Austin Journal of Molecular and Cellular Biology

Open Access

Austin Publishing Group

Review Article

Entrepreneurship and its Genetic Basis

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Received: December 07, 2015; **Accepted:** February 07, 2016; **Published:** February 09, 2016

Abstract

Entrepreneurship is generally considered the most important engine of economic growth. A novel and fruitful research area called as genoeconomics, become popular after global perspicacity of milestone projects of genetic science. Many multidisciplinary research groups consisting economists and geneticist tried to find out underlying genetic mechanisms for remarkable economic behaviours including entrepreneurship. This review evaluates (I) the different definitions of the entrepreneurship term, (II) possible genetic mechanism that is associated with entrepreneurship, (III) candidate gene studies and their challenges, and (IV) discusses some promising avenues for future research.

Keywords: Candidate gene; Genetic basis; Genoeconomics; Entrepreneurship

Abbreviations

DNA: Deoxyribonucleic Acid; HAPMAP: Haplotype Map Project; HGP: Human Genome Project; SMEs: Small and Medium Sized Enterprises

Entrepreneurship

It is impossible to consider firms independent of people. Firms are managed by a group of people who try to achieve some results. It is easy to start home-based businesses because they are part time activities. In these kinds of tasks, you can do the task you want to do easily. If the task is more complex and labour-intensive, difficulties emerge. As the operational area if the firm expands, multiple licenses, permits, offers and forms need to be acquired from several governmental agencies. Therefore, an entrepreneur is an important part of the organization [1].

Manufacturers produce by deploying production factors. Production factors are the tools used by the manufacturers to produce goods and services demanded by society. Production factors can be categorized as labour (including entrepreneurship skills), capital and land [2]. The fourth production factor that brings the three factors mentioned together and attempts to produce the goods and services demanded by the consumer by organizing these factors is called the entrepreneur. Entrepreneur is an important and scarce manufacturing factor as he takes on some risks while bringing related production factors together and undertakes some risks when making investment decisions. This entrepreneur is generally accepted as a dynamic manufacturing factor among these production factors and is considered different from labour in terms of administration or production, as it is the driving force of the organization. In order to accomplish the production activity an individual or individuals need to take the responsibilities that may emerge in the future. In this context, an entrepreneur is a strategic manufacturing factor that the economy cannot ignore [3]. Organizations with large production cannot function without entrepreneurship. Clearly, entrepreneurship is a rare human resource when there is a general reluctance to take risks and lack of the skills necessary to coordinate the work [4].

The word entrepreneurship is a French word that means the person who undertakes. More specifically, an entrepreneur is described as the person who organizes production by bringing production factors together, makes commercial decisions in terms of which goods or services are going to be produced, takes the risks that may emerge as a result of commercial decisions and an innovator that promotes new products, new technology and new work forms [5]. The word entrepreneur in modern English has two different meanings in economic literature. Kirzner describes entrepreneurship as a research process consisting of discovering the type of entrepreneurship and profit in a particular market system with insufficient knowledge. In fact, Kirzner's description of entrepreneurship discovery emerges from sellers asking for less money than the actual market prices while asking for more in other places. This person buys for less and asks for a price that he desires and the profit he makes attracts other entrepreneurs. Schumpteron the other hand defined an entrepreneur as an innovationist who leads economic developments and social improvements. Shumpter's entrepreneur creates new markets and new products while Kirzner's entrepreneur finds markets for existing products as well as locating gaps [6].

The entrepreneur is an important factor among production factors. Entrepreneurship implies the skills for seeing opportunities to bridge resources to find a new and efficient way to produce new or specialized goods. The motivating force of an entrepreneur is the belief in the possibility of high profits. The entrepreneur uses both his own resources and attempts to convince others who have large amounts of capital to present new production techniques and new products to seize these profit opportunities, thus sharing the potential profit [7]. Entrepreneurship is also defined as the process to organize, manage and taking the responsibility for the attempt. That's why an entrepreneur is a risk-taker [8]. It is difficult to describe or measure the amount of entrepreneurship. During certain periods, visionary entrepreneurship that drew a lot of attention emerged. Sam Walton, the founder of Wal-Mart, the founder of Microsoft, Bill Gates and the founder of Dell, Michael Dell are some examples of individuals who have extraordinary entrepreneurial skills. However, they are the visible entrepreneurs at the top among millions of others who are in small, medium or large ventures [9].

Visionary, entrepreneurial and risk taking individuals who

Citation: Dastan H, Calmasur G and Turkez H. Entrepreneurship and its Genetic Basis. Austin J Mol & Cell Biol. 2016; 3(1): 1007.

followed efficient ways to acquire, wealth, power and prestige always existed. However, the methods that they used to reach their goals vary in the capitalist system. They are in demand due to their methods of progress: organizing their business ventures like private armies, resembling independent corrupt big businessmen or the military, which supports the rule-making authority. They rent everything but money and compete to achieve the wealth they have. Sometimes entrepreneurs gain economic success through their careers in government bureaucracy. However, these forms of entrepreneurship activities rarely lead to the increase of economic efficiency [10].

Entrepreneurship is a highly complex and disputed concept. From a microeconomics perspective, advocates of Schumpeter suggest that the creative destruction process of an entrepreneur is beyond a single result. Entrepreneurial groups can be seen in a heterogeneous group with passive supporters, highly optimistic and even individuals who avoid unemployment. From the macroeconomics perspective, formation of an innovative new organization can provide permanent economic growth and lead to market irregularity [11].

The Characteristics of an Entrepreneur

An entrepreneur is the most interesting and most difficult to describe among actor that constitute economical analysis issues. For a long time, an entrepreneur was described as the top of the hierarchy that determines the behaviour of a firm. However, an entrepreneur takes extensive responsibilities for the survival of the free enterprise community. An entrepreneur is considered ever-present although it remains as a shadow unit with no defined structure and function in classical economic articles. Only Schumpeter and Knight successfully shed light on entrepreneurship by establishing an appropriate scientific field [12].

The entrepreneur has taken on a broad variety of functional tasks throughout the history of economic thought. An entrepreneur, from Richard Cantillon, who defined the concept before Adam Smith, up to today, is an important actor of production, distribution and expansion theories. An entrepreneur is a coordinator, a mediator, an innovator, and the one who perseveres through uncertainty in terms of determining location, time and problem [13]. When fundamental characteristics of an entrepreneur are listed, an entrepreneur takes risks, makes decisions and runs the organization. He identifies appropriate efforts, products, organization production size, location of production, and organizes production and sales. He supports new inventions, coordinates the processes, arranges raw material and machinery and creates order [14].

The Genetic Bases of Entrepreneurship

A very interesting and novel working area entitled genoeconomics, using Deoxyribonucleic Acid (DNA) or genes for tracing economic behaviours as base, have been introduced in scientific community. Notably, after global perspicacity of milestone projects of genetic science like Human Genome (HGP) and Haplotype Map (HAPMAP), a few multidisciplinary research groups consisting economists and geneticist tried to find out the rational way for testing whether remarkable economic behaviours including becoming an entrepreneur could be influenced by genes [15]. Curiously, some recent reports have dealed with this topic and provided quite convincing evidences for genetic underpinnings of

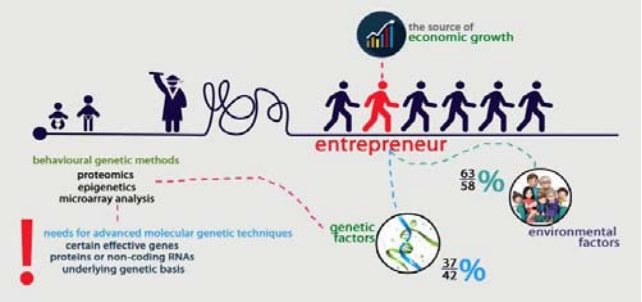

Figure 1: The schematic summary of underlying bases of becoming an entrepreneurship.

entrepreneurship [16,17]. In fact, it was revealed that between 37 and 42 percent of the variance in the tendency of people to engage in entrepreneurship accounted for by genetic factors [18]. This finding could lead us to interpreting that environmental factors were much more effective than genetic ones in becoming entrepreneurial individual. But it should not be forgotten that genetic factors or genes interact with the environment based on the actions of the individual in a dynamic, transformational, synergistic process that continually changes and refines the individual's performance [19]. However, the main question that how our genetics play its role in determining how likely we are to be an entrepreneur is still requires certain and substantial answers (Figure 1).

There are several proposed mechanisms for explaining the roles of genes in regard to genetic foundation of entrepreneurship. The first of these, commits that genes affect chemical mechanisms in brain. Brain chemistry is the whole of different chemical messaging systems including neurotransmitters, neuropeptides and psycho-pharmaceuticals that occur in the brain. These are also called neurochemicals and they play a major role in shaping everyday life via influencing the function of neurons. And it is well known that gene activation and/or inactivation alter behaviour and neurotransmission [20]. A previous investigation results indicated that an inter-individual variability of several neurotransmitter activation seemed to exist which was related to individual differences in behavioural responsiveness to novelty. Furthermore, these differences in neurotransmitter activity might be related to other known differences in both hippocampal structure and function. Thus, neurotransmitter expression patterns were considered responsible for observed inter-individual variability in novelty seeking and sensation seeking [21]. In supporting this phenomenon, twin studies clearly revealed that genes affected the tendency of people to engage in entrepreneurship by affecting the distribution of sensation seeking across people [17,18,22-24]. On the other hand, the evaluations of animal models and human brain imaging works in different organisms exposed to stress indicated altered neurotransmitter activity and suppression of neurogenesis [25]. At this point, entrepreneurships were reported to need a high tolerance for stress to cope with the several conditions such as hard work, important risks, social isolation, pressure and insecurity [26]. In conformity with these data, Dahl et al. [27] assessed the use of psychotropic among entrepreneurs. Interestingly, they noticed that there was a significant relation between entrepreneurship and receiving prescriptions for sedative/hypnotics both among the entrepreneurs themselves and their spouses. Due to this finding, the

investigators suggested that entrepreneurship could be associated with increased stress for both the entrepreneurs and their families.

The second, genes play role in becoming an entrepreneur by influencing individual characteristics particularly extraversion and neuroticism. Neuroticism was suggested to decrease the risk-taking propensity of individuals. In sharp contrast to neuroticism, extraversion shaped adaptations that increased the preferences for entrepreneurial exit [28]. Zhang et al. [29] found that extraversion and neuroticism mediated the genetic influences on women's tendency to become entrepreneurs, whereas extraversion mediated shared-environmental influences on men's tendency to become entrepreneurs. In a comprehensive study, multivariate genetics techniques were applied to a large sample of monozygotic and dizygotic twins from the United Kingdom and United States to examine whether genetic factors account for part of the covariance between the Big Five personality characteristics (openness, conscientiousness, agreeableness, extraversion and neuroticism) and the tendency to be an entrepreneur. The results of this study revealed that genes influenced the phenotypic correlations between only extraversion and openness to experience and the tendency to be an entrepreneur [30].

As a third one, genes were suggested to make some people more sensitive to environmental stimuli for creating entrepreneurship. Extended researches desired to know why certain individuals get disease when exposed to same environmental agents or toxins, but other individuals remain healthy. After developing novel analysis techniques in genetics such as microarray and DNA sequencing, a panoramic sight were built on inter-individual genetically variability. Along the same line, the main source of many behavioural personality differences like being more or less responsive, reactive, flexible, or sensitive to the same environment were thought to be due to inter-individual genetically variability. In this context, behavioural genetic studies produced exciting inputs. For example, neuropeptide S and its receptor NPSR1 were found to be involved in the regulation of arousal, attention and anxiety. Furthermore, the functional polymorphisms of NPSR1 gene were determined to influence personality, impulsivity, and attention-deficit/hyperactivity disorder (ADHD)-related symptoms [31]. In addition, a functional promoter polymorphism of the nitric oxide synthase 1 gene first exon 1f variable number tandem repeat (NOS1 ex1f-VNTR) was shown to related to impulsivity and related psychopathologies and its variants were suggested as associated with different coping strategies [32]. These mentioned traits were considered as crucial for being an entrepreneurial person. As a matter of fact, entrepreneurial person was reported to should have the ability to modulate arousal effectively. Again, an entrepreneur, since constantly subjected to large flows of information and in never-ending need for flexibility and change of strategy, might have more developed attention abilities than non-entrepreneurs. Finally, impulsivity might prove to be a functional advantage for certain individuals that recognize true entrepreneurial opportunities [33,34].

Candidate Gene Studies

Candidate gene studies for explaining human behaviour are becoming so popular in economics and entrepreneurship research. These studies are aim to choose a suitable candidate gene which may play a determinative role in entrepreneurial behaviour. In a recent time, a report was published indicating a significant association between a common genetic variant in the Dopamine Receptor D3 (DRD3) gene and the tendency to be an entrepreneur [35]. On the contrary, Matthijs et al. [15] have found that this previously suggested association had an opposite, insignificant effect using a much larger, independent dataset. However, several other candidate genes were offered including serotonin 2A and 1B transporters (HTR2A and HTR2B), dopamine and serotonin transporters (SLC6A3, SLC6A4), Dopamine Beta-Hydroxylase (DBH), Monoamine Oxidase B (MAOB) and genes associated with testosterone levels [36].

Quaye et al. [37] assessed the relations between genetic polymorphism from four candidate genes associated with dyslexia (ROBO1, KIAA0319, DCDC2, DYX1C1) and education on the tendency to become an entrepreneur. In this mentioned research, not only for genetic but also environmental factors were found to be effective in being an entrepreneurship. Moreover in several comprehensive candidate gene studies in entrepreneurship research proposed many different genes that specifically responsible for being an entrepreneur like adenosine A2a receptor (ADORA2A), alpha-2A adrenergic receptor (ADRA2A), Catechol-O-Methyltransferase (COMT), Dopamine Decarboxylase (DDC), Dopamine Receptor (DRD1, DRD2, DRD4, DRD5) and synaptosomal-associated protein 25 (SNAP25) due to the sexuality [35,38-40].

Conclusion

The roles of small and medium Sized Enterprises (SMEs) in World economy are increasing and coming into prominence as days pass. SMEs become more inalienable with their contributions on creating new employment areas, impacts on maintaining social and economic development and the abilities for adaptation to changing market conditions in economies of developed and emerging countries. And supporting and/or enhancing their entrepreneurship characteristics have important roles in national economies. Various numbers of studies have highlighted the importance of entrepreneurship education in the success of SMEs. At this point, novel findings of genetic area revealed that a significant part (37%-42%) of entrepreneurship ability is affected by genetic parameters via different mechanisms. SMEs must take into consideration of this significant correlation between genetic factors and entrepreneurship, and must organize educational programs for enhancing their entrepreneurial capacity by focusing on detecting and training of genetically suitable persons.

In the review, it is underlined that genes affect entrepreneurship primarily via altering chemical mechanisms in brain, influencing individual characteristics and making people more sensitive to environmental stimuli. This current data was obtained by generally twin studies. To be able to explore new and/or certain genetic mechanisms of entrepreneurship, it seems that it is necessary to apply behavioural genetic methods more extensively into genoeconomics area such as family and adoption studies, proteomics, epigenetic and microarray analysis. Interestingly candidate gene studies remain contradictory. Present conflicting results on suggested candidate genes could be due to selection approach of entrepreneur or non-entrepreneurs. Nominate, the genoeconomist researchers use different approaches for separating entrepreneur and non-entrepreneurs in further genetic comparisons. And a conventional approach for this

aim is urgently needed. Again, up to date, the majority of suggested candidate genes are related to neuronal functions and expression alterations in brain. In this point of view, thousands of new potential candidate loci among large numbers of brain-related genes could be added on present list. This condition exhibits infeasibility of candidate gene determining in complex behaviours like entrepreneurship. However, with the development of more advanced molecular genetic techniques, in future it should be possible to detect certain effective genes, proteins or non-coding RNAs underlying genetic basis of entrepreneurial behaviour.

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