Decision Making in Adolescent Brain and its implications for Human Computer Interaction

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Abstract
This paper reviews published literature on decision making in adolescents and impacts of interaction with computers amongst adolescents. The focus is on understanding the developmental stage of human brain during adolescent age along with physical, social and emotional impacts of interactions with computers. This will help in understanding areas where computer interactions have enriched the lives of adolescents and areas with negative consequences of computer interactions. The motives behind excessive online interactions are more important to predict negative consequences rather than time spent online. The adolescent brain understands reward-based interactions better than risk analysis and consequences of risky behavior. Adolescents tend to learn from their peers and they tend to take more risk in a group setting as compared to individual setting. Adolescents get addicted to online group play video games and find them as an escape from day to day miseries in their lives. Depressed adolescents get affected more negatively on social media as compared to normal adolescents. Adolescents and parents can connect with each other by participating in video games together. Social media and Internet based communication can also be helpful in motivating adolescents to exercise. These studies bring forward various important aspects of adolescent brains and how computer programs can be designed to cater to the needs to adolescents such as educational applications can be designed with reward-based system and allow sharing their achievement amongst their peers. Similarly, social media posts can be used as an input in analyzing psychological state of adolescents to detect depression amongst adolescents. Video games can be designed by making them a source of family entertainment to bring the family together.

*Keywords*: Adolescent, decision-making, computers, social media, video game, addiction
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**Introduction**

Adolescence is a life stage which starts with young humans reaching puberty along with a sense of independence and it lasts till when one gets a stable role in society. The human brain is going through a lot of changes during this phase of life and humans tend to take decisions based on emotions, peer pressure and take undue extra risks in life. This is also a stage in life which defines the prospects for success or failure of a person in life. Online communication and internet has become a way of life for adolescents with ever increasing engagement. Adolescents use technology to socialize, for education & entertainment, to explore and gain knowledge. However, technology also presents several challenges for the adolescents. Adolescents have one part of the brain well developed to understand that certain tasks get rewarded and they tend to like instant gratification rather than a greater long-term benefit. The part of the brain that performs risk-reward analysis is still under development and adolescents tend to take higher risks without thoroughly thinking about the negative outcomes attached with the risk. This trait of human behavior during adolescent age separates them uniquely from children and adults. Adolescents also go through several physical and emotional changes which makes them more vulnerable and bear negative consequences of excessive use of computer technology. The ability to understand the developmental phase of the adolescent brain and the ability to understand what portions of the brain are more developed has far reaching consequences in the field of Human Computer Interaction. Thus, a better understanding of the human brain in adolescents can act as a design guideline for the field of Human Computer Interaction for designing applications for adolescents.
Literature Review

The part of the brain that understands that a certain behavior is rewarding is more developed amongst adolescents when compared to risk-outcome analysis. Adolescents tend to mis-judge between short term smaller gains and long term larger gains and tend to live in present with instant gratification being more important than long term benefits. Sarah-Jayne Blakemore & Trevor W Robbins (2012) have presented a summary of various researches performed by several researchers on the brains of adolescents. They studied various aspects of decision making and evaluated cognitive reasons behind the decisions. They also studied what is the developmental phase of various parts of the brain and how it affects the decision-making process in adolescents. Sarah-Jayne Blakemore & Trevor W Robbins (2012) found out that the part of the brain that develops control over impulses, performs risk-outcome analysis, etc. develops at a linear pace and it is not completely developed in adolescents. While on the other hand, the part of the brain that develops responsiveness to rewards is far developed in adolescents. They also suggest that adolescents tend to make more decisions based on emotions and social factors such as peer pressure, etc. especially in a group setting. They also highlighted that during this phase in life, instant gratification is more valuable to adolescents than long term larger benefits.

Adolescents tend to prefer to learn from their peers rather than from adults. Adolescents take higher risk when they are in a group setting along with other adolescents when compared to adults. Dustin Albert, Jason Chein & Laurence Steinberg (2013) studied the neurobehavioral substrates of adolescent decision-making process when they are in company of other adolescents. They performed brain imaging to examine the neural dynamics behind adolescents being more responsive to peer pressure. Their experiments on adults and adolescents in a group setting and a
private setting demonstrated that adolescents take higher risk when they are in a group setting along with other adolescents when compared to adults.

According to the study conducted amongst 261 adolescents residing in California during year 2000-2001 by Elisheva F. Gross (2004), adolescent boys’ and girls’ online activities are similar. The purpose of the study was to evaluate that the gender of adolescents predicts they type of internet usage, i.e., boys spend more time online, browsing the web and engaging in violent games, while girls prefer to chat or shop online; that Internet use causes social isolation and depression, especially for adolescents; and that adolescents use the Internet for hiding behind misleading identities. The results of the study showed that adolescent boys’ and girls’ online activities are similar. Adolescents described their online social interaction occurs over e-mail and instant messages, with real life friends who are also part of their daily, physical lives, and the online activity is ordinary. Misleading Online identities were reported to be used to play a joke.

According to the study conducted by Paul Best, Roger Manktelowa & Brian Taylor (2014), there is either mixed or no effect of social media on the wellbeing of adolescents. The authors intend to study the beneficial and harmful effects of online communication and social media on adolescents. They concluded that most of the research work concludes that there is either mixed or no effect of social media on the wellbeing of adolescents. The studies found out that social media provides a perceived social support to adolescents. The researchers also found out that social media helps in raising self-esteem and belongingness. Research also found out that direct emotional and empathetic support via online networks promotes adolescents to seek help thus indirectly assisting in improving mental wellbeing. They also suggest that when social media is used as a channel for communication rather than for non-communicative purposes then it provides more benefits for the mental wellbeing. Malinda Desjarlais, Teena Willoughby (2010)
investigated amongst boys and girls, the relationship between friendship quality and use computers for social interaction. The study was conducted to investigate amongst boys and girls, the relationship between friendship quality and use computers for social interaction. The study also focused on the role of social anxiety as a moderator over time and investigate the support for social compensation and rich-get-richer hypothesis amongst adolescents. The study was conducted amongst adolescents living in Ontario, Canada over time when the students were in grade 9, 11 and 12. 545 students completed the survey at all three different times. The study found out that the quality of friendship overall declined as students progressed further in age. Social anxiety was negatively associated with quality of friendship equally amongst boys and girls. Students with lower social anxiety displayed higher positive friendship quality compared to students with higher social anxiety. The study found out that adolescent girls reported higher positive friendship quality amongst who used computers with friends versus who minimally used computer with friends. There was no change in behavior due to social anxiety amongst adolescent girls. Socially anxious adolescent boys rated higher friendship quality amongst the students who use computers for social interaction versus the students who do not use computers for social interaction. Boys who were less socially anxious did not show any difference in friendship quality between students who used computers extensively for social interaction versus the ones who used computers minimally for social interaction. The study also found out that happiness quality does not gets affected by online gaming among both boys and girls. On the other hand, the study conducted byAna Radovic, Theresa Gmelin, Bradley D. Stein, Elizabeth Miller (2017) examined the influence of social media on the mental wellbeing of 23 adolescents diagnosed with depression. The study found out that the adolescents with depression use social media more than normal adolescents. These adolescents typically had larger friend network with
large number of strangers as their friends. These adolescents used social media for changing their mood, gaining social support, expressing their emotions or for entertainment purposes to distract them. Even with good intentions, depressed adolescents might encounter negative effects over social media which worsens their situation. Depressed adolescents may encounter more negative comparisons over social media thus worsening their satisfaction level in life.

Sima Zach, Tamar Raviv, Yoav Meckel (2016) studied the impact of using internet and smartphones in providing motivational intervention to adolescent females towards performing physical exercise during their leisure time. They found that there is no significant difference in increase in activity level amongst groups assisted with technology and the control group. However, there was a significant reduction in resistance and negative affect towards running plus the self-belief that they can exercise by themselves also increased. The study conducted by Sarah M. Coyne, Laura M. Padilla-Walker, Laura Stockdale and Randal D. Day (2011) found out that when parents play video games with adolescent girls, the extent of internalization of aggressive behavior was reduced and there was an increase in prosocial behavior. The girls also felt more connected with their families when the parents engaged in playing age appropriate video games with them.

The study conducted by Charlotta Hellstrom, Kent W. Nilsson, Jerzey Leppert, Cecilia Aslund (2012) found out that men and boys are more predisposed to play Massively Multiplayer Online Role-playing Games (MMORPGs) as compared to women and girls. The study found that excessive number of hours spent in playing MMORPGs results in sleep deprivation as well as leads to game addiction along with other negative consequences. An important finding of the study was that when MMORPGs were played to escape, due to peer pressure or for gaining acceptance/status, etc. the adolescents displayed higher risk of negative consequences.
Adolescents that played MMORPGs for fun, showed lower risk towards negative consequences. The study emphasizes the importance of motives of play as an important contributor towards negative consequences.

**Discussion**

The literature review has provided insights into how adolescents consume information through computer and electronic devices as well as how their lives are affected through human computer interaction. This opens various areas where research should be performed: consumption of content through computers, response to content available through computers & applications which can be created to better serve adolescents. Future applications in education are of interest where content could be developed with a social context and students could interact with each other. The test results and social comments of adolescents could be analyzed to identify areas where an individual student is facing challenges and the course tailors itself to help the student. Science experiments could be performed in virtual reality with no safety hazards and students could walk to any part of the world and any museum to learn through experiences. Math concepts could be explained through real life application such as a toy store and students learning to use various denominations of currencies to buy toys. Application of known behavior of adolescents can greatly help in creating computer applications which enrich their lives.

**Conclusions**

Adolescents represent a large population size that spends relatively high amount of time in interacting with computers. Understanding various aspects of brain development amongst adolescents as well as understanding the complex social, economic and psychological environment in which adolescents grow and develop arms us with information which can be used to make the lives of adolescents better. The recognition of the fact that the adolescent brain
responds better to rewards as well as their lack of ability to assess risk implications makes them a unique group which is vulnerable while interacting with computers all by themselves. Social media along with online video games, messaging applications etc. impacts development of adolescents and computer applications should be designed in such a way that they provide more benefits with minimal harmful effects.
References


