Changing Entrepreneurial Cognitive Processes with Age: A Conceptual Discussion Based on Neuroscience

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How entrepreneurs process information, recognize opportunities, and act on market cues within the environment help us understand entrepreneurial processes. Based on neuroscience research, we discuss the effects of age on the cognitive processes of entrepreneurs. As the median age of the U.S. population continues to rise, understanding these effects will become ever more important to sustaining new venture creation rates, creating jobs, and maintaining the overall economic competitiveness of the nation. Following a review of the entrepreneurial cognitions and relevant neuroscience literature related to age, we develop four formal propositions and discuss implications for practice and future research directions.

INTRODUCTION

As a result of significant medical advances, improved pharmaceuticals, and better education about the benefits of exercise and healthy lifestyles, Americans are living longer. According to the U.S. Administration on Aging (AOA), 12.8% of Americans are now 65 years old or older. A century ago, just 4.1% of Americans were in that group (U.S. AOA, 2009). Based on U.S. AOA figures, over the last decade the number of Americans 65+ years of age increased by 4.5 million or 13.0%, compared to an increase of 12.4% for the under-65 population. Projecting out over the next several decades, the number of Americans older than 64 years will continue to increase at a faster pace than the general population. The reason can be traced to the fact that the number of Americans between the ages of 45 and 64 increased by 31% over the last 10 years. With these changing demographics, it is expected that nearly one in five Americans will be 65 or older by 2030 (U.S. AOA, 2009).

The aging of the American population poses unique social and economic challenges. Increasing the contributions of older Americans to the U.S. economy is critical for the future stability and competitiveness of the nation at a macro level. At the micro level, incentives, benefits, and job requirements may need to be adjusted to attract and retain older workers. However, with Americans living longer, their retirement savings and pension benefits will have to be stretched over a longer period which is likely to increase financial pressures for older individuals. Consider that there is also research that has shown that nearly 70% of Social Security beneficiaries aged 65 and above receive more than half of their income from the Social Security program (Whitman & Purcell 2006). It is unlikely that the U.S. will be able to meet its promised Social Security payment obligations if 20 percent of the population is over 64 years old. The growing concerns about the future long-term solvency of the Social Security program only serves to put

more pressure on policy makers to find ways to increase the participation of older Americans in the U.S. economy.

One way to increase economic participation of mature Americans is through the promotion of new venture creation and entrepreneurship. This is already happening through what Minerd (1999) described as the "Gray Wave" of entrepreneurs who are emerging out of the growing number of retirees from the aging baby boomer generation. However, even as some research on older entrepreneurs exists (e.g., Curran & Blackburn, 2001; Singh & DeNoble, 2003; Singh, 2009), it is very limited (Singh, 2009). Given the discussion above, and the record growth of new entrepreneurial activity among persons over 55 years of age (Rafter, 2010), there is a need to further study the impacts of aging on new venture creation. Are older entrepreneurs different from younger entrepreneurs? If so, how, why and in what ways do they differ? Does the emergence of these older entrepreneurs represent a response to increased financial pressures secondary to the recent economic downturn and its impact on employment opportunities, lost pension and savings, or does it reflect newly realized age-related cognitive and emotional strengths among older persons that are uniquely adaptive to new venture creation? The answers to these fundamental questions can help to address the need for greater economic participation by increasing the entrepreneurship rate of older individuals.

We believe that the issues, challenges, capabilities, and entrepreneurial processes chosen by this segment of the population differ significantly from younger entrepreneurs. Understanding these differences – assuming they do exist – will become increasingly more important as the U.S. population continues to age and the number of older, more mature, entrepreneurs rises. The study of older entrepreneurs can also tell us more about entrepreneurship in general. To the extent that there are differences, these differences may be able to identify profile characteristics that can help entrepreneurs succeed.

In this paper, we draw on the entrepreneurial cognitions literature (e.g., Baron, 1998; Baron & Ward, 2004; Markman & Baron, 2003; Mitchell, *et al*., 2002; 2004) to frame a broader discussion based on the neuroscience literature that shows how brain functions and cognitive processes change with age. Then, based on these two research streams we present four propositions, and discuss the potential impacts on entrepreneurship and new venture creation processes, particularly among older entrepreneurs. This conceptual paper closes with suggestions for both practice and future research.

COGNITIONS, NEUROSCIENCE, AND ECONOMIC BEHAVIOR

Historical and traditional entrepreneurship research focused on individual characteristics such as need for achievement (McClelland, 1961) or risk taking propensity (Brockhaus, 1980). Unfortunately, the study of individual traits/characteristics of entrepreneurs never resulted in a definitive profile of successful entrepreneurs, or even in isolating special characteristics or traits entrepreneurs may have relative to the general population (see Gartner, 1988; Low & MacMillan, 1988; Mitchell, *et al*., 2002).

In an effort to move the field of entrepreneurship forward and shift away from the study of individual traits, over the last two decades research has increasingly focused on social cognitive theories that examine distinctive thinking patterns of entrepreneurs (e.g., Baron, 2004; Baron & Ward, 2004; Markman & Baron, 2003; Mitchell *et al*., 2004), including their alertness to opportunities (Kaish & Gilad, 1991), opportunity recognition processes (Gaglio, 2004;), and decision-making abilities (Baron 1998; Busenitz & Barney, 1997). This is not surprising because to overcome the risks and pursue the rewards of entrepreneurship, individuals need to have a certain mindset (Baron, 1998; Baron & Ward, 2004). In addition, human behavior is driven by socially-constructed realities (Berger & Luckmann, 1966), and as Krueger (2000) points out, the entrepreneurial opportunity recognition process is a product of social construction. Understanding the cognitive process of entrepreneurs and how they interpret social cues, assimilate data, and construct their realities may help to unlock important aspects of successful new venture creation (Baron, 2004; Baron & Ensley, 2006; Berns, 2008).

We believe that drawing from the field of neuroscience can help further our understanding of entrepreneurial cognitions. For those who are not familiar with the term, neuroscience is the branch of the life sciences that deals with the anatomy, physiology, biochemistry or molecular biology of the nerves and nervous tissue and especially in relations to behavior (Merriam-Webster on line). Cognitive neuroscience is

the sub-branch that looks at how organisms know their environments and especially how, as humans, we derive information from the brain's ability to process sensory information and derive meaning from this input that helps us adapt (especially language, thinking and related information processing abilities). In recent years, there have been growing interest and study within the behavioral and cognitive neuroscience field which focuses attention on brain functions which allow sensory processing, pattern recognition, and decision making in various experiments that seek to approximate real life scenarios (for recent summaries of this field, see Ariely, 2008; Gardner, 2008)

We are concerned in this paper only with the macro level of how the brain functions throughout development, and the nature of how behavioral expression reflects the working of the brain's underlying structural and functional systems, i.e. what is happening in the brain when we encounter a given situation and then respond in a particular way. This approach relies especially on neuroimaging to observe how the brain works and neuropsychological testing to measure behavioral outputs that tie to brain activity. In fact, the development of new technologies such as Computerized Axial Tomography (CAT), Positron Emission Topography (PET), Magnetic Resonance Imaging (MRI) and other methods now allow researchers to visualize intact brains as they function. This has allowed modern neuroscience to study brain-behavior relationships that help identify which parts of the brain are working to process various kinds of environmental input in real time.

Within the neuroscience literature, there is a growing body of research that can help social researchers understand economic behavior (Ariely, 2008; Camerer, Lowenstein & Prelec, 2005; Knutson *et. al.*, 2005; Breiter & Rosen, 1999). In a series of remarkable images, Zweig (2007) shows areas of the brain that activate when experiencing emotions central to economic activity. For example, the nucleus accumbens activates with the anticipation of a monetary reward – this brain activity is similar to the reaction the brain has when a jolt of cocaine is about to kick in. Through MRI technology, mild satisfaction can be visually observed within the medial prefrontal cortex, and a belief that one's actions control a particular outcome – even if only an illusion – appears in the caudate nucleus of the brain. Zweig's (2007) images clearly show how differential brain activations occur when the brain evaluates different scenarios (e.g., certain vs. risky) and anticipated rewards. These images demonstrate that when one recognizes that he/she does not know the odds of making money, the amygdala (one of the sites for the brain's expression of fear) becomes very active. Finally, when the brain considers taking a gamble on a slot machine that offers a mix of big gains and losses, one of the brain's centers of pain and disgust – the insula – has been shown to demonstrate very strong firing.

These types of findings and physical observations of brain activity as a result of economic cues can and likely will help researchers better understand entrepreneurial cognitions and new venture creation processes. One area of collaboration between entrepreneurial scholars and neuroscientists – and the focus of this paper – that we believe may be particularly fruitful is the study of cognitive processes of older entrepreneurs in comparison to younger entrepreneurs. Not only can this help us better understand older entrepreneurs, it can inform us of how cognitive processes change over time. We expand on the potential effects of cognitive changes as people age with respect to economic behavior based on the growing body of neuroscience literature in the following section.

CHANGING COGNITIVE PROCESSES AS WE AGE

One cannot separate the entrepreneur from the firm (Lumpkin & Dess, 1996; Shane & Venkataraman, 2000; Singh, 2000; Timmons, 1994), and research has shown that the culture and orientation of a firm is driven by the personality, values, and intentions of the founding entrepreneur (Lumpkin & Dess, 1996). However, we believe there has been an implicit assumption within most entrepreneurship research that these characteristics are fixed qualities that do not change over time. The very nature of traditional traits-based research requires that the researcher accept that the trait in question is an unchanging innate quality of the individual. The reality is that people change with age and life experiences. The reasons for starting a new venture, desired financial goals, risk-reward assessment, and the firm time horizon for a 25-year old entrepreneur are likely to be quite different than those of a 65-year old entrepreneur. If these factors

are not fixed within individuals, then it stands to reason that there is no single profile that fits all entrepreneurs.

There is little doubt that age plays an important part in the cognitive abilities of individuals. And drawing from the neuroscience literature, age seems to bring with it some selected advantages in cognition and emotional control that contradict long-held ageist myths of universal cognitive deterioration and emotional regression in later life (Cohen, 2005; Goldberg, 2005). Cohen (2005) and Goldberg (2005) both suggest that as we age, our thinking patterns and brain activity change in ways that can compensate for losses of information processing speed and raw memory capacity (Goldberg, 2005). While a thorough review of this field is beyond the scope of this paper, we can say that there is evidence that suggests that the brain's ability to change in order to meet life's demands does not end with the onset of adulthood (see Doige, 2007).

Major theories of development of the last century – with few exceptions – held that all significant cognitive and emotional development were complete at the age of adulthood, or about 21. Studying mental phenomena in older persons was typically oriented to describing the nature and extent of the declining mental abilities that were presumed to be normal with age. This view persisted and maintained a nihilistic view of aging as there was an absence of any developmental theories that described continued development or maturation beyond adulthood's onset, and by the seeming ubiquity of senility (dementias) that we now know to be the results of diseases that afflict large numbers of older persons, and to a lesser extent the young as well, and not simply of longevity. These accepted nihilistic beliefs about aging and mental functioning, aided by self-fulfilling prophecies in clinical diagnostic situations called confirmation bias (Groopman, 2007), i.e. all memory loss in older persons is age produced "senility" and therefore untreatable, created a paucity of research about the true nature of mental functioning in the aging. But it was not until the 1960s, when clinical research on aging populations (Blessed, Tomlinson, & Roth, 1968) demonstrated that memory impairment in older persons was due to disease processes and not found in all older adults, that models to explain and elucidate normal cognition in aging were imaginable. This tradition was aided by new methods of cognitive assessment and research-based theories of cognitive development in aging (Moody, 2003) and further fueled by the development of CAT, PET, MRI, and other methods that have allowed the study of the healthy aging brain doing normal cognitive operations.

Though the research literature is now rather extensive, four important, replicated findings ultimately emerged that bear on our discussion (see Cohen, 2005; Goldberg, 2005; Jeste, 2010). These are:

1) The aging brain continues to develop new neural structures (nerve cells and branches on dendrites to allow new connections between cells to be made) that promote new learning.
2) The aging brain reorganizes how it works so it can take advantage of its strengths to allow new, more efficient approaches to problem solving that compensates for loss of working memory.
3) There is increased communication between the left hemisphere (where sequential, literal, functional, textual and analytic thinking reside) and the right hemisphere (where metaphorical, aesthetic, contextual, synthetic and simultaneous thinking take place).
4) There is better regulation of emotional states such that thinking is less impulsive and driven by emotion.

The result of these four neuroscience research findings is that contrary to the notion that "you cannot teach an old dog new tricks," just the opposite may be true for humans. As we age, the brain changes in ways that allows it to function better. These four factors can have significant benefits to would be entrepreneurs as they pursue the new ventures. We note that these findings are consistent and highly relevant to Drucker's (1998) observations that innovation of the kind that is required of entrepreneurs when they analyze sources of opportunity is both conceptual (left brain) and perceptual (right brain) in nature, and that the "glass is half full" mood needed by entrepreneurs to see opportunities is possible to the extent that fear of failure (Berns, 2008) is regulated so as not to lose focus.

There is some research which suggests that older individuals are better suited for successful entrepreneurship. Singh (2009) showed that for those individuals who are working full- or part-time, the rate of self-employment is nearly twice as high for those individuals who are 55 years and older in the U.S. (21.3% to 11.7%). It may be that older workers face discriminatory hiring practices which give them no alternative, but Singh (2009) also found that older workers (both self-employed and employed by others) were significantly more satisfied than younger workers. This would seem to suggest that older entrepreneurs are not necessarily forced to choose self-employment as a result of labor market inefficiencies or discrimination. Singh & DeNoble (2003) discussed the increased financial resources that some early retirees have and the heightened sense of confidence they have as a result of years of work experience. Retirees are less likely to have children to support or large mortgages to pay off. This may increase their available capital for a new venture and their work experience may indeed give them access to valuable social network contacts (e.g., customers, suppliers, investors) that may help them found their firms.

But, we believe that the differences between the brain functions of older and younger entrepreneurs should not be overlooked. In fact, we believe these differences may be more important to understanding entrepreneurship than available financial resources. The tendency for autobiographical story telling in the second half of life, and possibly one of the neural bases of taking stock and identifying new life directions – including, perhaps, entrepreneurial activity (Drucker, 1998) – appears to be an example of how older brains benefit from using both sides of the hippocampus, an area crucial to memory formation, while younger adults use primarily the left side (Maguire & Frith, 2003; Ryan, *et al.*, 2001). This is believed to contribute to a richer, more vivid experience during autobiographical recall because the brain is bringing intuitive, holistic and nonverbal skills that reside in the right hemisphere (Cohen, 2005) to the linear, sequential skills of the left hemisphere that memory of life events requires. In other words, older entrepreneurs may be better able to process information and benefit from the strengths of both the left and right sides of the brain.

Based on what we have presented throughout this paper above, we offer four formal propositions with respect to age and cognitive processes of entrepreneurs. These are further discussed in the following section.

Proposition 1: The cognitive processes and brain functions of entrepreneurs change over time, which is a major factor for why traditional research has not been able to identify a single unique profile for successful entrepreneurs.

Proposition 2a: The cognitive processes and brain functions of younger entrepreneurs are significantly different than those of older entrepreneurs.

Proposition 2b: The cognitive processes and brain functions of older entrepreneurs are more balanced in terms of right and left brain functions.

Proposition 3: Older entrepreneurs are more likely than younger entrepreneurs to achieve success with their new ventures as a result of the benefits they enjoy from their different cognitive processes and brain functions.

DISCUSSION

Given their growing numbers and the changing socio-demographics of the nation as a result of the aging baby boomers, there is certainly a need to understand the capabilities and motivations, as well as the issues and challenges that older entrepreneurs face. Empirical study of the four propositions using neuroscience technologies can address this need, as well as push our understanding of successful entrepreneurship to new levels.

As we stated earlier, new and powerful medical imaging technologies such as CAT and PET scans and MRI are giving neuroscientists new tools for understanding how the brain operates. As the field of neuroscience advances and efforts are made to incorporate brain imaging technologies to entrepreneurship research, scholars will have even more data and new types of information to assess and understand the cognitive abilities of entrepreneurs and how they may or may not be unique within the population. This

has been the goal and focus of much of the research that has examined entrepreneurs over the last 50 years. But if the changes in brain activity that occur in human beings over time significantly change the way information is processed and behavior itself, then it is not surprising that research has not zeroed in on a unique profile for successful entrepreneurs (Proposition 1). There can be no single profile if people are changing because there is no fixed, innate trait to find. However, now it may be possible to find the elusive traits and characteristics of successful entrepreneurs, based not on individuals or fixed innate qualities they may have, but on brain activity. At different stages of life and ages different brain activations may occur based on environmental stimuli. There may be an optimal activation for entrepreneurs that can predict success.

To study the changes and differences in brain functions and cognitive processes of human beings, longitudinal studies of individual entrepreneurs would be ideal, but they are challenging to conduct, expensive and time consuming. As an effective alternative, comparisons between older and younger entrepreneurs should be made. There is no question based on neuroscience that brain process changes occur as human beings age. It is likely that there will be some positive and some negative impacts of the aging brain on entrepreneurial activity (Proposition 2a). Memory recall issues may hamper efforts to successfully found firms, but it may be that brain functioning of older entrepreneurs reduce issues related to hubris (Hayward, Shepherd, & Griffin, 2006) and overconfidence (Singh, 2008) that are associated with most entrepreneurs and which may result in failure.

While we expect that there are positive and negative effects of aging on entrepreneurial cognitive processes (Proposition 2a), we specifically chose not to offer overly specific propositions. There just is not enough data within the neuroscience literature to draw specific conclusions. However, we did propose that there are cognitive benefits of aging that result from better functioning and interaction between left and right brain activities (Proposition 2b). The left brain provides the logical, objective, analytical analyses of problems, while the right brain tends to be more subjective, intuitive, and random. As we pointed out above, neuroscience research tells us that as one ages, there appears to be a tempering of the dominant side of the brain and there is likely to be more even functioning between the two sides of the brains. For younger entrepreneurs who may be overly analytical (left brain) or overly intuitive rather than objective (right brain), the odds of entrepreneurial failure are probably elevated over an older entrepreneur who may have more balance. This may be why a significantly higher percentage of working adults over 55 years old are self-employed versus those under 55 (Singh, 2009). They may be better able to understand opportunities and markets and fulfill unmet market needs. This is the basis for Proposition 3.

Future Research Directions and Practical Implications

Ultimately, data analysis is critical to theory development (Weick, 1995). The propositions need to be empirically tested through brain scans and imaging that tests how the various parts of the brain fire and behave for various entrepreneurs using different stimuli. Taking a wide range of entrepreneurs of all ages, it would be best if one could conduct imaging of their brains every year or several years for 25-50 years. This would allow us to test whether brain activity does indeed change over time with respect to environmental stimuli. However, as mentioned above, although ideal, the economic reality and time required would be enormous and it would be challenging to maintain all (or even most) of the study sample participants over that long a period.

A more feasible study would be to test a group of older entrepreneurs and younger entrepreneurs and examine the difference in their brain images. The sample entrepreneurs would be placed within scanning equipment and the brains' activities following written, audio, and visual stimuli could be measured and recorded. We would expect to see differences between all of the sample members, but it is likely that older entrepreneurs, as a group, would have different brain activation images than the pool of younger entrepreneurs. The ultimate goal would be to try to determine if there are optimum brain activation images that can be directly linked to superior firm performance.

We are at the very cusp of brain scan imaging to test neurological activity resulting from economic cues. A shift toward testing more specific new venture creation brain activities may open up new

knowledge about the entrepreneurial process. The ability to be creative and innovative should be related to right brain activities and analytical/logical activities should appear on images of the left side of the brain. Testing whether brain images of younger entrepreneurs show greater activation of one part of the brain than older entrepreneurs would be a significant finding. On the flip side, if it is true that older entrepreneurs are better able to manage their cognitive processes – consciously or unconsciously – such that they are able to take advantage of both sides of their brains, and that further, this results in higher success rates the field of entrepreneurship would be advanced by leaps and bounds. The practical effects of such a major finding would be enormous.

Such information could be used to design more effective training and education programs for entrepreneurs. Mental exercises, and even pharmaceuticals, which stimulate the appropriate parts of the brain and which depress those parts of the brain which are determined to be less desirable for entrepreneurial success could be designed and implemented. Depending on how strong the results are, that is, how direct the brain activation imaging can be used to predict entrepreneurial success, one can imagine effects on funding/investment decisions. It may yield greater interest in investing in firms owned by older entrepreneurs. This may help to spur increased levels of new venture creation among the growing population of older American – something that is critical for future economic competitiveness for the nation.

CONCLUSIONS

Finally, we recognize that this is a broad ranging conceptual paper, and to some extent it represents a work-in-progress, but we believe that it pushes the field forward and makes a significant contribution by introducing entrepreneurship scholars the body of neuroscience literature that they may not be aware of. Tools for the study of the brain are improving rapidly and over the next decade or two there is likely to be significant advancements in our knowledge about how the brain functions and how it directly impacts human behavior. As this base of knowledge expands, entrepreneurship scholars should look to team with neuroscientists so that the knowledge branches out to improve the success rates of entrepreneurial ventures.

We also focused our attention in this paper on the importance of studying older entrepreneurs and the potential advantages they may have in terms of neurological activity. Given the changing demographics which show that people are living longer, healthier lives as well as the long-term, global economic crisis that we are currently enduring, such knowledge is critical for advancing human productivity and economic success. Finding ways to increase labor and economic participation among the growing older population can help not only older people prosper, but the nation as a whole. We hope that entrepreneurship and neuroscience scholars begin to advance the directions of knowledge we have laid out in this paper. Certainly much work is needed on this important topic.

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