **Advances in experimental social psychology**, v. 25, n. 1, p. 1-65, 1992.

SCRIVEN, M.; PAUL, R. **Defining Critical Thinking**. 1987. Retrieved from: < <http://www.criticalthinking.org/pages/defining-critical-thinking/766> >. Accessed: 2015-09-01.

SENNETT, R. **The Culture of the New Capitalism**. Yale University Press, 2007. ISBN 9780300119923.

SHAMIR, B.; EILAM, G. "What's your story?" A life-stories approach to authentic leadership development. **The Leadership Quarterly**, v. 16, n. 3, p. 395-417, 2005. ISSN 1048-9843.

SHAW, M. E.; ROBBIN, R.; BELSER, J. R. **Group dynamics: the psychology of small group behavior**. McGraw-Hill, 1981. ISBN 9780070565043.

SOLDZ, S.; VAILLANT, G. E. The Big Five personality traits and the life course: A 45-year longitudinal study. **Journal of Research in Personality**, v. 33, n. 2, p. 208-232, 1999. ISSN 0092-6566.

SPALDING, S.; GIBSON, J. **Rebuilding the Polymath**. lulu.com, 2013. ISBN 1300737832.



SPEARMAN, C. " General Intelligence," Objectively Determined and Measured. **The American Journal of Psychology**, v. 15, n. 2, p. 201-292, 1904. ISSN 0002-9556.

SPIEGEL, J. S. Open-mindedness and intellectual humility. **Theory and Research in Education**, v. 10, n. 1, p. 27-38, 2012. ISSN 1477-8785.

SRIRAMAN, B.; FREIMAN, V.; LIRETTE-PITRE, N. **Interdisciplinarity, Creativity, and Learning: Mathematics with Literature, Paradoxes, History, Technology, and Modeling**. IAP, Information Age Pub., 2009. ISBN 9781607521020.

STAJKOVIC, A. D.; LUTHANS, F. Social cognitive theory and self-efficacy: Goin beyond traditional motivational and behavioral approaches. **Organizational dynamics**, v. 26, n. 4, p. 62-74, 1998. ISSN 0090-2616.

STERNBERG, R. J. **Thinking Styles**. Cambridge University Press, 1999. ISBN 9780521657136.

STERNBERG, R. J.; LUBART, T. I. The concept of creativity: Prospects and paradigms. **Handbook of creativity**, v. 1, p. 3-15, 1999.

STOGDILL, R. M. Personal factors associated with leadership: A survey of the literature. **The Journal of psychology**, v. 25, n. 1, p. 35-71, 1948. ISSN 0022-3980.

STOGDILL, R. M. **Individual Behavior and Group Achievement**. 1959. Retrieved from: < <https://books.google.com.br/books?id=u3gED0CJX8cC> >. Accessed: 2015-03-13.

SUIKKANEN, J. Consequentialism, constraints and the good-relative-to: a reply to Mark Schroeder. **Journal of Ethics and Social Philosophy**, 2009.

TALLON, A. **Head and Heart: Affection, Cognition, Volition as Triune Consciousness.** Fordham University Press, 1997. ISBN 9780823217724.

TODD, A. R.; BODENHAUSEN, G. V.; GALINSKY, A. D. Perspective taking combats the denial of intergroup discrimination. **Journal of Experimental Social Psychology**, v. 48, n. 3, p. 738-745, 2012. ISSN 0022-1031.

TODD, A. R. et al. Perspective taking combats automatic expressions of racial bias. **Journal of personality and social psychology**, v. 100, n. 6, p. 1027, 2011. ISSN 1939-1315.

TODD, A. R.; GALINSKY, A. D.; BODENHAUSEN, G. V. Perspective taking undermines stereotype maintenance processes: Evidence from social memory, behavior explanation, and information solicitation. **Social Cognition**, v. 30, n. 1, p. 94-108, 2012. ISSN 0278-016X.

TWIGGER, R. Master of many trades. **Aeon magazine**, 2015. Retrieved from: < <http://aeon.co/magazine/culture/anyone-can-learn-to-be-a-polymath/> >. Accessed: 2015-03-10.

UHL-BIEN, M.; MARION, R.; MCKELVEY, B. Complexity Leadership Theory: Shifting leadership from the industrial age to the knowledge era. **The Leadership Quarterly**, v. 18, n. 4, p. 298-318, 2007. ISSN 10489843.

VAN VUGT, M. Evolutionary origins of leadership and followership. **Personality And Social Psychology Review: An Official Journal Of The Society For Personality And Social Psychology, Inc**, United States, v. 10, n. 4, p. 354-371, 2006. ISSN 1088-8683.

VANDEWALLE, D. Development and validation of a work domain goal orientation instrument. **Educational and Psychological Measurement**, v. 57, n. 6, p. 995-1015, 1997. ISSN 0013-1644.

VARON, E. J. Alfred Binet's concept of intelligence. **Psychological Review**, v. 43, n. 1, p. 32, 1936. ISSN 1939-1471.

VEN, A. H. V. D. Nothing Is Quite so Practical as a Good Theory. **The Academy of Management Review**, v. 14, n. 4, p. 486-489, 1989. ISSN 03637425. Retrieved from: < <http://www.jstor.org/stable/258553> >. Accessed: 2015-01-29.

VOCABULARY.COM. **Polymath**. 2015

WALUMBWA, F. O. et al. Authentic leadership: Development and validation of a theory-based measure†. **Journal of management**, v. 34, n. 1, p. 89-126, 2008. ISSN 0149-2063.

WEINER, I. B.; GREENE, R. L. **Handbook of Personality Assessment**. Wiley, 2011. ISBN 9781118045596.

WIKITIONARY. **Mathematics**. 2015. Retrieved from: < <https://en.wiktionary.org/wiki/mathematics> >. Accessed: 2015-05-06.

WOWER, J. A. **De Polymathia tractatio: integri operis de studiis veterum**. Laurentii Sigismundi Corneri, 1665. Retrieved from: < <https://books.google.com.br/books?id=T3kyrg5SI3oC> >. Accessed: 2014-08-03.

ZAKARIA, F. Why America's obsession with STEM education is dangerous. **The Washington Post**, 2015. Retrieved from: < [https://www.washingtonpost.com/opinions/why-stem-wont-make-us-successful/2015/03/26/5f4604f2-d2a5-11e4-ab77-9646eea6a4c7\\_story.html](https://www.washingtonpost.com/opinions/why-stem-wont-make-us-successful/2015/03/26/5f4604f2-d2a5-11e4-ab77-9646eea6a4c7_story.html) >. Accessed: 2015-03-07.