

Research Paper

## Cognitive Flexibility and Meta-Cognition among Adolescents and Adults

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### ABSTRACT

Depression, anxiety and other mental health among youth concerns are found to be worsening in recent years due to several factors. In this scenario, having the ability to shift their perspective and adapt to new unexpected situations- cognitive flexibility - is essential to deal with daily life crisis. In this study we hypothesize that being aware of one's own thoughts will significantly contribute to cognitive flexibility. Thus, the study focuses on how meta-cognition contributes to fostering cognitive flexibility. A total of 143 adolescents and adults have completed the cognitive flexibility inventory and metacognition questionnaire – 30. t-test, correlation, and hierarchical regression were conducted to find the effect of age and metacognition on cognitive flexibility. From the result it was found that metacognition significantly contributed to cognitive flexibility. Age is also found to be a significant predictor. Enhancing one's metacognitive ability can significantly enhance cognitive flexibility among youth.

**Keywords:** *Mental Health, Cognitive Consciousness, Metacognition, Cognitive Flexibility*

Despite the consistent effort and attempt to improve mental health of adolescents and adults, it is still deteriorating according to some surveys (eg: Panchal et al., 2023; Anderson et al., 2024). Along with these reports, suicidal rate among adolescents and adults are also reported as high in recent years (WHO, 2025) This situation demands more research to find elements that can foster mental health among the group. Among this, Cognitive flexibility – a capacity to shift one's thought and behavioral pattern to adapt to an unexpected novel situation- has been studied extensively in recent years due to its significance in psychological functioning. It has emerged as a critical construct that contributes to adaptation, emotional processing and mental health outcomes. is important in understanding individual differences in learning, and successful functioning across academic, professional and social domains in an increasingly changing complex world (Ionescu, 2012).

As a higher order cognitive system, it has been found to be linked to problem solving (Drigas, A., & Karyotaki, M, 2019), resilience (Artawijaya, L.M et al., 2024), creativity (Qunlin Chen et al., 2014), and adapting to novel situations (Laureiro-Martínez et al., 2018;

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R. Spiro et al., 2019). Furthermore, cognitive flexibility is negatively associated with psychological symptoms (Rawya M. Al-Jabari et al., 2012), trauma related outcomes (Jessica A. Keith et al., 2015), irrational beliefs (B. Gündüz et al., 2013), emotion regulation strategies (Semra Kiye et al., 2024), psychological well-being (Dehghani et al., 2022), attachment style and childhood psychological experiences (Hasan Kütük et al., 2024). Considering this influence of cognitive flexibility on mental health outcomes, it is necessary to explore the constructs which can foster and enhance cognitive flexibility.

The term cognitive flexibility was formally introduced by Scott (1962) to describe the adaptive quality of cognitive system. It refers to the mental ability to switch between thinking and behavior when an unexpected situation arises and concurrently consider multiple perspectives (Diamond, 2013). According to the cognitive flexibility theory, the ability to switch the cognition depends on attentional processes and knowledge representation (Cañas, J, 2006). A higher level of attentional control is necessary to identify and evaluate the changes in the environment and thus to adapt to new behavior. Human behavior is influenced by knowledge acquired through learning from similar situations. However, this knowledge must be modified when the situation changes and should be reinterpreted for new task requirements.

Previous studies have complex multifaceted understanding about what facilitates cognitive flexibility. From a behavioral perspective, evidence shows that cognitive flexibility can be conditioned by simple incentives typically known to drive lower-level learning, such as stimulus- response associations (Braem & Egner, 2018; Egner & Siqu-Liu, 2024). Zeytinoglu et al. (2018) found that maternal support during the problem-solving process can foster cognitive flexibility among children. Additionally, it has been found that, in the childhood, the development of cognitive flexibility is underpinned by inhibitory control and memory (Doğru et al., 2023).

From a recent study, it was seen that metacognition, a higher order executive function, can have a significant effect on cognitive flexibility. While studying the effect of mindfulness on cognitive flexibility, Arora (2005) found that mindfulness is significantly associated with cognitive flexibility through attentional control, emotional regulation and meta-awareness while metacognition is significantly associated with attentional control (Sandved-Smith et al., 2021) and emotional regulation (Mansueto et al., 2022; Mansueto et al., 2024) which implies the awareness about one's own thought process can predict cognitive flexibility. Yet, the interplay of the factor is not explored much. Thus, the current study explores this relationship.

Metacognition is often described as thinking about thinking which implies how a person thinks about his own thinking, and problem-solving skills (Fleur et al., 2021). The definition also includes the ability to regulate the cognitive processes. Meta-cognition thought have two main components: metacognitive knowledge and metacognitive regulation (Fleur et al., 2021). The former is concerned with what individuals know about their own cognitive processes and the latter concerned with the process of planning, monitoring and evaluating one's own thinking and strategies. Currently no studies have been found to look at how metacognition is related to cognitive flexibility. This study considers metacognition as an important factor which can contribute the cognitive flexibility for two reasons. Firstly, metacognition is also a higher order executive function as cognitive flexibility. Secondly, to adapt to a new unexpected situation, one should be aware of their own thought processes and should be able to regulate the thoughts by inhibiting the automatic processing of the

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situation. Thus, this study hypothesizes that metacognition can significantly contribute to cognitive flexibility.

From Neuro-imaging studies, the factors that seem to be contributing to cognitive flexibility involves gray matter volume especially in the anterior insula and the functional connectivity between anterior insula and midcingulate cortex (Müller et al., 2014). Taking the neurodevelopmental perspective, the development of cognitive flexibility is closely linked to the maturation of prefrontal cortex (Klune, C.B et al., 2021) It is rapid throughout childhood and adolescents and peaks in adulthood (Lauren Kupis et al., 2021; Schwarze, S.A et al., 2024; Parr et al., 2024). This development is followed by a gradual, variable decline in later adulthood. This emphasizes the importance of age in understanding cognitive flexibility.

### *Objective*

- To see the difference in metacognition and cognitive flexibility among adolescents and adults
- To see the relationship between metacognition on cognitive flexibility

### *Hypothesis*

- **H1** There will be a significant difference in meta cognition and cognitive flexibility among adolescents and adults.
- **H2** metacognition will be correlated with cognitive flexibility.

## **METHODS**

### *Sample*

A total of 170 participants completed the cognitive flexibility scale and meta-cognition questionnaire-30. The sample size was determined by the estimate of G\* power. The sample included 86 adolescents aged between 13-19 years and 84 adults aged between 20-33 years.

### *Inclusion and*

- Anybody who turned to adolescents and adulthood has been included in the study.
- Only Indian citizen is included in the study
- Adolescents and adults between the ages of 13 to 35 are included in the study

### *Exclusion criteria*

- Individuals who did not give informed consent are excluded from the study.
- In the case of adolescents, parents did not consent to participate their children are excluded.

### *Research design*

A cross-sectional correlational design was used in this study. The relationships among metacognition, and cognitive flexibility were examined using correlation analysis, and hierarchical multiple regression was conducted to determine the predictive contribution of age and metacognition to cognitive flexibility.

### *Variables*

#### **Independent variable:**

- Age
- Metacognition

### Dependent variables:

- Cognitive flexibility

### Measures

*Cognitive flexibility inventory* (Dennis R. Dixon et al., 2007). This scale measures an individual's ability to change their thinking and adapt to new situations. It consists of 20 items that assess different aspects of cognitive flexibility, such “mention two three questions”. The items are rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The scale has demonstrated high internal consistency ( $\alpha=0.90 - 0.91$ ) and adequate test-retest reliability with correlations ranging from 0.72 to 0.85 over a 2–4-week interval (Dixon et al., 2007; Ponsoda et al., 2014).

*Metacognition questionnaire -30* (Adrian Wells & Sam Cartwright-Hatton, 2004). MCQ-30 is a short form of the metacognitive questionnaire which consists of 65 items. The scale identifies five dimensions of metacognitive aspects which are positive beliefs about worry, uncontrollability and danger, cognitive confidence, control of thought, and cognitive self-consciousness. In the current study, only cognitive consciousness factors of the scale are considered as other dimensions are more relevant in psychopathology. The score of cognitive consciousness subscale ranges from 6-24. The scale showed good – excellent internal consistency ( $\alpha=0.72-0.93$ ). The internal consistency for the subscale cognitive self-consciousness also found to be 0.56–0.83. The subscale also exhibited excellent test-retest reliability in Pearson re-test correlation ( $r=0.87$ ).

### Procedure

Purposive sampling method was used to draw the sample. The consent form was included in the questionnaire. For the adolescent participants, the consent form which must have to be signed by the parents also added to the form for adolescence. Questionnaires for cognitive flexibility and metacognition were added in the form along with demographic details.

### Statistical analysis

SPSS version 26 (cite) was used to perform various statistical analyses on the data collected. Descriptive statistics were computed to summarize the participants' scores on cognitive flexibility and meta cognition. Cognitive flexibility and meta cognition were checked for normality using Shapiro-Wilk test and found it to be normal. t-test was administered to find the age difference in cognitive flexibility and metacognition. The correlation between cognitive flexibility and metacognition was found using Person's product moment correlation.

## RESULTS

Descriptive statistics of variables have been presented in table.

**Table 1: mean and standard deviation of cognitive flexibility and cognitive consciousness subscale of meta-cognition among the participants**

	Mean	SD
Cognitive flexibility	91.94	11.65
Cognitive consciousness	15.78	3.48

From the table, participants have moderate level of cognitive flexibility ( $M=91.94$ ,  $SD=11.65$ ) and cognitive consciousness ( $M=15.78$ ,  $SD=3.48$ ).

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To determine the difference in cognitive flexibility and metacognition between adolescents and adults, t-test is employed.

**Table 2: standard deviation, mean difference, t value and significance of cognitive flexibility and cognitive consciousness among adolescents and adults.**

		N	Mean	SD	t	P
<b>Cognitive flexibility</b>	Adults	84	97.14	9.10	6.38	>0.001
	Adolescents	86	86.87	11.68		
<b>Cognitive Consciousness</b>	Adults	84	17.60	3.09	7.86	>0.001
	Adolescents	86	14.100	2.88		

*Df=141*

The results obtained from the t-test showed that adults have higher cognitive flexibility ( $t=6.38, p<0.001$ ). Similarly, significant differences were seen in cognitive consciousness dimensions of metacognition among adolescents and adults ( $t=7.86, p= >0.001$ ). Thus, the first hypothesis regarding the age difference in cognitive flexibility and cognitive consciousness is accepted.

Pearson correlation analysis was conducted to examine the correlation between cognitive flexibility and cognitive consciousness. The result is presented in table 3.

**Table 3: correlation between cognitive consciousness cognitive flexibility and its significance**

	Cognitive consciousness
<b>Cognitive flexibility</b>	<b>0.374**</b>

\*\*sig <0.001

Metacognition is found to have a moderate correlation with ‘cognitive consciousness’ dimension of metacognition ( $r=0.374, p<0.001$ ). This implies when cognitive consciousness increases, cognitive flexibility is also increasing. Thus, the second hypothesis stating about the correlation between cognitive flexibility and metacognition is accepted.

## DISCUSSION

The present study aimed at studying the effect of age and metacognition on cognitive flexibility. Study also looked at the interplay between cognitive flexibility and metacognition. Findings of the present study show that participants have a moderate level of cognitive flexibility and metacognition. Participants scored average in dimensions ‘cognitive consciousness’ which indicates most of the participants have the tendency to focus attention to the thought processes (Cartwright-Hatton & Wells, 1997).

It has been found that there is a significant difference in both cognitive flexibility and metacognition among adolescents and adults. Cognitive flexibility is a higher executive functioning which is controlled by prefrontal cortex (Fleming, S. M., 2010; Ke Tong et al., 2024). The structural development of this region throughout adolescence to adulthood explains the higher cognitive flexibility among adults than adolescents. It is also evident that adults in the cognitive consciousness factor of metacognition, which relate to the degree to which a person monitors ongoing thinking processes, scored higher than adolescents.

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Cognitive consciousness is also found to be correlated with cognitive flexibility. Cognitive consciousness dimension of metacognition assesses the extent to which one is aware of about own thoughts one is having which includes constant monitoring of thoughts. When an adverse unexpected situation arises, cognitive consciousness makes it possible to recognize that the current approach is not working and thus the need to change the current thought processes and behavioral pattern. This relationship can be explained by Dunlosky and Metcalfe (2008). They identified three facets of metacognition: metacognitive knowledge, metacognitive monitoring, and metacognitive control. Metacognitive knowledge is people's knowledge about their own thinking; metacognitive monitoring refers to ongoing evaluation of the thoughts in other words, cognitive consciousness; and metacognitive control refers to effective control over the thought process. Metacognitive control is typically the result of metacognitive monitoring. Because the shifting or changing strategy depends on accurate monitoring, cognitive consciousness will contribute to cognitive flexibility.

### CONCLUSION

The study revealed the significant association between cognitive consciousness and cognitive flexibility. Along with this age is also found to be a predicting factor of cognitive flexibility, where adult samples have higher cognitive flexibility than adolescents. The finding emphasizes the developmental and metacognitive aspects in adaptive thinking. Enhancing cognitive consciousness may represent a promising intervention target for improving flexibility among adolescents and adulthood.

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### **Conflict of Interest**

The author(s) declared no conflict of interest.

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