THE BIDIRECTIONAL INFLUENCE OF SOCIAL MEDIA AND ADOLESCENT DEVELOPMENT OF SELF-REGULATION AND EXECUTIVE FUNCTIONING

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ABSTRACT

Adolescence is a period of life full of change, whether it be physical change or psychological change. As part of this psychological change and in preparation for adulthood, adolescents must properly develop self-regulation and executive functioning. These aspects are vital for goal-setting, planning, staying on task, and attending to tasks later in their life. With social media becoming more and more prevalent, it is important to understand how the use of social media affects adolescent development. Increasing social media use is being driven by adolescents, prompting the exploration of its influence and development of these cognitive processes. Increased use of social media is affecting the development of various regulatory behaviors throughout adolescence. As these behaviors play a role in goal-setting and planning, social media is also shaping how adolescents plan for their future, make goals, and carry out those goals. Regulatory behaviors also play a role in determining the amount of time adolescents spend on social media, creating a bidirectional influence of the two subjects. I will be exploring the impact social media has on the facilitation of developing these aspects and how self-regulation and executive functioning play a role in the amount of time spent on social media.

I. INTRODUCTION

Social media use is becoming more and more prevalent in society. With the ownership of smartphones rising in 2012 and seeing a drastic increase in social media use around the same time, there has been a call to understand the impact that social media use has on individuals. Seeing as social media is still a relatively new form of media, there has been an ever increasing body of research done on it to better understand not only its psychological impact on individuals, but also the physical impact it can have. With adolescents being the largest group of users on social media, there is an even bigger need to understand the impact it has on them. Adolescence is a vital time of development for individuals and better understanding how social media impacts them will allow us to better understand how it will impact them as future adults and better ways to monitor and regulate use for generations to come.

II. DEFINITIONS

ADOLESCENT DEVELOPMENT

Before defining adolescent development, it is important to break the phrase down and understand what exactly adolescence is. Adolescence is a time where a child goes through mental and physical changes that prepares them to take on the roles and responsibilities of an adult (Arnett, 2018). Harmon (1948) defines adolescence as the period of time where a child undergoes changes that lead to the emergence of the adult personality. Adolescence is characterized by the onset of puberty, which encompasses the physiological changes that occurs in the individual's reproductive organs marking them becoming physically capable of reproducing (Goldman, 1981). As defined by Dahl and Spear (2004), adolescence is "that awkward phase between sexual maturation and the

attainment of adult roles and responsibilities" (p. 9). For the purpose of this thesis, I will be focusing on the mental changes that take place during late adolescence, or the high school years, as outlined by the 15- to 18-year-old age range.

SOCIAL MEDIA

Social media consists of various websites that allow individuals to connect with others and create a social setting within an online space. Social media is found on social networking sites, which are defined by Boyd and Ellison (2007) as:

> Web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. (p. 211)

The rise of smartphones has allowed more adolescents access to online communities regularly. According to the Pew Research Center, 95% of teens have a smartphone or access to one and 45% describe themselves as being online almost constantly. The Pew Research Center also found that 45% of teens say that social media has not had a positive or negative impact on their lives, while 31% say social media has had a positive impact and 24% say it has had a negative impact. (Pew Research Center, 2018). American teens spend an average of nine hours a week on social networking sites, with 95% of 12-17 year old's admitting they are online and 80% of them saying that their time online is spent on social media (Hur & Gupta, 2013). The most commonly used forms of social media include Instagram with 35% of teens saying they use it, YouTube with 32% of teens confirming their use of this social media site, and finally Facebook with 15% of teens admitting to using it (Anderson & Jiang, 2018).

On these online communities you can connect with family, friends, celebrities, and strangers. There are different privacy settings that can be toggled depending on the social networking site (SNS) that is being used, to decide if just people they are friends with can see their profile or if those they are not connected with can also see it (Boyd & Ellison, 2007). Different social media sites allow you to do different things, but for the most part all allow for a post to contain some form of writing by the user. For example, on Facebook and Twitter users can make postings that are simply written text, but on Instagram users must post a photograph that they are able to caption with written text. This allows for the widespread display and spread of personal ideas, opinions, and messages on these social networking sites.

III. THE BRAIN

Within the brain, there are different areas that are recognized for different cognitive abilities. These areas have specific functions and work together to incorporate, integrate, and use different knowledge gained throughout life. Areas of interest in relation to the development of self-regulation and executive functioning include the cortex, limbic area, brain stem, prefrontal cortex, and the frontal lobe.

The cortex is the outer layer of the brain and is where most of our cognition, or thinking, occurs. When individuals reflect, perceive, think about or remember something, plan, and make decisions it occurs in the cortex. The cortex is responsible for many aspects of cognition, as it is home to the four lobes, each serving a different and vital part in relation to self-regulation and executive functioning. The cortex works in communication within itself and throughout the other areas of the brain to interpret input and respond to stimuli. This is where awareness of self and others originates from,

allowing individuals to utilize their self-regulation and executive functioning (Siegel, 2013).

The limbic area of the brain is responsible for emotional regulation. This is the area where emotions are generated and it is also in charge of motivation, focusing attention, and memory. The limbic area works with the brainstem to form reactions (Siegel, 2013). The frontal lobe plays a vital role in planning, self-awareness, problem-solving, and regulatory behaviors. It is also vital for higher-order cognitive abilities, which include working memory, performance monitoring, and response inhibition (Larsen & Luna, 2018). These abilities all play a part in self-regulation and executive functioning. The frontal lobe is one of the last areas to develop in adolescence, displaying the vast amount of cognitive changes it undergoes and its importance in the roles it facilitates. The prefrontal cortex is located at the very front of the frontal lobe. This area is where the coordination and balancing of energy and information from other areas of the brain and the outside world occurs and plays a vital role in higher-order cognitive abilities. This region is most well-known in relation for social interactions and in response to stimuli. It is vital for integration as it allows processing to occur and responses to stimuli to be formed. Integration is vital for adolescent development as it allows the whole of the brain to communicate and allows for cognitive control, emotional regulation, and self-understanding (Larsen & Luna, 2018; Siegel, 2013).

IV. DEVELOPMENT

NEUROBIOLOGY OF PUBERTY

Throughout adolescence the brain goes through neurogenesis, pruning, and myelination of neurons. These processes allow the individual to further grow their

mind, think faster, and stop the development of various areas that are not as important (Blakemore & Choudhury, 2006; He & Crews, 2007; Hoffman & Dobscha,1989; Ming & Song, 2011; Sherin, & Bartzokis, 2011). During this time, individuals are learning new concepts in school and in the real world, leading to the development and growth of new neurons or neurogenesis (He & Crews, 2007; Ming & Song, 2011). This allows for pathways to be made in the brain that lead to better understanding and recall of the information they are learning. Pruning is the process of better developing neuronal pathways through degeneration of unnecessary neurons (Hoffman & Dobscha,1989). Myelination includes wrapping neuronal pathways in a fatty sheath that is myelin based. This sheath appears as white during MRI scans, showing there is increase in white matter in the adolescent brain (Blakemore & Choudhury, 2006). This process allows for neurons to fire more often and send the information they are trying to communicate faster and better (Sherin, & Bartzokis, 2011).

These processes occur in the brain and are important in the development of an adolescent's mind. The processes are experience driven, meaning that the adolescent needs to be engaged in their environment and developing an understanding of the natural world in order for neurogenesis, myelination, and pruning to occur. Experiences through the environment include things such as social interactions with peers, educational opportunities through school, and familial relationships (Singer & Bashir, 1999). Although the adolescent's prefrontal-cortex is not finished developing, it allows them to think critically and make decisions based on the information they are presented with, working on a top-down approach. A top-down approach includes the ability of the individual to choose what stimuli will guide development and which will be ignored. This

decision drives which neurons will develop, which will degenerate, and which will become encased in myelin (as cited in Hansen & Jessop, 2017).

While the development of self-regulation and executive functioning are psychological changes that occur during adolescence, it is important to note that there are also physical changes that occur. The processes of neurogenesis, pruning, and myelination occur throughout adolescence as these psychological changes are taking place. It is important to note that these developments and physical changes occur simultaneously and that one could not happen without the other.

DEVELOPMENTAL THEORIES

When approaching the topic of adolescent development, it is vital to break down the different theories of knowledge acquisition and development. These theories outline how the adolescent mind changes during this period, however it is also necessary to consider theories from childhood development and continued development into adulthood. Childhood developmental theories lay the foundation for adolescent development to occur, while continued development in adulthood displays the necessity of the developmental changes that occur during adolescence. These theories break down socialization, motivation, procurement of new information, and the various neuro-cognitive aspects of adolescence.

Piaget's theory of development is arguably the most well known theory of cognitive development. Piaget describes development as four stages which are identified as the sensorimotor period which takes place from birth to two years of age, the pre-operational period developing from 2-7 years of age, the concrete operational period occurring from 7-11 years of age, and the formal operational period which begins around

11 years old and finishes developing between the ages of 15 and 20 (Miller, 2010). However, newer research has outlined that development doesn't just end with formal operational cognition, but continues into adulthood and is known as post formal thinking. This includes the ability to go beyond formal operations, thinking of how complex, abstract ideas apply to real-life situations which is done through gaining experience in the real-world and facing different situations that could not be prepared for (Arnett, 2018). The formal operational period begins in early adolescence and extends into emerging adulthood. This period allows for mental operations that the individual has developed to not only be applied to concrete objects but to be considered in hypothetical situations as well, employing the use of deduction in order to solve problems, known as hypothetical-deductive reasoning. This develops during adolescence and allows for the individual to understand how their actions affect their future and those around them (Hur & Gupta, 2013; Miller, 2010). Piaget also defined assimilation and accommodation, which are vital aspects of development. Assimilation is the process of the individual applying what they know to their environment, or fitting reality into their cognitive organization. Accommodation includes the adjustments that the individual makes to their cognitive organization in order to fit it to reality as a result of their experience in the world (Arnett, 2018; Miller, 2010).

Now that we have addressed theories breaking down the acquisition of knowledge during adolescence, the focus can shift to theories about what drives knowledge acquisition. Self-determination theory asserts the idea that goal-directed behavior is developed through intrinsic motivation and internalization of extrinsic motivation. There are three psychological needs that are considered in this theory and must be met for

optimal development, these include autonomy, competence, and relatedness. As adolescents are developing, they must meet these three psychological needs so that they can develop the previously mentioned motivations (Deci & Ryan, 2000). In meeting the needs of relatedness and competence, individuals begin to internalize the valued behaviors of society and adopt them as their own valued actions and behaviors. When meeting the need for autonomy, individuals integrate the valued actions and behaviors into their cognition and develop regulatory behaviors that allow the individual to self-motivate and, in turn, function in ways that society deems acceptable (Deci & Ryan, 2000). These needs are met through socialization with the peer group, support from family and teachers, and engaging in interesting activities. Once these needs are met, adolescents can adopt the necessary motivational capacities that lead to self-determined actions that are carried out through self-regulated actions and behaviors (Deci & Ryan, 2000).

Grounded theory research of agency development in adolescence suggests that learning during adolescence occurs in three steps. These steps including engaging in a priori requirements, demands of them working, and feedback. A priori requirements cause the individual to feel like they have to act in a certain way and allow the individual to develop different strategies of self-motivation, which allow them to explore different areas of passion and to develop their creative and analytical reasoning. Demands that individuals work on different tasks allow them a stage for the a priori requirements to take place in (Hansen & Jessop, 2017). Feedback on the actions taken during the first step allows for the individual to evaluate the success or failure of their work. In doing so, the individual reflects on their self and different ways that they could have acted in the

situation. Support from adults in the individual's life and actions the adults take to keep them on track allow for the individual to begin to understand deadlines and self-motivate (Hansen & Jessop, 2017).

Social cognitive theory asserts that the acquisition of knowledge and culture occurs through what is seen in social interactions and outside influence. Simply put, that society has a direct influence on what individuals learn and think. This theory is a vital part of adolescent development as it is experience driven. The experiences that individuals have involving personal factors, environmental influences, and behavior patterns influence the individual (Bandura, 2001a). Social cognitive theory views social diffusion of new behavior patterns in three steps, these steps being the acquisition of knowledge about new behaviors, the adoption of these behaviors, and support for and the spread of the behavior on social networks (Bandura, 2001b). This directly shows the influence of society on adolescent development, showcasing the importance of this theory. This theory also touches on mass communication through globalization and the use of social media to spread ideas, making it vital in consideration to how social media facilitates adolescent development (Bandura, 2001b). As phone ownership and social media user rates increase, it is important to consider how it impacts the information adolescents are receiving and how this form of information consumption affects adolescent development.

Another important theory that needs to be explored concerns identity development. Erik Erikson's theory of psychosocial development explores identity exploration and choice. He posed that individuals achieve a sense of identity by experiencing conflicts that require the individual to to resolve crises in order to gain a

better understanding of how they view their self and their role in society. The individual must explore different identity roles in order to decide which role they will step into as an adult (Erikson, 1968; Hansen & Jessop, 2017) James Marcia further developed this theory by coming up with different identity statuses that individuals can achieve. These statuses include achieved, diffused, foreclosed, and moratorium. An achieved identity status means that the individual has chosen an identity and experienced a crisis that reaffirms their choice in identity as the correct one for them. Diffused status is when the individual has not experienced a crisis and has not chosen an identity and is not really exploring different roles they could potentially fulfill. Foreclosed status is when the individual has not yet experienced a crisis but has committed to an identity. This is typically an identity that they did not choose for themselves, but was chosen for them by their parents. Finally, moratorium status involves an individual that has not been through a crisis and has not made an identity commitment, but it actively exploring identity roles they could fulfill (Marcia, 1966). Identity choice is important in regard to development of self-regulation and executive functioning as whatever identity role the adolescent chooses helps to guide the goals and plans the individual creates for their self. This will be further explained in the following section, breaking down the importance within both the development of self-regulation and executive functioning.

SELF-REGULATION AND EXECUTIVE FUNCTIONING

During adolescence, children's brains are developing new ideas and ways of operating. These developments include self-regulation and executive functioning. These two processes are important to how the child will think and respond to events in the future, as they allow for higher level thinking to occur, handling of emotions, planning

for their future and consideration of how their current actions will impact it (Dishion, 2016). This section serves to define the listed areas of development, how they are impacted by social media will be further discussed in the next chapter.

Self-Regulation

As simple as it sounds, self-regulation has to do with the development of regulatory habits during adolescence that are driven by the self. Self-regulation allows adolescents to develop long-term goals, prioritize and obtain them, and allows for self-development (Gertsdottir, Geldhof, Lerner, & Lerner, 2017). Development of self-regulation is experience driven and the individual must be able to assimilate the new information within the knowledge they already have and coordinate this new information to their thoughts, emotions, and actions (Singer & Bashir, 1999). Puberty gives the individual an opportunity to learn self-regulatory capacities, in order to prepare for functioning in an adult society later on. Adolescence is the golden age of regulatory development due to the amount of neurological growth that occurs during this time.

According to Singer and Bashir (1999) there are three subprocesses involved in self-regulation. These include the ability to observe or monitor the self, make judgements or evaluations of the self, and adjust the behavior in order to better accomplish goals. Self observation includes the individual's ability to identify what task it is that they are doing. Self evaluation includes the individual's ability to judge whether or not they are on task. Adjusting behavior occurs when the individual changes what they are doing so that they are on task if they have recognized during self observation that they are not doing what they should be doing (Singer & Bashir, 1999). Self-monitoring and self-modification are also illustrated as important parts of self-regulation by Gestsdottir and Lerner (2008)

They aid in decision making, action planning and regulation of actions in order to obtain long-term goals (Gestsdottir & Lerner, 2008).These can be easily seen when a student is completing a task. For example, when a student is assigned a paper they must prepare for it by gathering information and planning how the paper will be written, staying on task while writing the paper, and in the editing process when they go back and make changes to improve their paper.

Regulatory habits are also developed through the process of self-determination. As mentioned in the theories section, self-determination theory includes meeting three psychological needs that are autonomy, competence, and relatedness. The internalization of these components allows individuals to develop regulatory habits, as they directly impact the reason an individual does something (Deci & Ryan, 2000). When self-determination is developed in an optimal setting, individuals will recognize and identify with important social regulations, assimilating them into their own idea of what is acceptable behavior and accept them as their own. When this is done, individuals begin to regulate their actions and behaviors in order to better fit into society. They perceive it as their own motivation to do so, making it self determined and more likely that the individual will continue to take part in those actions and behaviors. If self-determination is not developed properly, then individuals will not assimilate the information as their own motivation and will not fully develop these regulatory habits, causing them to rely on outside pressure to motivate and regulate them (Deci & Ryan, 2000). This process occurs optimally when the individual has met the three psychological goals of self-determination theory. When the individual feels a sense of relatedness from socializing with others, competence with the regulatory behaviors that are being developed, and feels

support in their autonomy. These led to the development of intrinsic motivation and the internalization of extrinsic motivation, or self-regulations, and allow the individual to begin to regulate their actions and behaviors on their own. It has been found that having active involvement of parents and teachers, socialization with peers, and support for autonomy leads to the adoption of these motivations and, therefore, to the development of self-regulation (Deci & Ryan, 2000). For example, rather than telling a teenager that it is important to eat healthy and be active, parents and different health teachers could outline the benefits of living a healthy and active life style, while friends who play sports and are active will cause the adolescent to want to participate in those activities. If the adolescent receives support for taking part in activities that lead to a healthier life style, it will allow the individual to internalize the idea that it is important to continue that lifestyle and feel as if they came to decision to do so themself as they took part in the decision process and saw the benefits of doing so themselves.

The development of self-regulation parallels cognitive development that involves prefrontal cortical maturation and temporal organization dealing with speech, behavior, and cognition, or higher-order thought processes. Without this parallel ontogeny, individuals would not develop inhibitory responses tied into regulation, as this reorganization of the temporal lobe allows for the growth of neurons involved in inhibition of actions that play a role in the delay of gratification and staying on task (Larsen & Luna, 2018; Siegel, 2013). During adolescence, there is a process known as self-regulated learning, that emphasizes the individual's ability to develop regulatory behaviors. Self-regulated learning allows individuals to develop self-directive processes and self-beliefs that serve as motivation to the individual. This enables learners to

transform their mental abilities into academic performance, such as converting language and verbal understanding into writing (Zimmerman, 2008). Both self-regulated learning and self-determination theory emphasize the importance of motivation to drive self-directive processes, showing the importance of developing self-regulatory habits during adolescence so that individuals are able to do so and act as the originators of their own actions. In doing so and being successful in their actions, it reinforces the development of the regulatory behaviors and continues to further promote the development of said behaviors. To expand on the previous example, as adolescents begin to live a healthier life style and see improvements in their physical health and mood, they learn to reinforce those activities themself and self-motivate to take part in them.

With the development of self-regulation comes the ability to withstand temptations and stay on task, overcome obstacles and think outside of the box to address problems, and delay gratification so that the individual can see the work to the end and reap the full benefits (Fitzsimmons & Finkel, 2011). Through the development of these regulatory behaviors, adolescents begin to prepare for the responsibility of adulthood. For the sake of this paper, self-regulation will be briefly defined as the ability to self-monitor actions, change those actions as necessary to reach the defined goal, and stay engaged in completing them. As previously mentioned, self-regulation is experience driven, specifically driven by interactions with peers and their actions and behaviors. It is fully reliant on those interactions with peers, the environment, and the individual's own behavior, making it vital for adolescents to be engaged in their environment and face-to-face interactions with their peers in order for this process to develop properly (Singer & Bashir, 1999).

The development of identity is also important to development of self-regulation so that the individual has a sense of self. Identity is important in relation to the development of self-regulation as this is what defines their goals and leads to regulatory behavior in order to achieve them. Without choosing an identity role that the adolescent wants to fulfill, they have nowhere to point their goals and nothing to motivate themself toward. As adolescents begin to choose what they want to major in and what they want to do upon entering adulthood, they begin to outline future plans. Having plans for the future is what drives the development of goals and having goals to reach drives the development of relegation so that the adolescent can begin to work towards their ideal future.

Executive Functioning

As adolescents develop, they face problems that require the ability to think about the future, how their actions will affect those around them, and what is best for the goals they wish to achieve. In order to do so, development of executive functioning must occur. Executive functioning is a broad area of cognition, having implications in memory, goal setting, and planning processes (Singer & Bashir, 1999). It's further broken down by emphasis on different aspects of it. It is defined by some as it's ability to develop and enact plans (Pennington & Ozonoff, 1996), as problem-solving skills (Hayes, Gifford, & Ruckstuhl, 1996), and as simply as inhibitory processes and with regard to it's importance in working memory (Denckla, 1998). Miyake and Friedman (2012) defined it as the "general-purpose control mechanisms, often linked to the pre-frontal cortex of the brain, that regulate the dynamics of human cognition and action" (p. 8). It has been outlined as the decision-making and planning process of a task, it has been discussed in

terms of how it is involved with working memory and inhibition, and it has been characterized as defining a problem at hand (Singer & Bashir, 1999).

For the context of this paper, executive functioning will be discussed in regard to planning, problem-solving, attention, and decision-making. It is fundamental to setting goals and how individuals will attain their goals. Executive functioning is most easily seen when it is used to decide what the individual wants to do, how they will do it, and holding those plans in working memory (Hur & Gupta, 2013; Shanmugan & Satterthwaite, 2016; Singer & Bashir, 1999). This can be seen as adolescents begin to plan for the future by deciding what they want to major in at college, what college they will be going to, and where they would like to live and work at in the future.

Executive functioning serves as the primary problem-solving area. It is responsible for holding future plans in working memory and creating those plans as they pertain to the problem. Whether it be in a novel and nonautomatic task or as part of a prepotent, competitive response, executive functioning is seen through its ability to address and solve problems (Hayes et al., 1996; Pennington & Ozonoff, 1996). This cognitive ability is used at the outset of a problem, being employed by the adolescent brain to stop and analyze the issue rather than pursue action without forethought (Singer & Bashir, 1999). In stopping to analyze the problem, the adolescent must be aware of their goals. When solving problems, it is vital to have future goals in mind as these actions are helpful in determining the plan in order to attain their goals. This employs the use of executive functioning in reflection of one's goals, planning and organizing in order to address the problem, and inhibiting actions that will not aid in the fulfillment of their goals (Singer & Bashir, 1999).

Throughout the development of executive functioning, the adolescent brain integrates experiences and memories while the maturation of neurons occurs, and they undertake a dynamic learning process. This allows adolescents to establish hypothetical-deductive reasoning which allows for the individual to make deductions based on hypotheses they have about their environment. Such cognition allows for the development of problem-solving skills, the ability to think about the future and the impact their actions will have on it, and improve attention and working memory (Hur & Gupta, 2013). Development of executive functioning is linked to the prefrontal cortex of the brain, the area that regulates cognition and action. Within executive functioning, there are three sub-domains that include inhibitory control, working memory, attention shifting (Miyake & Friedman, 2012). Working within the prefrontal cortex, the development of these aspects aids in higher-order cognitive abilities and stimuli response. These are all vital aspects of adolescent development that are necessary for adulthood and preparing for the roles and responsibilities that comes with it.

As seen throughout both sections, there is obvious overlap in the areas of self-regulation and executive functioning. Inhibitory processes are seen as part of goal setting and achievement of goals, which is also underscored as an important feature of both cognitive developments. Both areas allow for adolescents to integrate inhibition of stimuli, planning, organizing, and goal setting as vital parts of their cognitive domain. The close overlap of functions illustrates their proximity in development and further emphasizes the importance of the cognitive domains. This displays the bidirectional influence they have on each other due to their close relation in function. As they are both used in these functions, the development of one aids in the development of the other.

When developing regulatory behaviors in order to reach goals, it requires that the adolescent begins to plan for the future and make decisions in order to reach those goals. Without having a plan for the future, the adolescent cannot fully develop goals which aid in the development of regulatory habits in order to achieve said goals. Further illustrating the bidirectional influence of the development of self-regulation and executive functioning.

Executive functioning also plays a role in the development of identity. As adolescents try and chose their identity, they must take steps in planning for their future in that identity. Not only that, but they must now inhibit actions that do not fit the identity that they are trying or have chosen. They are faced with the problem of figuring out which identity they wish to step into and how they decide that directly relies on executive functioning. These developmental aspects are all important individually, but also tend to play a role in the other aspects. This makes the full and correct development of them vital to how an individual will be in the future, who they will become, and what they do.

V. IMPACT OF SOCIAL MEDIA

SELF-REGULATION

Adolescents today receive instant gratification in many aspects of their life, but social media plays a huge role in this. If they want to decide whether or not to cut or dye their hair, they can message their friends about it or put up a poll on any number of social media sites. If they are feeling down, they can write a post on almost any social media site and get a response. Social media has paved the way for instant gratification to take place much easier than before, hindering the development of self-regulation in adolescents.

The American Academy of Pediatrics recommends limiting media time to no more than two hours a day for children ages 6-18. This is to ensure that children and adolescents are exercising and being active in order to reduce obesity rates (Committee on Nutrition, 2003). However, it also can be applied to the development of self regulation. Two studies were done looking at the influence of limiting screen time with adolescents. Both found that setting rules on amount of screen time allowed per day, along with effectively communicating those rules between the parent and child, is the most effective way to cut down on too much time spent on media (Carlson, Fulton, Lee, Foley, Heitzler, and Huhman, 2010; Ramirez, Norman, Rosenberg, Kerr, Saelens, Durant, and Sallis, 2011). By implementing screen time rules and clearly communicating them, adolescents begin to develop self-regulatory habits as both studies found that the presence of rules and proper communication of and agreement on them leads to adolescents following said rules better (Carlson et al., 2010; Ramirez et al., 2011). It is incredibly important to set screen time limits so that there are regulatory boundaries set up which the adolescent will begin to self-implement displaying proper development of self-regulation.

In a study conducted by Stanford psychologists, the amount of time spent on media, in face-to-face communication, and media multitasking were measured to better understand social well-being in adolescent girls. This study included an online survey where adolescent girls were asked about how much time they spent on different types of media and in face-to-face communication and how often they used other forms of media while already participating in one of the previously mentioned activities. For example, if they said they spent time on one form of media, there was a follow up question asking

how often they used the other forms of media while using the initial one (Pea, Nass, Meheula, Rance, Kumar, Bamford, … Zhou, 2012). This was done to measure the amount of media multitasking they participated in and they were also asked how often they used media while already participating in face-to-face communication. They were then asked questions about their social well-being, specifically in regard to whether they felt they had social success, feelings of normalcy, and if they had friends that their parents perceived as bad influences (Pea et al., 2012). The results of this study found that increased time spent on media and media multitasking had a negative correlation with social well-being, that adolescent girls felt less successful sociallly, did not feel normal, and had more friends that their parents perceived as bad influences. Face-to-face communication was found to be associated with more positive social feelings and girls that participated in more face-to-face communication were less likely to multitask with media while communicating with others (Pea et al., 2012). These results could be perceived as the girls who participated in more face-to-face communication as having more developed regulatory behaviors and, therefore, better able to focus on a single task, such as communicating with someone.

EXECUTIVE FUNCTION

Executive functioning is vital to adolescent development as it directly impacts their cognitive abilities that are necessary for adulthood. There are many consequences associated with deficits in development of executive functioning. Not only does it impact academic achievements, which is easy to assume, but it impacts self-esteem, social skills, and behavior. There is found to be lower self-esteem in individuals who do not fully develop executive functioning, which in turn leads to social isolation. The

underdevelopment of executive functioning also leads to increased risk-taking behaviors as the individual does not fully think through their actions, causing them to take more risks as they do not fully think about the results and/or consequences of their actions (Shanmugan & Satterthwaite, 2016).

In the previously mentioned study conducted by Pea et al. (2012), the results can also be applied to development of executive functioning. The girls who spent more time in face-to-face communication were less likely to spend time media multitasking and be better able to focus on the task at hand. This could have to do with development of attention, a core feature of executive functioning. However, this study only measured the correlation between media use, face-to-face communication, and media multitasking and adolescent girls social well-being. Further studies would need to be conducted in order to better understand the causation of these developmental tasks that I am proposing are affected by media use and media multitasking.

In a study done by Murphy, McLauchlan, and Lee (2017) looking at inhibitory control processes of response inhibition and filtering, they compared light media-multitaskers, average media-multitaskers, and heavy media-multitaskers to see if there was any impact of media-multitasking on the development of inhibitory control which is an aspect of executive functioning. They defined media-multitasking as "simultaneous use of two or more media types or constant, fast swapping between media types" (Murphy et al. 2017, p. 667). They used a flanker task, which is an experiment where the individual has to respond to relevant stimuli that is presented with irrelevant stimuli flanking it, and go/no-go task, in which an individual is either supposed to "go" and respond to relevant stimuli or "not go" and not respond to irrelevant stimuli, in order to

compare response times and accuracy and compare distractor congruency effects. Distractor congruency effects are the measurements of a distractor's effect in similar or dissimilar conditions.Their results suggest that there may be a link between media-multitasking and inhibitory executive functioning as there was no significant difference between light and heavy media-multitaskers on the two tasks (Murphy et al., 2017). Average media-multitaskers were found to perform more poorly than light and heavy media-multitaskers on the go/no-go task which may have been due to average inhibitory control skills and working memory capacity (Murphy et al., 2017). The results of this study imply that heavy media-multitaskers may be able to improve their inhibitory control processes through simultaneous use of or rapid switching of media, suggesting that increased media use in adolescence could aid in the development of executive functioning.

Ophir, Nass, and Wagner conducted a study in 2009 comparing the cognitive control differences in individuals who were considered light media multitaskers and heavy media multitaskers. After identifying individuals as either light or heavy media multitaskers they had them complete various tasks measuring filtering of information in working memory and task switching, it was found that heavy multimedia users tended to have delayed responses in the tasks showcasing the extra cognitive control they required to complete the tasks (Ophir, Nass, & Wagner, 2009). Heavy media multitaskers have a harder time filtering out irrelevant stimuli from their environment, filtering irrelevant information in their working memory, and are less effective at enacting response inhibition in task switching. This implies that heavy media multitaskers have more difficulty in filtering out irrelevant information and staying on task, potentially due to the

distraction of multiple streams of media in their day to day life and not fully developing response inhibition and filtering which are core aspects of executive functioning (Ophir et al., 2009). Based on this research, it can be concluded that increased use of media and constant multitasking, the consumption of different forms of media at once or the rapid switching between media, are not being fully developed in those individuals. The lack of development in these areas and the effect it has on executive functioning directly impacts other aspects of the individual's life as they are employed in day-to-day tasks.

VI. BIDIRECTIONAL INFLUENCE

As seen throughout the previous sections, development of self-regulation and executive functioning go hand-in-hand as they are so closely related. The development of one impacts the development of the other, displaying the bidirectional influence they have on each other. A bidirectional influence is one in which both parts impact each other, so as executive functioning develops it impacts the development of self-regulation, and as self-regulation develops it impacts the development of executive functioning. As as those areas are not developed, it appears that adolescents spend more time on social media.

With increased social media use comes less time spent in face-to-face communication and in the adolescent's environment, which is necessary for the proper development of self-regulation and executive functioning. Adolescents need to be interacting with their environment and those around them to develop correct social cues and understanding of how to communicate and interact with people. Involvement with their environment also allows for healthy development as this is what drives the neurobiology of puberty and allows for accommodation and assimilation of new

knowledge. Thereby show casing the bidirectional influence of social media on adolescent development. As adolescents grow up, they begin to have access to social media. With access to social media comes more time spent online rather than in their environment. With less time spent in their environment and interacting with others, there is less opportunity for self-regulation and executive functioning to develop. As these cognitive processes are not fully developed, adolescents lack the regulatory and attentive needs to limit the amount of time they spend on social media sites. As these cognitive processes and behaviors are not present, they spend more time on social media, creating a circular process that impacts the adolescent's development of necessary aspects for proper functioning in the adult world.

This brings in the question of nature versus nurture and how do we ensure the development of these vital cognitive processes throughout adolescence? Individuals can naturally have a better inclination towards activities that will allow for the development of these aspects, but what about those who do not? We should encourage participation in activities and behaviors that aid in development of these areas. However, there is not one right answer. It is not a debate of nature versus nurture, but how nature and nurture interact with each other during this developmental period. Within this context, there needs to be an understanding that both nature and nurture impact the adolescent. As adolescents are going through this time, they are gaining autonomy and the choice of what they want to do. As they realize this, they still need structure in order to aid in development. This structure can be loose and still allow adolescents to have the opportunity to make their own decisions about their future, but should be there so that healthy development of these cognitive process is occurring. With this understanding

comes a vast amount of options that can be taken into consideration when trying to ensure healthy development of self-regulation and executive functioning.

VII. CONCLUSION

Adolescence is a vital time in an individual's development. Not only is the individual going through physical changes, but they go through vast amounts of psychological changes as well. With consideration to the different developmental theories discussed, it is obvious that the individual needs to be engaged in their environment and interacting with those around them so that they are properly developing. Within the context of psychological development, the necessity for healthy development of self-regulation and executive functioning is vital. These cognitive processes allow for planning for the future, goal making, staying on task, and regulation of behaviors and actions.

With the rise of social media and adolescents being the driving force in increased use of it, it is vital to understand how the newest form of media impacts development. As discussed in the previous section, we can see that with increased social media use comes decreased adolescent development of cognitive processes, looking at self-regulation and executive functioning specifically. With decreased development of these processes comes increased time spent on social media. This creates a cycle of social media use and impaired development of self-regulation and executive functioning.

Self-regulation and executive functioning have been identified as vital aspects of psychological development that takes places during adolescence. These processes allow for individuals to better plan for, interact with, and understand the real world leading to better actions and behaviors on their part. Not only that, but these cognitive processes

play a vital role in the individual's life as well. Without regulatory behaviors and executive functioning, the individual cannot properly plan for their future and reach their goals. Adolescence is the time in the individual's life where they are having to make decisions regarding their future, for example what college they should attend, what they should major in, or if they should go to trade school instead of college. The adolescent needs to have healthy development so they can make the right choices for themself regarding their future and what they want to do. As a society we owe it to those we are raising to do what we can to help them we successful and ensure a better future for generations to come. Encouraging socialization and engagement in the environment throughout adolescence allows us to aid in the development of adolescent brains, impacting not only their future, but the future of our society as well.

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