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**Wired for Innovation: Valuing the unique innovation abilities of emerging
adults**

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Abstract

This conceptual paper argues that young people's brains are 'wired for innovation' and that society should better engage this age group to access its innovation potential. Research published in the neuroscience and developmental psychology literature shows that between 15 and 25 years of age adolescents and emerging adults possess traits of successful innovators. They are collaborative, creative, observant, curious, willing to experiment, willing to challenge the status quo, risk takers, action oriented and visionary. In addition, Millennials and Generation Z are coming of age in a context that provides them with innovation ability during adolescence and emerging adulthood beyond that of previous generations. This paper proposes that organizations able to effectively engage young people will be more innovative. Also, when young people are meaningfully engaged, society is more likely to find solutions needed to tackle social, environmental and economic challenges.

Introduction

A considerable amount has been written about the attributes of emerging adults - both negative (Twenge, 2013) and positive (Arnett, 2013). The majority of emerging adulthood research has focused on this life stage being a period of transition (Steinberg, 2014) and how to ensure that emerging adults successfully transition into adulthood (Arnett, 2004). What has not been explored in depth is whether emerging adulthood is simply a developmental stage on the way to adulthood, or whether this life stage might also serve one or more meaningful societal and economic purposes.

While it is well known that adolescence and emerging adulthood are a time of heightened brain capacity (Hall, 1916), research about this cohort has focused on those elements of the brain which are not yet fully developed during this life stage (Jensen & Ellis Nutt, 2015). Rarely are the unique abilities that are possessed during this particular life stage, and what valuable contributions might be possible as a result of these abilities, explored.

This article advances emerging adulthood theory by arguing that young people, regardless of generation - and emerging adults in the Millennial and Generation Z cohorts in particular - are not simply "partially formed" adults whose only role is to transition into adulthood. Rather, they have unique abilities and potential while they are young. In particular, in this article we explore young people's innovation potential, a role that is of increasing societal and economic importance.

Defining Emerging Adulthood & Adolescence

The age cohort examined in this article is between 15 and 25 years old. The definition that is most often used for emerging adulthood is 18 to 25 years old with a flexible upper boundary (Arnett, 2004). We examine a broader age cohort in this article because we combine research from the emerging adulthood domain (Arnett, 2004, 2013; Schwartz, Cote, & Arnett, 2005; Tanner & Arnett, 2009) with research from neuroscience (Jensen & Ellis Nutt, 2015; Thompson, Blair, & Henrey, 2014) and developmental psychology (Epstein, 2010; Steinberg, 2014).

Neuroscience and developmental psychology tell us that by the age of 15 young people have reached many, if not all, of the intellectual markers of adulthood (Epstein, 2010; Raven, 1948) and that by 25 years old, the heightened brainpower of youth has begun to decline (Baltes, Staudinger, & Lindenberger, 1999). There is discussion, however, even amongst neuroscientists, which suggests that this upper boundary is flexible (Steinberg, 2014). For the purpose of this article, we believe that there are enough similarities between the brain capacity of 15 year olds and that of 18 year olds to support the inclusion of young people that range from 15 to approximately 25 years old in our argument.

Throughout the article the terms 'adolescence' and 'emerging adulthood' are used. We are employing both terms as some of the sources quoted define

adolescence as puberty to 25 years old (Steinberg, 2014) or as 14 to 24 years old (Hall, 1916) thus encompassing the age cohort we are most interested in. For the purpose of this article we use the terms 'adolescence and emerging adulthood' when we are speaking about research that refers to 15 to 25 years old, and 'emerging adulthood' only when we are referring to research that refers only to those 18 to approximately 25 years old.

Throughout the article we will also make reference to two generational cohorts, Millennials, who for the purpose of this article are defined as those born in 1982 until the mid-1990s (Howe & Strauss, 2009) and Generation Z born starting in 1993 until present day (Statistics Canada, 2015).

Heightened Brain Capacity

Being young has always been seen as a significant life stage. G. Stanley Hall, recognized for having developed the concept of adolescence, (Hall, 1916) wrote in his seminal early 1900s work *Adolescence:* "these years are the best decade in life. No age is so responsive to all the best and wisest adult endeavour" (Hall, 1916, p. preface).

Since his book was published, research in the field of neuroscience and psychology has backed up what G. Stanley Hall believed about the enhanced traits of the young. Recently, the importance of the life stages of adolescence and emerging adulthood in human development has been recognized as being

equal to that of first few years of life (Steinberg, 2014). Puberty to 25 years has been identified as a period of heightened neuroplasticity defined as "the brain's potential to change through experience" (Steinberg, 2014, p. 9), thus making this period the last key window for interventions that hope to adapt behavior in adulthood (Steinberg, 2014). Experts argue that the heightened neuroplasticity of this life stage also makes adolescence and emerging adulthood a time of great potential and extraordinary accomplishment (Jensen & Ellis Nutt, 2015; Steinberg, 2014).

In addition to heightened neuroplasticity, by age 15 another important cognitive development is occurring. By that age a young person is capable of adult thinking (Epstein, 2010); reasoning ability is fully developed (Jensen & Ellis Nutt, 2015) as is intelligence, philosophical speculation, experimental thinking, theory development and the ability of a young person to analyze their own thinking (Epstein, 2010).

In addition as young people enter emerging adulthood, they reach the height of numerous measures of aptitude including verbal, numerical ability, finger dexterity and clerical perception (Tanner & Arnett, 2009).

Recent developments in neuroscience have also begun to help us understand that the human brain is not static, our cognitive development continues throughout our lifetime (Driemeyer, Boyke, Gaser, Buchel, & Arne, 2008). However, it is important to note that by age 24 a decline begins (Thompson et al.,

2014). A recent study using video games to examine cognitive-motor skills concluded that the declines beginning around age 24 are substantial enough that they are applicable in a real world context (Thompson et al., 2014). Intellectual ability declines after age 24 (Raven, 1948) and operational thinking also begins to decline in the 20s (Epstein, 2010) as do abilities such as reasoning, spatial orientation, perceptual speed (Baltes et al., 1999) and fluid intelligence (Tanner & Arnett, 2009).

In addition to adolescence and emerging adulthood being the height of brain functioning for young people of each generation, Millennials and Generation Z may also have additional benefits when it comes to brain capacity during this life stage. Although we are very much in the beginning stages of understanding how technology and new media impacts the brain, some experts argue that young people who grow up with technology may think differently (Tapscott, 2009). Suggesting that contact with modern technologies may push the Millennial and Generation Z brain past "capacity limitations" (Tapscott, 2009, p. 113). Experts also argue that exposure to technology from a young age may also encourage a new form of intelligence called "distributed cognition" developed through collaboration with people and machines (Tapscott, 2009, p. 114). Exposure to new media has lead to increased opportunities for self-directed learning that may allow young people to become experts on subjects much sooner, especially those related to technology (Ito et al., 2008). Studies suggest that young people today no longer need to remember facts, rather they just need to remember

where to find the information (Sparrow, Liu, & Wegner, 2011). Not needing to

recall information in the same way as previous generations, even in an era where

information is more readily accessible than ever before (Pew Research Center,

2014), may mean that the brain can more often engage in high-level

contemplation, critical thinking and problem solving (Taylor, 2012).

This begs the question; is it time that we go beyond thinking only about how

developmental tasks occur in adolescence and emerging adulthood, and instead

turn our focus towards exploring the unique attributes that adolescents and

emerging adults possess while they are young and how these might be applied

for social and economic benefit? Might adolescence and emerging adulthood be

a valuable source of untapped social and economic potential?

Definition of Innovation

The definition of the word innovation has been widely contested (Garcia &

Calantone, 2002) until recently when the business community has begun using

the term to describe innovation as a business process (Scott & Bruce, 1994). In

this context, innovation can be defined as "the production or adoption of useful

ideas and idea implementation" (Scott & Bruce, 1994, p. 581). There has been

criticism around the identification of this concept solely as a business term, and

alternative definitions that aim to broaden the definition have also been

suggested. For example, social Innovation has been defined as "an initiative,

product or process or program that profoundly changes the basic routines,

resource and authority flows or beliefs of any social system" (Westley, 2008, p. 1).

For the purpose of this article, we will use a broad definition of innovation, which encompasses both business innovation and social innovation. We will define innovation as coming up with new and useful ideas, processes, products, initiatives, procedures, or programs (Farr & Ford, 1990; Westley, 2008) where the envisioned outcome is to produce some kind of benefit; social, environmental and/or economic (Jong & Hartog, 2007).

The modern economy has been described as an era that requires relentless and continuous innovation (Schwab, 2016) due to a historically unprecedented pace of change (Drayton, n.d.; Nunes, Bellin, & Lee, 2016). There is widespread agreement amongst economists, policy makers, and business leaders that our long-term economic health is based on our ability to create more innovation (Jarvis, Mark, & Jarvis, 2016; Wagner, 2012). The same can be said for addressing increasingly complex social and environmental problems (Westley, Zimmerman, & Patton, 2006).

Traits of Successful Innovators

We determined what traits are needed in order to be a successful innovator through a broad literature review of sources from both academic and popular literature. The traits that were most frequently identified in the literature review as core to being a successful innovator were: collaboration, creativity, being

observant, curiosity, a willingness to experiment, being a risk taker, a willingness to challenge the status quo, action oriented and being a visionary.

It has been suggested that young people are born with an inherent desire to explore and to envision new possibilities (Wagner, 2012). In the following section, we will examine the nine traits of successful innovators, and make the argument that adolescents and emerging adults, ages 15 to 25, and Millennials and Generation Z in particular, possess enhanced potential to innovate during this life stage.

Collaborate

Collaboration can be defined as interactions between innovators and those who may offer drastically different points of view (Dyer, Gregersen, Christensen, & Foster, 2011). It is widely known that peers are central to young people's lives during adolescence and emerging adulthood (Epstein, 2010). The underlying reason for this is that young people have a heightened awareness of social stimuli during these years (Steinberg, 2008). Their brains are wired to pay more attention to expressions, thoughts and opinions of other people than in any other life stage either before or after (Steinberg, 2014). Community (Quan-Haase & Boyd, 2011) and attention from others (Steinberg, 2014) become of critical importance during this life stage. For most young people, the central question might very well be "what are my friends doing and saying now?" (Taylor & Pew Research Center, 2014, p. 145).

Not only do Millennials and Generation Z have this heightened awareness of their social context and relationships, but they have an added benefit of a broad interconnectedness (Ito et al., 2008; Tapscott, 2009) supported by technology and new media. They have unparalleled reach, and can engage with and effect others more than ever before (Tapscott, 2009). These ties are broad but also deep; internet users have 23% more meaningful social ties than nonusers (Tapscott, 2009). New media also breaks down traditional markers of status and authority (Ito et al., 2008) allowing young people to meaningfully engage with a more diverse group of individuals over a significantly wider geographic area. These generations also have a much more vast potential for mobilization than did previous generations (Clarke & Dougherty, 2010). Experts suggest that Millennials and Generation Z are natural collaborators who understand that reciprocal sharing is at the core of developing collaborative relationships (Tapscott, 2009; Taylor & Pew Research Center, 2014). At their core, given their exposure to new media, these are generations that understand the importance of relationships and how to collaborate.

Millennials are also the most racially diverse generation in North American history with 43% of Millennials in the US being non-white (Drake, 2014) and in Canada, Millennials are the most culturally diverse generation yet (Norris, 2015). These trend lines are predicted to continue for Generation Z (Perez & Hirschman, 2009). As a result of access to technology and new media as well as

increased diversity the argument can be made that Millennials and Generation Z have an increased exposure to drastically differing opinions and points of view.

Creative

Creativity can be defined as "the production of novel and useful ideas" (Scott & Bruce, 1994, p. 581). In a global survey in 2011, 69% of respondents agreed that innovation is driven by individual's creativity rather than by scientific research (General Electric, 2011).

In emerging adulthood, creative thinking is at its neurobiological peak (Jensen & Ellis Nutt, 2015). As we age we gain the benefits of knowledge and wisdom, but the originality needed for creativity is more present when we are young (Lehman, 1960). It has been argued that one reason this might be the case is that adolescents and emerging adults are less bound by societal rules (Epstein, 2010). Studies have shown that as we enter emerging adulthood there is a significant drop in conformity scores (Epstein, 2010). To support creative thinking, emerging adulthood is also a particularly important time because at the same time as conformity sources are low, the "black and white" dichotomous thinking of early adolescence is replaced by an ability to see complex points of view (Simpson, 2001).

Observant

Innovators are "intense observers. They carefully watch the world around them" (Dyer et al., 2011, p. 24). During adolescence and emerging adulthood the brain has an increased sensitivity to and awareness of one's environment (Steinberg, 2014). Young people during this time are in a nearly permanent state of heightened attentiveness (Jensen & Ellis Nutt, 2015). The brain is built to be aware of what is happening around them, even things of which they might not be conscious (Steinberg, 2014).

In addition, adolescents and emerging adults have superior memory abilities (Epstein, 2010). Events that occur during this life stage are recalled more frequently than events that occur either before or after in the life span (Steinberg, 2014; Tanner & Arnett, 2009). This so-called "reminiscence bump" (Steinberg, 2014, p. 19) makes this time of life one where observation their surroundings comes more naturally to adolescents and emerging adults.

Curious

Curiosity can be defined as "an unrelenting quest for continuous learning" (Gelb, 2000, p. 9). Curiosity leads to exploration and information-seeking behaviors (Robinson, Demetre, & Litman, 2016). Research has shown that emerging adults are more curious that those in mid-life and older adults (Robinson et al., 2016). A reason for this may be that adolescents and emerging adults are primed to learn due to heightened neuroplasticity during this life stage (Jensen & Ellis Nutt,

2015). After the age of 24 this ability declines and as aging takes place it takes more time and practice to achieve the same learning goals (Baltes et al., 1999).

In addition, for Millennials and Generation Z, the period of life where identity formation and searching for meaning and purpose play a prominent role, has become prolonged (Schwartz et al., 2005). Young people today, due to more time spent in education (Schwartz, Zamboanga, Luyckx, Meca, & Ritchie, 2013), have more freedom for exploration and a longer moratorium from the responsibilities of adulthood then generations before them (Arnett, 2004). This increased interval during which young people are given an extended opportunity explore and learn may lead to a heightened motivation to innovate (Wagner, 2012). In addition, technology and new media has increased the opportunities for identity play, subversion (Buckingham, 2008) and for young people to become subject area experts in subjects they find of interest (Ito et al., 2008). Allowing further space for curiosity, self-directed learning and identity exploration that were not available to past generations.

Experimentation

To experiment can be defined as when "innovators constantly try out new experiences and pilot new ideas" (Dyer et al., 2011, p. 24). At a time of increased neuroplasticity, defined as "the brain's potential to change through experience" (Steinberg, 2014, p. 9), adolescent and emerging adult brains are moldable, similar to plastic (Jensen & Ellis Nutt, 2015). Openness to new experiences

peaks in emerging adulthood and declines with age (Roberts, Wood, & Smith, 2005; Simonton, 1988). Values associated with openness to change including "being independent, original, adventurous, and of seeking surprises and new experiences" (Robinson, 2013, p. 14) are negatively correlated with age. In human evolution, this was important because a willingness to experiment and remain open to new ideas was vital for survival and adaptation during this life stage (Jensen & Ellis Nutt, 2015; Steinberg, 2014). In a modern context this tendency towards experimentation in emerging adults also serves the important function of encouraging young people to establish autonomy and independence at a time when the brain is most open to new experiences (Steinberg, 2008).

Millennials and Generation Z may have the added benefit of remaining in a period of heightened neuroplasticity and the openness to new ideas and experimentation that comes with it, for longer than any generation before them. Studies have shown that time spent in "novel, challenging, and cognitively stimulating activity" (Steinberg, 2014, p. 62) such as post-secondary education and service learning extends of the period of heightened neuroplasticity. Playing action video games may have similarly positive impacts on cognitive development (Bavelier, Green, Pouget, & Schrater, 2012).

Risk Taking

Risk taking, defined as "a willingness to embrace ambiguity, paradox, and uncertainty" (Gelb, 2000, p. 9), is often viewed as a negative attribute in

adolescence and emerging adulthood. However, throughout history risk taking

was often necessary for survival or reproduction, and when not taking a risk

might have been more dangerous than the risk itself (Steinberg & Belsky, 1996).

In fact, it has been argued that natural selection has favoured a predisposition

toward some risk taking behaviour during adolescence and emerging adulthood

(Steinberg, 2008). In a contemporary context, risk taking is often portrayed

negatively (Reyna & Farley, 2006), but in fact research suggests that risk taking

should be valued as a means to opening emerging adults to a broader set of

possibilities and opportunities in work and education (Ravert, Murphy, &

Donnellan, 2015). Risk taking is also important tool for identity exploration

(Schwartz, 2015a) building self-confidence, resilience, as well as encouraging

young people to solve problems on their own and learn about limits

(Participaction, 2015).

Studies have shown that adolescents' take more risks then adults not because

they are uninformed, unreasonable, or make flawed estimates (Reyna & Farley,

2006) nor do they take risks solely for their own enjoyment (Ravert et al., 2015).

Rather, adolescents and emerging adults take more risks because their brains

assign more value to the potential reward that may come from taking a risk then

to the potential dangers that may occur as a result of the risk (Jensen & Ellis

Nutt, 2015; Steinberg, 2014).

Challenge the Status Quo

Challenging the status quo, can be defined as "asking questions to understand how things really are today, why they are that way, and how they might be changed or disrupted" (Dyer et al., 2011, p. 23). The belief that young people are more able to make radical departures from the status quo is broadly held (Jones, Reedy, & Weinberg, 2014). This is important from a sociological perspective as it allows knowledge that is no longer relevant or useful to be forgotten and new ideas to be introduced (Mannheim, 1952). One way that this expresses itself is youth make up their own social movements to create their own solutions and critique the status quo when their ideas or actions may not be welcomed within traditional institutions (Clarke & Dougherty, 2010). In a modern context it has been argued that new media and technology has empowered Millennials and Gen Z to challenge the social norms and the status quo in unique ways by breaking down traditional structures of authority and concepts of who is an 'expert' (Ito et al., 2008).

Vision

Vision can be defined as inspiring "the impossible - fiction becomes truth" (Westley & Mintzberg, 1989, p. 15). Adolescence and emerging adulthood has been described as "the birthday of the imagination" (Jensen & Ellis Nutt, 2015, p. 6), and is a time when everything seems possible. Emerging adults are known for their openness to diverse possibilities and options (Schwartz et al., 2013) and emerging adulthood is know for being a time when dreams are paramount

(Arnett, 2004). Young people are often called idealistic, defined as believing "that everything is possible in their lives and the world" (Epstein, 2010, p. 260). Though idealism is often seen in a negative light, this ability of young people to imagine possibilities and emerging adults to have "high hopes and big dreams" (Arnett, 2004, p. 3) can be viewed as an enhanced capacity to be visionary.

Action Oriented

Being innovative requires not only coming up with new ideas but also being able to turn these ideas into reality. Research tells us that young people wish to be seen as ""community resources" (Zeldin, 2004, p. 76) and meet the real needs of themselves, their communities and those around them. Learning is most effective for young people when it takes place in the context not of knowledge as an end goal but rather with action as an end (Stauch & Cornelisse, 2016). Young people also want to be part of history, they are most likely to be engaged when work is relevant to what they care about but also has a purpose larger than themselves (Zeldin, 2004).

Millennials, often bemoaned for their impatience, are a generation who want to understand how their work is contributing to success (Tapscott, 2009) and have the desire to work for impact (Kingston, 2014). Both of these characteristics suggest a bias towards action. Researchers suggest Generation Z are also a generation who are action oriented; one of their key traits being that they are eager to have an impact (Kingston, 2014).

Implications and Conclusion

Though our work focuses on the positive abilities of adolescence and emerging adulthood, there is a body of research which points to the areas where young brains have not yet reached full maturity. Adolescence and emerging adulthood is a time where the brain reorganizes the neural network particularly in the pre-frontal cortex and the limbic system (Steinberg, 2014). The pre-frontal cortex makes us rational, and the limbic system is responsible for emotions (Steinberg, 2014). Prospective memory, defined as the ability to remember to do something at a later time does not improve until the 20s (Jensen & Ellis Nutt, 2015), and the ability to multitask is still developing in adolescence and emerging adulthood (Jensen & Ellis Nutt, 2015). In addition, the amygdala, the part of the brain involved in emotional states, remains immature during this life stage (Jensen & Ellis Nutt, 2015). Rational thought processes in adolescence and emerging adulthood can also be disrupted by fatigue, stress and emotion (Steinberg, 2014). Adolescents and emerging adults are more likely to make poor decisions in the presence of peers (Steinberg, 2014) and adolescences is a time of increased risk taking which can also have many negative consequences (Schwartz, 2015b).

It is our contention however, that during adolescence and emerging adulthood these weaknesses can be offset by intergenerational support and mentorship (Ho, Clarke, & Dougherty, 2015) and that the potential benefits of young people's

meaningful contributions to society far out way the potential risks inherent in offering them the responsibility needed to contribute.

Young people, though they may all share the common characteristics of this life stage as described in this article, are also individuals and varying life circumstances will have an impact on how likely this potential is to be realized. For example young people who might be considered at risk due to their socio-economic circumstances are likely to need more support and guidance in order to fully realize their potential (Khanna, MacCormack, Kutsyuruba, McCart, & Freeman, 2014).

The findings presented in this article: that emerging adults have great potential to become successful innovators and that their unique abilities while they are young may hold economic and social potential, is of utmost importance in a modern economy and society that relies heavily on innovation.

The argument outlined in this article suggests that organizations, businesses and governments who effectively engage their young employees, and societies or communities that value and engage young people should be more innovative. If innovation is indeed a key ingredient to addressing social, environmental and economic challenges, then as young people increase their meaningfully engagement in society and their communities we will should be more successful

in addressing these issues. However these findings are only meaningful if we determine how to realize the full innovation potential that young people possess.

A first step towards ensuring that the full potential of young people's abilities is realized might be an attitudinal shift. Moving from focusing on young people's failings and deficits to focusing on their achievements and abilities (Tanner & Arnett, 2009). When adults encourage young people to positively address complex social, environmental and economic challenges while they are young and recognize young people's accomplishments, research suggests that there are benefits for society at large (Ho et al., 2015).

A second step and a more difficult one, may be a shift from youth and adult relationships that are based solely on "guidance, support and resources" to one where as young people become more autonomous "power is shared, mutual, and reciprocal" (Tanner & Arnett, 2009, p. 40) while at the same time ensuring young people have the support they need to grow and learn (Steinberg, 2014). In business, government and organizations this shift can occur through intergenerational partnerships where young people and adults work together collectively for a common goal (Zeldin, 2004) and where young people's contributions are valued. Research explains that when young people with bold ideas are given access to decision-makers and work collaboratively in an intergenerational context it can be a means of effectively addressing complex social and environmental problems (Ho et al., 2015).

An area for further study could be to determine how businesses, governments and organizations can most effectively change their organizational structures in order to systematically engage young employees and harness their innovation potential. Another interesting area of research may be to determine if societies where youth are civically engaged and have higher rates of adolescent and emerging adult voting and community engagement are in fact more innovative. Further research could examine how educational institutions, both high school and post-secondary, encourage or discourage young people to innovate while they are young. Further research is also needed to determine how negative stereotypes may hold young people back from making unique contributions during this important life stage. Examining other unique abilities young people possess during adolescence and emerging adulthood could also be explored.

It is our hope that this article sparks an interest amongst those who study emerging adulthood to examine more closely young people's unique abilities; both innovation potential as well as the many other abilities that young people may possess while they are young. In doing so, we may find benefits for all of us, regardless of age or generation.

Declaration of Conflicting Interests

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