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CONSCIOUSNESS QUOTIENT AS A PREDICTOR OF EXECUTIVE FUNCTIONING

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The present paper is an empirical account of the relationship between conscious experience and executive functioning. Over the years, there has been a long debate but no common consensus on the functional aspect of consciousness has been arrived at. This may be due to lack of empirical studies in this direction. The present descriptive study on 200 adolescents examines the relationship between two executive functions (self-regulation and cognitive flexibility) and conscious experience, which were explored with the Consciousness Quotient inventory (CQI). The findings reveal a significant positive correlation between the consciousness quotient and the two executive functions. Through regression analysis, it has been shown that consciousness quotient is a predictor of both self-regulation and cognitive flexibility. Future prospects and educational implications in light of the results have been discussed.

KEYWORDS: Consciousness, Executive Functioning, Self-Regulation, Cognitive Flexibility

INTRODUCTION

The concept of consciousness is the most familiar yet most mysterious to the human beings (Gennaro, 2012) and it is the only mental phenomenon, which resists informative explanation so thoroughly (Rosenthal, 2002). Until a few decades back, only philosophers, psychologists and religious practitioners

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were boggling their minds in the field of consciousness. But lately scientists from neurosciences and cognitive sciences are exploring the field widely. The research in this field has gained momentum to the extent that Baars (1997) has declared it as the biggest and loudest phenomenon we can possibly study. Any attempts to clarify the concept of consciousness have been found to be in vain as no philosophical term carries so much ambiguity and argumentation as it does. Despite all notoriety, consciousness remains one of the most important contemporary issues among various disciplines.

Prominently there are two different methods of studying consciousness i.e. experimental and experiential (Prabhananda, 2010). In the former approach, consciousness has been defined as a property of being aware, awake and sentient (Rosenthal, 2009), the awareness of the world and feeling of control over one's behaviour and mental state (Posner & Rothbart, 1998). In experiential approach, the conceptualization of consciousness ranges from simply presence or absence of an experience (Velman, 2009) to 'What it is like to have certain experience' (Nagel, 1974; Block, 2003) for e.g. How it feels like to be a bat? Block (2003) considers reflection on this experience also as a part of consciousness. Another group of thinkers consider consciousness as the universal solvent in which all subjective and objective experiences arise and subside (Ladd, 1894). The similar idea is shared by Indian seers particularly by Ramana Mahirishi (as cited in Mudalier, 1999). Through an analogy of a movie theatre, he tries to explain the appearance and the disappearance of the experiences on the screen of consciousness as shadows come and go on screen.

With the emerging interdisciplinary approaches and neuro-imaging techniques, a rigorous headway has been made in the field of consciousness (Prabhananda, 2010; Thagard, 2014). But despite substantial efforts, we do not have any generally accepted scientific theory on how brain activity can create conscious experience. This fact is troublesome especially when we have a large body of research on correlations between brain activity and consciousness (Hoffman, 2014). The great paradox, which usually accounts for this limitation on part of neurosciences and cognitive sciences, is that consciousness can only be explored by consciousness (Talbot & Floyd as cited in Mathur, 1987). As a result, in all the disciplines unanimously, the realization is becoming stronger that nothing much can be achieved without developing methods for studying first hand experiences of individuals (Fiala, 2014; Stillfried, 2014) Moreover, it is difficult to design experimental protocols to study experiences relating to consciousness which arise in inner laboratory of human beings (Giri, 2010).

Contributing to the study of first person experiences, Psychology and Neuro-science have given a solid evidence for an unconscious counterpart of every conscious experience of same level of complexity (Lycan, 1999). Thus, possibilities have been created for exploration of conscious human experience as a psychological variable, which was almost impossible a few decades back

(Baars, 1997). In this regard, Brazdau (2013) has introduced the concept of consciousness quotient, a composite psychological construct, based on a list of traits, skills and abilities that describe conscious experience. To be conscious means to have a degree of witnessing awareness and a degree of freedom of choice when thinking, feeling, sensing and interacting with people and the environment (Brazdau, 2014). Using the above operational definition, the CQ inventory (CQ-i) evaluates the frequency of various behaviours and the usage of specific skills and abilities, providing a detailed description of conscious awareness experiences (Brazdau & Opariuc, 2014). As a composite measure, the CQ-i includes some other concepts related with the conscious experience (e.g. mindfulness, self-reflectiveness, autonomy, purpose in life). Although these concepts were originally included as sub factors in the CQ-i, the subsequent researches concluded that they cannot be used as separate scales for the consciousness quotient, and that CQ is a unitary concept (Brazdau & Opariuc, 2014).

A significant number of empirical studies have been conducted in last two decades exploring the relationship of consciousness with other mental constructs and behaviours. Consciousness has been found to predict academic achievement (Brazdau & Mihai, 2011) and mental constructs such as learning, attention, perception (Grossberg, 1999), creativity and imagination (Das & Sharma, 2013), intelligence, learning ability, and intellectual performance (So, 1995). It has a role in determining the fundamental aspects of education such as degree of creativity, confidence and motivation (Sharma, 2008). Moreover, consciousness is also related to inclination of leadership approach from transactional to a more conscious form of leadership i.e. transformational leadership (Chauhan, Sharma & Satsangee, 2013; Jones, 2012).

Executive Functioning And Consciousness

Executive function is an umbrella term for the neurologically based skills involving mental control and self-regulation. Among the various prevailing definitions of executive functions, few important ones describe them as a set of mental processes that helps connect past experience with present action (National Centre for Learning Disabilities, 2005) and the management of one's self and one's resources to achieve a goal (Kahn & Dietzel, 2008). The working paper of 'Centre on the Developing Child', Harvard University, (CDC, 2011) put the working memory, inhibitory control and cognitive and mental flexibility in the arena of executive functioning, Whereas NCLD (2005) ascribes activities and functions such as planning, organizing, strategizing, paying attention to, remembering details, and managing time and space to executive functions. The present paper limits the exploration of relationship of consciousness to two executive functions i.e. self-regulation and cognitive flexibility.

According to Barkley (2012), self-regulation involves any action individuals direct at themselves so as to result in a change in their behaviour (from what they might otherwise have done) in order to change the likelihood of a future consequence or attainment of a goal. Many psychologists over the years have used executive function in exchange with self-regulation.

Regarding cognitive flexibility, there is a general agreement by the researchers on the fact that it is a component of executive functioning (NCLD, 2005). Cognitive flexibility can be defined as having the understanding and awareness of all possible options and alternatives simultaneously within any given situation (Martin & Rubin, 1995) and the mental ability to switch between thinking about two different concepts, and to think about multiple concepts simultaneously (Scott, 1962). Cognitive flexibility facilitates students with transferring knowledge to new situations, apply and use it according to changing environmental conditions and situations and solving a problem by having multiple perspectives to visualize it.

Researchers have established that executive functions play an important role in learning and impact students' achievement (Halen, Thompson & Gathercole, 2006). Best, Miller and Naglieri (2011) have shown that though the correlation between complex executive functions and academic achievement varies across age groups but the developmental pattern of the strength of these correlations was remarkably similar for overall math and reading achievement, suggesting a domain-general relation between complex EF and academic achievement. According to CDC (2011), executive functions are distinct from (yet foundational to) school readiness and academic success. Children's executive function skills provide the link between early school achievement and social, emotional, and moral development.

Since executive functioning is a term used for a spectrum of control mechanisms, it is yet to be established whether it is governed by conscious or unconscious mind. Various control mechanisms have been divided into the field of control of conscious or unconscious by the researches (Kunde, Reuss & Kiesel, 2012). Denying the close association of the two, McCloskey (2008) propounds that executive functions are not synonymous with consciousness. It can operate on a non-conscious as well as conscious level. Similarly, Rosenthal (2008) proposes that consciousness of thoughts, desires, and volitions adds little if any benefit for rational thinking, intentional action, executive function, or complex reasoning. Hommel (2007) propounds that except for very few, most of the models of cognitive sciences leave no or very small room for the functional aspects of consciousness.

But a strong body of intuitive and psychological theorizing supports a positive relation between consciousness and control. In this regard, Baars (1998) proposes that consciousness performs a multitude of vital functions in

nervous system. According to Umilta (1988), conscious experience is the only agent that performs the control tasks. It has been found (Nani, Eddy & Cavanna, 2011) that only sensory information that is reported as conscious, activates the executive regions of the brain. Many psychologists have even termed consciousness as an executive function due to its overlapping neural mechanisms with that of neural mechanisms of consciousness (Catherine, 2012). Emphasizing the role of consciousness for self-regulation, Posner and Rothbart (1998) have termed consciousness as the outgrowth for the need of energy efficient self-regulation, which requires the evolutionary frame work to establish itself but once established, consciousness directly contributes to the self regulatory capacity. Some recent studies by Zelazo (1999, 2004), Emerson and Miyake (2003) and Goschke (2000) have revived Vygotsky's idea of 'control of actions by inner speech'. Also, a group of theories of consciousness including Integrated Informative theory (Koch, 2004) and Global Workspace theory (Baars, 1988) maintain that consciousness has an integrative or binding role in human cognition.

However, most of these arguments are theoretical and intuitive. Hommel (2007) suggests and warrants us against treating consciousness and control synonymously without having any empirical foundation or evidence, which proves so. Therefore, the present study empirically explores the relationship (if any) between consciousness (measured as conscious experience in terms of consciousness quotient) and executive functioning (Self-regulation & cognitive flexibility).

The paper explores answers to the following research questions:

1. What is the extent of variance in self-regulation as accounted by consciousness quotient?
2. To what extent does consciousness quotient predict variation in cognitive flexibility?

Research Methodology

Sample

The sample consisted of 200 adolescents in the age group of 13 to 19 (Mean age: 16.05, S.D=1.62). 78 boys and 122 girls from eighth to twelfth grade participated in the study. The data was collected in five phases from the students of more than 10 different schools of Agra, India, selected randomly. In first two phases data was collected from 11th standard students of School I and School II. In the third phase, data was obtained from 9th standard students of School III. Students of a diploma course (after 10th standard) from Dayalbagh Educational Institute were included in gathering responses for fourth phase. In the fifth phase, 30 teacher trainees were involved in data collection as a part

of their training program. Each trainee collected responses of 5 adolescents from different schools. For each phase the consent of the principal or head of the institution and the participants was sought.

Overall test administration was done on a sample of 200. Fake responses were removed by intentionally leaving extra spaces in between the items and using lie scale in CQi. Outliers were excluded by removal of scores having Z scores > $\pm$ 3 SD. After removing outliers and fake responses, obtained valid questionnaires were 152 CQi's, 149 Cognitive Flexibility Scale (CFS) responses and 108 Adolescents Self Regulatory Inventory (ASRI) responses. Impaired sets were excluded for obtaining valid pairs of CQi-CFS and CQi-ASRI. Finally, for calculating correlation, 116 pairs were obtained for CQi - CFS and 85 pairs for CQi-ASRI.

TOOLS USED

Students completed the bilingual version (English and Hindi) and adapted Indian version of Consciousness Quotient Inventory (CQ-i v. 2013) by Brazdau, Sharma and Ahuja (2014), Adolescents Self Regulatory Inventory (ASRI) by Moilanen (2007) and Cognitive Flexibility Scale (CFS) by Martin and Rubin (1995).

CQ-i consists of six dimensions (physical, emotional, mental, spiritual, self & social-relational consciousness). The author adapted the inventory through difficulty level analysis (Brazdau, Sharma & Ahuja, 2014) and the items with high difficulty level were reframed. For example, the item 'I know the moments when my life partner is momentarily focused on priorities other than our relationship, even if they are not telling me' was reframed as 'I know the moments when my best friend is momentarily focused on priorities other than our friendship' and 'I try to understand other people's ideas about spirituality' was simplified as 'I try to understand other people's ideas about spirituality (the idea about soul, god etc.)'. The Cronbach alpha was found to be 0.90 (N=200).

ASRI consisted of 36 items with scales for both short term as well as long-term regulation. The reported reliability (short term ASRI) alpha = 0.70, 0.69, 0.88 (alpha for adolescent's self report, parents' self report, parents report about their child). For long term ASRI, alpha = 0.82, 0.72 to 0.91. It consisted of items such as 'When I am bored I fidget or can't sit still', 'little problems distract me from long-term plans' etc.

To assess flexibility in cognition, CFS (Martin & Rubin, 1995) was used. It consisted of 12 Items. Martin & Rubin (op. cited.) report a Cronbach alpha = 0.81. CFS included items such as: 'I can communicate an idea in many different ways', 'I am willing to work at creative solutions to problems' etc. The

descriptive analysis of the constructs is presented in Table 1.

Table 1

Descriptive Analysis of the Scales.

Scale*	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
CQ-i	152	178.00	147.00	325.00	247.24	38.64	14.93
CFS	149	31.00	33.00	64.00	48.48	6.71	45.03
ASRI	108	123.00	33.00	156.00	115.41	16.90	285.79
ASRI (Short Term)	108	33.00	25.00	58.00	39.20	6.77	45.94
ASRI (Long Term)	108	30.00	34.00	64.00	49.67	7.16	51.28

*only for those included in the statistical analysis

RESULTS OF THE STUDY

Pearson's linear correlation analysis was performed to assess the relation between consciousness quotient, cognitive flexibility and self-regulation. Data analysis revealed a significant low positive correlation between CQ and cognitive flexibility ($r = 0.25$, $p < 0.05$) as well as a significant moderate correlation between CQ and self-regulation ($r = 0.40$, $p < .01$).

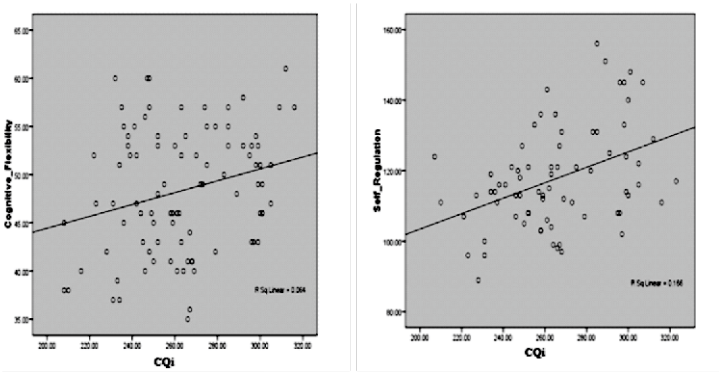
A detailed analysis of short term and long-term self-regulation as given in Table 2 revealed that consciousness quotient relates moderately and significantly to long-term regulation ($r = 0.44$, $p < .01$) than to short term regulation ($r = 0.122$, $p > 0.05$). A linear regression analysis was performed to check whether consciousness quotient is a predictor of the two executive functions or not. It was found that CQ accounts for 6.4% variation in cognitive flexibility [$R^2 = 0.064$, $F (1, 90) = 6.182$, $p < 0.05$] and 16.6% variation in self-regulation [$R^2 = 0.166$, $F (1, 71, 14.096$, $p<0.01$)]. These findings suggest that the extent of relationship of consciousness quotient with different executive functions varies. It was revealed that consciousness quotient accounts for greater variation in long term self regulation [$R^2 = 0.193$, $F (1, 78) = 18.62$, $p< 0.01$] than for short-term regulation [$R^2 = 0.015$, $F (1, 78) = 1.207$, $p > 0.05$]. Interestingly, it was found that even two executive functions i.e. cognitive flexibility and self-regulation are positively and significantly correlated ($r = 0.46$, $p<0.01$). Figure 1 and 2 give the scatter plot diagrams for the correlations.

Table 2

Coefficient of Correlation and Coefficients of Determination.

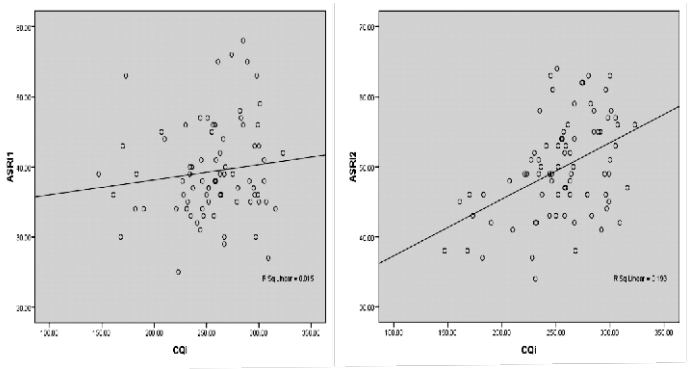
Variables	Correlation	Coefficient of Determination, R^2
Consciousness Quotient and Cognitive flexibility	0.25**	0.064
Consciousness Quotient and Self Regulation	0.40* (0.44* for long term, 0.122 for short term)	0.16 (0.193 & 0.015)
Cognitive flexibility and Self Regulation	0.46*	0.211

**Correlation significant at p < 0.01, ** Correlation Significant at p < 0.05*



(a) (b)

Figure 1. Scatter Plots Showing Correlation with Line of Fit for a) Consciousness Quotient and Cognitive Flexibility B) Consciousness Quotient and Self-Regulation.



(a) (b)

Figure 2. Scatter Plot and Line of Fit Showing Correlation between a) Consciousness Quotient and Short Term Self-Regulation b) Consciousness Quotient and Long Term Regulation

DISCUSSION OF RESULTS

The present paper aimed at studying the relation between conscious experience as measured by CQi and two executive functions i.e. cognitive flexibility and self-regulation. Findings based on self-reports reveal that executive functioning is moderately but significantly related to consciousness quotient, although the relationship may vary for different executive functions. Consciousness quotient accounts for greater variation in self-regulation as compared to cognitive flexibility. Thus, it can be inferred that students with higher score on self reported consciousness quotient will tend to have greater long term self regulating abilities and a more flexible cognition than those with a lower score.

The findings are found to be consistent with the propositions of Dehaene and Naccache, (2001) and Jack and Shallice, (2001) that cognitive control processes necessarily require awareness. Jack and Shallice (2001) emphasized that the underlying processes engaged by conscious action are different from those engaged by automatic action. Similarly, Dehaene and Naccache (2001) suggest in their workspace model that routine actions are possible without consciousness, while consciousness is required for cognitive control. They state that "it should be impossible for an unconscious stimulus to modify processing on a trial-by-trial basis through top-down control" (Dehaene & Naccache, 2001, p. 21) and that "an unseen prime cannot be used as a source of control to modify the choice of processing steps" (Naccache, Blandin, & Dehaene, 2002, p. 423).

However, the general debate on role of consciousness in executive functioning and the proposition that executive functioning can take place on conscious as well as on non-conscious level (McCloskey; Rosenthal, op. cited) cannot be denied. Perhaps, this may be the reason for the low percentage of variance in self-regulation and cognitive flexibility as accounted by consciousness quotient. The possibility of non-conscious level governing executive functioning can't be ruled out. Future studies may address this issue.

Secondly, a significant correlation may not necessarily indicate a high degree of relationship or variance. Sometimes this may be due to the overlap in constructs. Some items from CQi, ASRI and CFS may give readers a feel that they are measuring the same thing. However, earlier in this paper, it has been made clear that CQi is a composite measure which includes many other constructs related to conscious experience such as mindfulness, self-reflection, etc., which can't be used as subscales separately. Underlying dimensions of cognitive flexibility scale also include 'awareness in a given situation' as one of the dimension, which may overlap with consciousness. But these scales were prepared independently and are measuring different

constructs. In any case, to explore such correlation is out of scope of this paper. Future studies may address this issue.

As an implication of this paper, every effort for transformation in consciousness will also lead to transformation of self-regulation and flexibility in cognition. Therefore, attention should be diverted towards a serious effort for consciousness-based curriculum in educational institutions. Future researches which may empirically strengthen the findings of present study on large populations are required. A multi-method approach may be used for getting rich data and converging evidence in this direction can be used. Especially the importance of qualitative approaches to study the phenomenon of consciousness should never be undermined. The present study was directed at only two executive functions. Future researches may be directed at discovering the possibilities and relationship of various other executive functions with consciousness.

The study provides a much needed empirical support to theory of consciousness-control relationship and can have vital implications in various fields including education. The findings shed an intriguing light on the necessity of consciousness based education for a sound development of executive functioning in students, whose necessity in every sphere of life cannot be underestimated.

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