EXPLORING COGNITIVE CONTROL PROCESSES OF YOUNG ADULTS IN MULTITASKING ACTIVITIES: A SCIENTIFIC PERSPECTIVE

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Abstract: Doing multiple activities at the same time is something that most people are familiar with. Therefore, the cognitive control process is an important cognitive mechanism in regulating and controlling human mental activity. This process involves the ability to process information, allocate cognitive resources, control attention, and make decisions. This research is a cognitive science study conducted through a simulation involving three young adults at a university in Bandung as participants. Each participant followed a structured simulation with the same rules. In an effort to collect data, the researcher collected data using a journaling method with self-report technique. This study aims to analyze the picture that occurs from the cognitive process in response to young adults multitasking activities. The cognitive control process has benefits to help individuals in doing several tasks at the same time so that it will save time and make activities run more effectively. Based on the results of this study, it was found that almost all young adults described complicated cognitive processes in multitasking activities and had difficulty completing the activity objectives to the fullest. However, through cognitive control, it was found that two subjects were finally able to complete the task by choosing one of the activities that should be done quickly and accurately in their thought process..

Keywords: Cognitive control in scientific perspective, multitasking, young adults.

INTRODUCTION

The process of cognitive control plays a central role for a variety of complex daily life activities and influences individual development. Cognitive control refers to an individual's ability to regulate, supervise, and control their cognitive processes in an effort to achieve certain goals. In humans there are two pathways for processing emotional stimuli, namely the subcortical pathway (automatic) which is related to intuitive and reflective impressions and the cortical pathway (slower) which is related to the interpretation of information. Meanwhile,

cognitive processes occur in the subcortical pathway in the brain (DeLisi, 2018). Collectively, the process of cognitive control is known through five things, namely: (1) controlling which stimuli and actions will be retained in the Working Memory (WM), (2) operating or manipulating information in the WM, (3) monitoring the context for changes in task requirements, (4) organizing or rearranging the contents of the WM, and (5) switching attention or reconfiguring perceptual along with response bias as the context changes (Wager et al., 2004).

When a person engages in complex cognitive activities, functional interactions and integration occur across different areas of the brain (Caudle et al., 2023). Cognitive control includes a collection of processes involved in generating and maintaining appropriate task goals and suppressing irrelevant task goals. In its development as a field of science, cognitive control is a core concept in modern neuroscience derived from the cognitive revolution in the 1950s and 1960s. Theorizing about cognition is to require us explicitly to model the mechanisms that link environmental stimuli with specific responses and the tacit processes that govern these mechanisms (Gratton et al., 2018; Mackie et al., 2013; Schroder et al., 2014). As a core component of cognitive control, a person must have the ability to organize their thoughts and actions to conform to internally represented behavioral goals (Braver, 2012). In life, we find that each individual will receive a stimulus that enters him until it is processed in their cognitive. After going through the process in cognitive, a person can then decide something he will do related to the stimulus he received.

Living in the era of the industrial revolution 5.0, days with the presence of information technology is something that cannot be avoided and has an impact on changes in the lives of Indonesian people in all aspects (Azis, 2019). This condition often requires a person to be able to do many jobs simultaneously and is a challenge for human cognition. Especially for adults, many phenomena from cognitive and social psychology are considered to depend on automatic processes (Veen et al., 2006) and require consistent cognitive control abilities (Luna et al., 2015). In reality, technology always develops from time to time. This development starts from simple processes in everyday life to the level of fulfilling individual self-satisfaction and the social environment. The peak of very rapid technological progress began in the 2000 era, this was marked by the presence of information and telecommunications technology which eventually became a trend in the lives of every individual (Danuri, 2019). Of all the incoming stimuli, in fact the control mechanisms – in the brain – that a person uses to regulate task performance can be separated into evaluative and executive components (Veen et al., 2006).

The adult generation has had so many experiences, while the younger generation has various ideas about the future. The digital era has provided opportunities and disasters when individuals are not ready for change (Azis, 2019). Among the changes that occur, individuals are required to have creativity and qualified abilities so that they can act quickly and effectively in various activities. Multitasking ability is one of the important abilities to have so that it can compete in an increasingly sophisticated world.

Spink et al. (2008) explains multitasking as the human ability to handle more than one task at the same time. In addition, it can also be defined by the ability to switch quickly from one task to the next in a rapid sequence of tasks. Waller (in Spink et al., 2008) states that multitasking at the individual level involves the allocation of his or her limited cognitive resources and resources among multiple tasks as well as the moderating impact of task elements, task processes, and task resources on an individual's multiple task performance.

Every day, multitasking using electronic devices is a common practice among all age groups, but the younger generation is the group that does it the most, especially in the form of dual task/media multitasking. In a study conducted by Carrier et al. (2015) entitled "Causes, effects, and practicalities of everyday multitasking" mentioned that learners are the most common group to multitask while studying. This is based on external factors (such as alerts from their smartphones) and internal factors (such as thoughts about future online activities) that influence the prevalence of multitasking. Research conducted in the laboratory shows that there are some differences in the practice of multitasking in the real world. Theoretically, multitasking in everyday life should be able to accomplish some information processing. However, empirical research shows that learning is most likely to be negatively affected by multitasking in conjunction with technology.

Among the multitasking activities discussed in this article are reading a book while writing, listening to music and eating crackers at the same time. These activities are multitasking activities that involve visual and auditory attention and include physical and mental activities. Reading is one of the important things that requires ability. Rahim (in Muammar, 2016) revealed that the ability to read is something that is vital, because every aspect of life must involve reading activities. Because of the importance of reading, several studies and even simulations have been conducted to increase a person's interest and ability to read, starting from early childhood to adulthood. This is also the case with problems related to low interest in reading in individuals in adolescence to adulthood (Witanto, 2018).

Reading is an activity that involves physical and mental activities simultaneously (Purwandari et al., 2021). In this context, reading is a physical activity that requires visual attention. One of the physical activities performed is when the reader moves the eyes along the lines of writing contained in a reading text. In addition, the mental activity of reading can be understood as the process of understanding the text to the fullest. Therefore, reading is not just an activity of moving the eyeballs, but also includes thinking activities to understand a reading.

Similar to reading, writing also requires physical activity that requires visual attention. Writing is even mentioned as one of the skills that must be (Widodo et al., 2020). When reading is understood as a physical activity that includes mental effort to understand the text, writing also includes mental activity. But in an effort to pour ideas into written form through a series of words which are then presented as a whole, complete and clear. So that in the end it will be able to convey to the reader what the idea of thought clearly (Praptanti et al., 2017).

Likewise, listening to music and eating crackers will affect individual auditory abilities, because the sounds produced will be a stimulus to the cognitive process and mental activity of the individual. Wagemans (2004) reveals that auditory attention to the system requires a process that allows the listener to pay attention to a certain set of sounds without being confused by the overlap of other irrelevant sounds. Slightly different from visual attention, although we do not look simultaneously at everything that surrounds us, we can certainly see more than one thing at a time.

Doing different activities at one time will eventually force individuals to choose one of the activities to be given maximum attention, this is as explained by Ophir et al. (2009) and Wagemans (2004) which is in line with the application of selective attention, namely when individuals choose to pay attention to some stimuli and let other stimuli. This happens when the two activities carried out simultaneously are two activities that have similar modalities in the form of verbal activities.

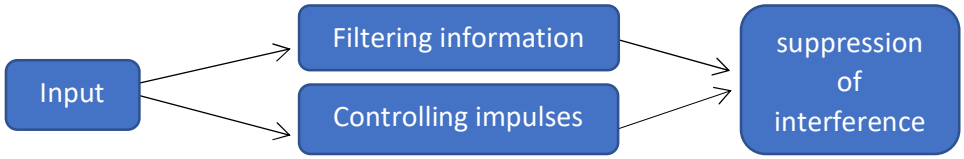

Figure 1. The process of cognitive control occurs through information filtering and impulse control after the entry of the stimulus, after which the new suppression of distractions so that individuals will remain focused (Braisby & Gellatly, 2012).

This explanation is also discussed by Wagemans (2004) in the discussion of divided attention, namely attention given to two tasks simultaneously. According to Treisman and Davices (1973) and Wickens (1984, 2008) in (Eysenck, 2020; Groome et al., 2021; Spink et al., 2008) if there are two stimuli or tasks that have the same sense modality, then one of the tasks is compromised. Conversely, if the two tasks rely on different sense modalities, processing components and sources, then both tasks will be successfully performed.

The activities discussed above certainly cannot be separated from the process of cognitive control in achieving certain goals. This process involves selecting, monitoring, and regulating the cognitive resources needed to complete the task efficiently. In the context of education and learning, cognitive control becomes an important factor in evaluating young adults' ability to cope with complex academic demands. One situation that often requires effective cognitive control is when individuals engage in multitasking activities, such as reading a book while writing, listening to music and eating crackers at the same time.

One of the most important abilities that humans must possess is the capacity to allocate mental resources flexibly and goal-directed. This - through cognitive control abilities - will enable a person to prepare to respond to something he is about to do (Mackie et al., 2013; Munakata et al., 2012; Ophir et al., 2009). Baddeley (in Wager et al., 2004) argues about working memory (WM) which is explained as relevant mental representations maintained in an active state. Multitasking is one of the important theoretical and practical phenomena for cognitive and information science, especially for theories and models of information behavior. There is no doubt that multitasking is an essential human behavior.

There are several studies that examine multitasking. Cognitive scientists have studied many aspects of multitasking for decades. Buser & Peter (2012) mentioned that the increasing complexity of the global information environment means that people will increasingly engage in multitasking behavior. However, many interactive technologies are still unable to provide effective support for managing multitasking behavior. Research Buser & Peter (2012) examines multitasking from the aspect of how multitasking can affect a person's performance, namely whether individuals can perform more optimally or vice versa. The results of this study show that in multitasking activities carried out - either by men or women - there is no difference in the quality of performance of both. Women and men suffer equally when forced to perform multiple tasks simultaneously. Furthermore, not only to understand how multitasking activities affect the effectiveness of a person's performance, furthermore is about the description of the cognitive control process that occurs in multitasking activities, so that systematic and comprehensive research is needed. In this article, the

authors aim to describe and analyze the description of cognitive control processes that occur in some young adults in multitasking activities and explore the strategies used by students in coping with this complex task.

METHOD

This type of interpretative qualitative research is used to capture data in an effort to get a clearer picture of the description of the cognitive control process in individuals who are studying at the universities in the city of Bandung in multitasking activities. Furthermore, this article also uses a research approach with the true simulational design method through simulation. This research is referred to as a true simulation because of the research design that includes the researcher as a controller of all external variables that affect the course of the simulations (Lubis, n.d.).

Experiments in this study were conducted through simulations. Each participant follows a structured simulation with the same rules. In an effort to collect data, researchers collected data using the journaling method with self-report techniques. This means that the subjects as participants directly write themselves about their experience of the simulation they have participated in with details.

This article takes three selected samples of young adults at one of the universities in Bandung as research objects. The subjects consist of two women aged 24 and 27 years old and one man aged 26 years old. The three subjects are young adults studying at the postgraduate level who are in their second semester.

In this study, the selected sample will be the subject of the simulation to obtain an overview of the cognitive control process of young adults. Each sample is given the same rule in the activity being simulated. Simulation activities were carried out four times by including favorite books with memorable songs in the first simulation, including favorite books with disliked songs in the second simulation, including scientific texts/articles with memorable songs in the third simulation, and including scientific texts/articles with disliked songs in the fourth simulation. However, in this article, we only focus on the simulation results of the multitasking activities performed by the subjects in terms of reading while writing and reading while eating crackers.

The following are the rules of the simulations followed by the sample and the focus of the research:

a. The first simulation (the first 3 minutes focus on reading a favorite book; the next 3 minutes are reading a book while recording the essence of the book and listening to a memorable song; and the last 3 minutes are reading a book while eating chips and listening to a memorable song).

b. The third simulation (the first 3 minutes focus on reading scientific texts/articles; the next 3 minutes are reading scientific texts while recording the essence and listening to memorable songs; and the last 3 minutes are reading scientific texts while eating chips and listening to memorable songs).

RESULTS AND DISCUSSION

The results of simulations that have been conducted from three young adults at one of the universities in Bandung city show the diversity of cognitive control activities that occur. Although given the same rule (the first 3 minutes focus on reading favorite and scientific books; the next 3 minutes is reading a book while recording the essence of the reading; and the last 3 minutes is reading a book while eating chips) in the simulational rules, simulations conducted four times to three different subjects still show differences in the cognitive control process of each subject.

Table 1. An overview of the simulation results of the first subject in the first simulation

The first subject is a 24-year-old young adult (female)				
Reading your favorite book + writing a summary				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a favorite book	His attention slowly and fully shifts to the writing process. When writing, he tries hard to organize his words	pronouncing the words he wants to write in his heart	pronouncing the words he wants to write in his heart
Memory	Remembering how the essence will be written because of remembering the UTS guideline			
Reading favorite book + eating crackers				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at favorite book - Opening a package of crackers - The sound of	when distracted by eating the snack, it was not the crunching sound of the snack that was distracting, but the process of picking up the	- Her reading comprehension was completely lost when she continued reading. - Having the thought "the	gave up on continuing to read

	the crackers	snack (because of the difficulty of the packaging).	important thing is that the essence has been written"

Table 2. An overview of the simulation results of the first subject in the third simulation

The first subject is a 24-year-old young adult (female)				
Reading scientific texts/articles + writing a digest of the readings				
	Stimulus Input	Reaction	Cognition Process	Cognitive control
Sensation Memory	- Listening to memorable music - Viewing a scientific article Unintentionally underline sentences because they are accustomed to learning and retaining the content of the reading passage	When the digest was written (as in the previous 2 simulations), he was still only able to focus on the writing process and could not continue reading.	gave up	only being able to write down a little digest of the reading.
Reading scientific texts/articles + eating crackers				
	Stimulus	Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a scientific article - The sound of the cracker snack	when the snack starts to be eaten, the focus is again lost and only focuses on the sound of the crunch. At that time, the student had started reading the introduction of the article	trying very hard to understand the first paragraph	could only understand 1 point without writing it down.

Table 3. An overview of the simulation results of the second subject in the first simulation

The second subject is a 27-year-old young adult (female)				
Reading your favorite book + writing a summary				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a favorite book	The subject recorded the essence of the reading while doing the first and second activities.	Focus on understanding the gist and then writing it down	The subject writes down 4 general points from each sentence written from the book so that the subject can write it down quickly.
Reading your favorite book + eating crackers				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a favorite book - Gum pain	The subject found it difficult due to the swollen condition of the subject's gums. This makes the subject unfocused in reading.	focusing so that the chips do not hit the swollen gums	The subject can only read a little from before

Table 4. An overview of the simulation results of the second subject in the third simulation

The second subject is a 27-year-old young adult (female)				
Reading scientific texts/articles + writing a digest of the reading				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Viewing scientific articles - Cat distraction - Rumbling sound	The subject can still write down the essence of the reading, it just becomes less	Continuing to write	the subject can still write down the essence of the reading, it just becomes less
Reading scientific texts/articles + eating crackers				

	Stimulus	Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at scientific articles - The sound of eating crackers	subject is not focused on the reading	Continuing to eat the crackers carefully	Did not focused on the reading

Table 5. An overview of the simulation results of the third subject in the first simulation

The third subject is a 26-year-old young adult (male)				
Reading your favorite book + writing a summary				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a favorite book - Ringing cell phone	- distracted by the lyrics of a memorable song, - distracted by the sound of a friend's cell phone	Trying to remember the essence of the reading to be written down	Not focused on reading or writing
Memory	Memorable song lyrics	- What the subject has read little by little forgets to be recalled and for what words to write		
Reading your favorite book + eating crackers				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at a favorite book - Many distracting noises - The sound of snacking on crackers	- lost concentration on reading - focus on the taste of the chips that stick to the tongue - savoring the chips slowly while appreciating	- focused on the taste of the chips that stuck to the tongue. - It occurred to the subject that if he eats the chips, he shouldn't	Reading activities are neglected

	- Enjoying the good taste of chips	every bite of the chips - concentration on reading is not so strong and there is no strong power to remember what is read - enjoyed the memorable music accompanied by the crunch of chips that entered the mouth	hurry up because it will be gone soon, - fun and enjoy enjoying the memorable music accompanied by the crunch of chips that enter the mouth.

Table 6. An overview of the simulation results of the third subject in the third simulation

The third subject is a 26-year-old young adult (male)				
Read scientific texts/articles + write a digest of the readings				
Stimulus Input		Reaction	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at scientific articles	- trying to repeat the reading and trying to dig the essence of the reading that the subject reads - prepare what the subject will write even though the subject knows not so much that the subject remembers. - although the subject does not know what the subject is reading about, occasionally	- trying to repeat the reading - trying to dig the essence of the reading that the subject reads	Recording the essence is more about recording what is written only

		the subject notes the English language and occasionally the subject also sees what the correct writing is like.		
Reading scientific texts/articles + eating crackers				
Stimulus		Reaksi	Cognition Process	Cognitive control
Sensation	- Listening to memorable music - Looking at scientific articles - The sound of snacking on crackers - Noticing less crackers	- subject's focus on the chips which the subject realized were less than before - immersed in the song - ignoring the reading	Subject thought that he did not know what he was reading because it was in English	Ignoring the reading

Cognitive control process is the ability of individuals to organize and control their thoughts, attention, and actions in order to achieve a particular goal. In the context of young adults at one of the universities in the city of Bandung who participated in multitasking simulations, the process of cognitive control in the activities of reading books while writing and reading books while eating crackers has involved several important aspects. One of the main aspects is related to reading comprehension. Before arriving at comprehension, subjects in the simulations first went through the main stages in the cognitive process which included input, perception, learning and memory stage, retrieval, and thinking (Groome et al., 2021).

Furthermore, the subject must use their cognitive control in processing information so as to obtain the essence of the book they read. This process involves the ability to identify and understand main ideas, draw connections between different concepts and then integrate relevant information with pre-existing knowledge. In this process, there are also three complex task-switching phases, namely: (1) The desire to switch tasks, (2) Switching tasks, and (3) Returning to the previous task (Buser et al., 2012).

When doing book reading activities along with writing, three subjects in the simulations showed how the cognitive process began to run as multitasking activities were carried out. It can be seen from the simulation results in the table

above that every time the subject receives a signal to switch tasks, the subject automatically has the desire to switch tasks and then switch tasks (from reading to writing, or from reading to eating crackers) and then return to the previous task with various forms of distraction that occur, especially when the subject has difficulty understanding the next activity command so that without thinking the subject turns to the previous activity and enjoys the work.

In addition, as revealed by Schweickert & Boggs, 1984, there are findings that doing more than one type of task can actually reduce productivity because of the limited human ability to perform mental operations simultaneously by the capacity of the central mechanism. The first subject as depicted in tables 1 and 2 shows that there is a decrease in activity productivity when one activity is performed simultaneously with another activity. According to the simulation results, the first subject did not succeed in writing down the essence of the reading when he performed reading and writing activities together. Likewise, when the activities carried out were reading and eating crackers, it also showed the same results so that the subject was only able to complete one of the activities. Not much different from the first subject, although the second and third subjects showed success in carrying out writing while reading activities as in tables 3 to 6, the level of success in the productivity of these activities was also minimal. This means that the activities carried out together at one time cannot be completed perfectly to achieve certain goals by the three subjects in the simulations.

The process of cognitive control in these simulations can help subjects in organizing and compiling information into a comprehensive understanding. Basically, there are two important cognitive control abilities, namely: (1) Filtering out distracting information and controlling impulsivity, and (2) Suppression of distractions. Filtering out distracting information is a process that requires sustained attention to process relevant information and ignore irrelevant information. On the other hand, impulsivity can be considered as a con(Gusril, 2021)sequence of strong impulses and is modulated by dispositional and situational variables (Checa et al., 2015).

As a form of description of the cognitive process experienced by three subjects in this simulation, we can understand that the subjects have experienced quite complex problems in their brain system. Various input stimuli then become distractions that affect cognitive subjects so that they have an impact on attitudes and decision making. Before conducting the simulations, the subject was first given simulation rules with an explanation of the conditions during the simulations and the tools needed during the simulations. Supposedly, all simulational activities can be predicted by the subject before conducting the simulations so that when the simulation takes place the subject can recognize problems and filter out negative stimuli as distractions in the implementation of

the simulations. When the simulations took place, the subject revealed an input stimulus that affected the subject's sensation or memory. Due to these conditions, the subject reacts to filter out the incoming stimulus to then leave certain activities that are in accordance with the goal. The subject was also seen to suppress the disturbance when in the end choosing to cut off the disturbance that occurred or instead enter to enjoy the disturbance of the activity. For example, when the third subject as depicted in table 6, the subject was distracted in reading when the distraction of eating crackers came, but the subject decided to suppress the activities that should be continued reading crackers, and continued to enjoy the crackers that had been eaten.

In addition, cognitive control also plays a role in maintaining focus and concentration during multitasking activities. Schroder et al. (2014) in this context explains that our abilities can change, mindsets will affect learning, achievement, and interpretation of performance. However, the neurocognitive mechanisms responsible for these effects remain unexplored. With cognitive control can help subjects in controlling destruction, maintaining their learning goals, and focusing their attention on the task they are working on. This is illustrated by the activities carried out by the second subject as described in tables 3 and 4, it can be seen from the table that the subject can complete the writing activities that are guided to do while reading favorite books and scientific articles. Subjects can focus their attention even though they are distracted by other activities that must be done simultaneously.

Overall, cognitive control plays a central role in young adults reading and writing activities. Through the effective use of cognitive control, subjects can understand the reading better and organize information in a more structured way, maintain focus and concentration, and improve the quality of writing through effective revision and editing processes (Wen et al., 2018). This process of cognitive control provides an important foundation for subjects to become more skillful and effective readers and writers.

CONCLUSION

Multitasking requires managing and activating complex cognitive control processes. To achieve the goal of effective multitasking, individuals need to divide their attention wisely between different tasks. If this ability can work well, then individuals will be able to become more productive and agile in every activity. On the other hand, multitasking ability, which requires the effectiveness of cognitive control, will make individuals feel disadvantaged when they cannot control cognitive control properly. So that in the end, the activities obtained will be inversely proportional to the expectations and goals of the activity. In addition, switching tasks smoothly is an important aspect in multitasking so that individuals

are able to set goals, plan time well, and monitor performance when switching between one activity to another.

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