PSYCHOLOGY AND COGNITIVE SCIENCES

Openventio PUBLISHERS

ISSN 2380-727X

Open Journal

http://dx.doi.org/10.17140/PCSOJ-3-135

Observational Study

***Corresponding author**
Stephen Ntim, PhD, MPhil, MA, BEd
Faculty of Education
Catholic University of Ghana
P.O. BOX 363, Sunyani
Fiapre, B/A, Ghana
E-mail: stephenntim58@yahoo.com; stephenntim58@gmail.com; stephen.ntim@cug.edu.gh

Volume 3 : Issue 4
Article Ref. #: 1000PCSOJ3135

Article History
Received: September 29th, 2017
Accepted: November 30th, 2017
Published: December 1st, 2017

Citation
Ntim S. Epistemic curiosity, conceptual ambiguity and cognitive conflict: Do these implicate students exploratory behavior? *Psychol Cogn Sci Open J*. 2017; 3(4): 131-136. doi: 10.17140/PCSOJ-3-135

Epistemic Curiosity, Conceptual Ambiguity and Cognitive Conflict: Do these Implicate Students Exploratory Behavior?

Stephen Ntim, PhD, MPhil, MA, BEd*

Faculty of Education, Catholic University of Ghana, P.O. BOX 363, Sunyani, Fiapre, B/A, Ghana

ABSTRACT

Background: Contemporary demands in the labour market continue to be more scientific-technological. Onus is on institutions of higher learning to develop in students' flexibility of thinking, as well as an inquiring and inquisitive mindset, that would stimulate in them the culture for curiosity and scientific research. Consequently, this paper establishes a link of cognitive/educational psychology research to epistemic curiosity and human exploratory behavior in postgraduate students attending educational psychology classes, to assess how epistemic curiosity implicates their inquiry and affects critical thinking for classroom practice.
Method: A total of two hundred (200) random sampling size of students' in a university, located in the middle belt of Ghana, aged between 24-30 years, participated in this study. They were tested to assess the discrepancy between their feel-of-knowing on three variables: general fluid reasoning, memory test recognition and curiosity-trait questionnaire.
Results: Participants with high intensity level to knowledge demonstrated lower knowledge gap, compared to those with low-level of intensity. Similarly, the lower the knowledge gap between curiosity and cognition, the higher the arousal indicating that the '*I know*' experienced acute stimulation relative to the '*I don't know*' participants. In the experiments performed, scores of the '*I know*' group correlated more positively with epistemic curiosity, feelings of knowing and exploratory behavior than the '*I don't know*' individuals.
Conclusion: Human cognitive architecture seems to be structured to avoid cognitive ambiguity. Interest and deprivation-type curiosity in humans appears to be the leading predicting factor inducing humans to search for answers to bridge the gap between cognition and cognitive dissonance, triggering exploratory behavior to find answers.

KEY WORDS: Epistemic curiosity; Cognitive dissonance; Exploratory behavior; Feeling-of-knowing

ABBREVEATIONS: FOK: Feelings-of-knowing; LTM: Long-Term Memory; CNS: Central Nervous System.

INTRODUCTION

Epistemic curiosity has to do with the desire to bridge the gap between cognition and cognitive dissonance. On theoretical grounds, the concept is not unrelated to conceptual ambiguity and cognitive conflict as far as the literature on uncertainty and curiosity in human exploratory behavior is concerned. As has been discussed in this paper, the three concepts are used interchangeably to convey the same idea. As a theoretical framework, the concept of epistemic curiosity could be traced back to the works of Berlyne.[1] According to this author,[1] uncertainty is heightened, when humans encounter something diametrically different from what they would expect to encounter in their experiences. This incongruity and dissonance in cognition, consequently precipitates arousal in the central nervous system (CNS).[1-5] For example, a child in Primary 3 goes to school in the morning, expecting to see his/her Primary 3 teacher. Instead

ISSN 2380-727X http://dx.doi.org/10.17140/PCSOJ-3-135

he/she sees a substitute teacher. The dissonance between what is already encoded in the child's cognitive architecture, especially in the child's Long-Term Memory (LTM), and what he/she sees could induce physiological responses, such as, fast heartbeat, shallow breathing, and increased dilation of the pupil of the eye. It is the cognitive dissonance and conceptual ambiguity that heighten all these responses. This aroused emotional state, precipitated by uncertainty, is what was referred to as *curiosity* by Berlyne[1] a little over five decades ago. This curiosity triggers behaviors that would be typically exploratory, aimed at minimizing the curiosity and uncertainty.

With respect to its characteristics, epistemic curiosity is essentially a complex psycho-cognitive state involving both emotions and motivation, anticipating the learning of something new, to get rid of unpleasant feelings of incongruity and uncertainty in the knowledge gap.[6] In such a situation, the expected human reaction is to seek for information that would eliminate the uncertainty between discrepancy and the desired information. This leads to what is referred to in the literature as a *feeling-of-knowing.* This *feeling of knowing* implies that at the level of metacognition, the person in doubt, would make a judgment and an evaluation of his/her available knowledge in the LTM to help resolve the impasse.[7-9] The stronger the feelings of knowing experiences, the smaller the gap between cognition and cognitive dissonance. For example, in the example cited above in the case of the third grade child, he/she would spend considerable time trying to size up the substitute teacher from head to toe, trying to pay attention to the new teacher's response to his/her other colleagues in the class, or even to ask the substitute teacher simple question such as: '*Sir, do we have social studies today?*'. These are psycho-meta/cognitive approaches, by means of which, one collects information through exploration, to reduce one's level of arousal. It is in this respect that according to Berlyne[1], this theory of epistemic curiosity is reinforcing.

Regarding the topic of human exploratory behavior, this researcher is of the view that considerable number of studies have been undertaken in respect of its manipulative forms, especially in the areas of shape inspection and the solution of puzzles in psychological and cognitive literature.[10,11] More studies are yet to be conducted, specifically, with the aim of acquiring new knowledge through arousal induced by cognitive dissonance. Consequently, the purpose of this short research paper is to respond to this lacuna.

With specific reference to epistemic curiosity, Loewenstein[4] presented the hypothesis, that when there is a dissonance between cognition and people's experiences, the *feelings-of-knowing* leading people to the realization that they have more access to information (and therefore smaller knowledge gaps) is more likely to arouse a heightened stimulation towards exploratory behavior, than people with perceptions that they have little knowledge, and therefore larger knowledge gaps. With the above hypothesis of Loewenstein[4] as backdrop, this short research investigated whether or not, students' exploratory behaviors are aroused more, when they perceive to have more knowledge in the face of dissonance or less aroused, when there is a perceived little knowledge.

Based on the above, this paper investigated the following three research questions:

1. What are the possible relationships between mental thoughts (cognition) and the intensity of behavior (motivation)?

2. In what ways can the feelings-of-knowing (FOK) induce epistemic curiosity?

3. What are the instructional/pedagogical implications that could be derived from conceptual ambiguity and cognitive conflict for effective classroom interaction?

METHODOLOGY

Participants

A total of two hundred (200) random sampling size of postgraduate students in Educational Psychology class in a university located in the middle belt of Ghana participated in this study. Their ages ranged between 24-30 years. Out of this, one hundred and thirty (130) participants were males, and the remaining seventy (70) were females. All the participants held Bachelor's degree in various areas of discipline, such as Mathematics, Science, Social Sciences, the Arts and Language. Thirty (30) of them in addition to the Bachelor's degree, also possessed a second degree. In terms of family background, about 80% of the participants were from Middle class civil service background, while the remaining 20% came from a working class farming background. All of them were not native speakers of English and therefore had English as a second language.

Design and Materials

The participants responded to all three research questions through three research instruments: a) a structured questionnaire and b) a Likert's scale type assessment on multiple choice questions on memory test recognition and c) curiosity trait-questionnaire.

Structured questionnaire on fluid reasoning knowledge: The structured questionnaire was based on the Woodcock Johnson Test Guide[12] to assess the discrepancy between their *feel-of-knowing* of the general knowledge on fluid reasoning on: i) concept formation and ii) analysis synthesis. Questions on concept formation had 50 simple questions and that of analysis synthesis also had 50 simple questions. All questions were scored over one hundred (100), that is, each of the questions had a score value of 1. Each question was to be answered in one simple word. To enhance the *feel-of-knowing* responses, questions were varied along two normative probabilities (p) of valid retrieval and accurate subject matter categorization. Participants were asked to write down the responses they reported to be knowing.

ISSN 2380-727X http://dx.doi.org/10.17140/PCSOJ-3-135

Regarding the participants' meta/cognitive judgments of their knowledge of answers to questions, this was evaluated through the subsequent two mechanisms: a) participants were asked to show their feel-of-knowing by indicating either '*Yes I know the answer*' or '*No I don't know the answer*' If the answer was yes, they were asked to write the answer'.

Memory test on recognition on Likert's scale: On a Likert's scale, respondents were asked to rate the intensity of their feel-of-knowing for all the 'Yes I know' responses to indicate the level of confidence ranging from 5 to 1, the highest score indicating the highest level of confidence and the lowest score indicating the lowest state of confidence level in a multiple choice questions.

Curiosity-trait questionnaire: Two different instruments were used in this section of the experiment. Ten (10) items questionnaire were posed, using a variant of the Epistemic Curiosity scale of Litman and Spielberger,[5] and another 15-item questionnaire with a variant of Curiosity- as-a-Feeling-of-Deprivation scale of Litman and Jimerson[6]. On the first instrument, they were asked to rate their pleasures of interest or otherwise in connection with learning (e.g. I like to learn things that are unfamiliar) or unpleasant experience (e.g. I feel uneasy when I am learning something I do not understand). In both, the following were the 4-point scale from 1-5, 1=almost never; 2= At times; 3= Often, 4= Almost always.

Procedure

All materials and questionnaires were administered through group/class testing during a 3-hour Psychology class from 11.30 am to 2.30 pm by the author and two Faculty Research Assistants. Students had already been informed about this experiment and participation was purely voluntary. Students were informed that the purpose was purely academic. The experiment was meant to gauge the feelings, sentiments and general knowledge of postgraduate students specifically on how variables such as epistemic curiosity, conceptual ambiguity and cognitive conflict implicate the intensity of students' exploratory behavior. All detailed explanations were given to the students before each phase of the experiment. For example, it was explained, that the experiment would be conducted in three phases: a) *structured questionnaire on fluid reasoning knowledge; b) Memory test on recognition on Likert's scale to test the level of confidence of all 'I know states' and c) Curiosity-trait questionnaire.* Detailed instructions on each of the three measures were clearly explained to all the participants. All raw scores were computed into mean scores and standard deviations.

RESULTS

The results have been presented in three categories. The first part presents the summary of the descriptive statistics on the types of feelings of knowing (FOK) states on fluid reasoning which were all assessed to find out whether or not FOK intensity level measures as well as their retrieval accuracy varied as predicted. The second part presents the expected hypothesis of the link between FOK, epistemic curiosity state and its implied exploratory behavior. The third section offers some relationship between epistemic curiosity traits and states, FOK and human exploratory behavior.

The first row in Table 1 presents the two variables of the '*I don't know'* and the *'I know'* states as measured on fluid reasoning, while the first column presents the scores of the FOK states. So Table 1 presents the mean, the standard deviation and the alpha scores for answers that were correctly recalled on the general knowledge for FOK between the '*I don't know*' and the '*I know'* groups for the total sample of 200. Additionally, it explains the number of responses correctly recalled when participants were reading the questions on fluid reasoning which was gauged to measure whether or not the FOK level measures together with their retrieval accuracy differed as predicted. The mean scores having varied superscripts were scores that significantly varied from each other at $p \leq 0.05$ .The low alpha values were suggestive of the FOK intensity and indication that they varied appreciably. Answers that were correctly retrieved when respondents indicated '*I know*' *p* (retrieved) were reported in the right corner with the correlation between the level of confidence (intensity) as well as the '*I know'* correlations with correctly retrieved answers

The first column of the Table 2 shows the feelings of knowing state between the two variables of '*I know'* and '*I don't know',* while the second and third columns indicate the correlation scores for recognition and feelings of knowing level. Thus, the Table reports the level of confidence of the FOK

Table 1: Summary of Descriptive Statistics on Confidence Level of Feel-of-Knowing States in Respect of Retrieval Indicators for 'I know' States on Fluid Reasoning (N=200).

For Intensity	*'I don't know'*	*'I know'*
M[1]	1.75^{a}	3.67^{b}
SD	0.65	0.28
α	0.51	0.52

p (retrieval)[2]=0.73
Point biserial r=0.38

ISSN 2380-727X http://dx.doi.org/10.17140/PCSOJ-3-135

Table 2: Memory Test on Recognition Index to Rate Intensity (Level of Confidence) for all the 'I know' States (N=150) on Likert's Scale.

FOK State	*p* (recognition)	Point-biserial *r* in relation to FOK level of confidence
'I know'	**0.76**	**0.27**
'I don't know'	**0.49**	**0.06**

states for the '*I know*' and the '*I don't know'* groups in terms of correlation between recognition and level of confidence. Thus it reports memory test on recognition index to rate intensity (level of confidence) for all the '*I know states*' of a random sample of 150 out of the 200 total sample size, which included 100 male students and 50 female students, both groups being postgraduate students. Using the Goodman-Kruskal gamma co-efficient, the FOK states of participants in this test was evaluated to see whether or not, the results were of different retrieval and also where the accurate answers commensurate with each type of the FOK state.

The first row in this Table 3 presents the three variables of epistemic curiosity, feelings of knowing and exploratory behavior that were correlated. The first and subsequent columns show the correlation scores between the '*I know'* and the '*I don't know'* The Table reports that the correlation between the three measured variables, namely, state of epistemic curiosity, FOK intensity as well as exploratory behavior for each category of FOK conditions. Curiosity state correlated negatively with '*I know state*' as shown on the table. Thus, as hypothesized in this short study, when people are innately convinced that they have not succeeded in giving an answer, the intensity in the FOK is heightened and this commensurates with the heightened state of curiosity.

DISCUSSION

This study investigated the connection between perceived knowledge and cognitive dissonance and how the gap between these two variables precipitates epistemic curiosity and its consequent exploratory behavior to resolve the discrepancy. The data in all the tests indicated above, are suggestive, that typically, when people have the mindset that they have access to knowledge, this realization induces a more heightened arousal, relative to people with the belief that they have a much larger knowledge gaps. Central to the desire to bridge this gap is epistemic curiosity which is an essentially emotional-motivational state. This complex state is aroused by both the positive and negative feelings which are correlated to both the anticipation of a new learning, as well as not so pleasant feelings of uncertainty. For example, in Table 1, which sought to measure the general comprehension knowledge of these sampled postgraduate psychology class students, to measure their general comprehension knowledge, suggested that those who perceived to have knowledge ('*I know*'), recalled by far more accurate responses, than those who did not ('*I don't know*'), as shown in the scores in Table 1: M=3.67 (SD=0.28) compared to M=1.75 (SD=0.61) respectively. Additionally, in terms of correlation scores, the scores of those who perceived to have knowledge ('*I know*'), correlated with a *p* (retrieval) of 0.73, while the intensity levels were positive correlation of *r*=0.38.

Similarly, in Table 2, results in the recognition accuracy indicators point to the same fact. The answers with the highest number of correct responses at the FOK states were more in the '*I know*' state, than it was in the '*I don't know*'. This findings seem to corroborate the fact that participants in this study appeared to have been more conscious of their knowledge and because of this they were able to either in part or in full retrieve the correct responses as indicated in *p* (recognition) indicating 0.76 for '*I know*' and 0.49 for '*I don't know*' as well as *r*=0.27 and *r*=.06 respectively. The scores in the correlations in Table 3, between the three variables of epistemic curiosity, feelings-of-knowing, and exploratory behavior, by and large are in favor of the '*I know*', compared to the *'I don't know'*.

As predicted in this study, the findings above, by and large corroborate the thesis of Loewenstein[4], namely, that when there is a cognitive dissonance or cognitive ambiguity or conflict concerning the probability that the feelings-of-knowing already stored in people's LTM would come to the fore arousing a heightened stimulation towards resolving the conflict. The findings from this study support the following three interrelated

Table 3: Correlation between Epistemic Curiosity, Feelings-of-Knowing and Exploratory Behavior (N=200).

	Epistemic curiosity		**(FOK) intensity**		**Exploratory behavior**	
	'I know'	***'I don't know'***	***'I know'***	***'I don't know'***	***'I know'***	***'I don't know'***
For Intensity	-0.12	0.24	-0.20	14		
Exploratory behavior	0.28	0.43	-0.21	17		
CFD scale	0.01	0.12	0.00	0.06	0.03	0.08
EC scale	0.01	0.23	0.02	0.06	0.01	0.11

Note: Figures in bold are significant correlations.

ISSN 2380-727X http://dx.doi.org/10.17140/PCSOJ-3-135

theses that: a) there appears to be greater recognition memory when there is a feeling of knowing for all who feel that they have an access to knowledge. This comes out clearly in this study when the scores were more favorable to the '*I know*' state in relation to FOK; b) the participants in this study, who indicated '*I know*', seemed to have experienced more of a heightened stimulation than those who showed '*I don't know*' and c) for all the three study variables, namely, epistemic curiosity, feelings of knowing state and exploratory behavior, the scores of participants in this study who indicated '*I know*' correlated more positively with exploratory behavior for all the FOK states. The above fundamental findings confirm other studies such as Jordan, Tiffany & Ryan,[13] Keller Schneider & Henderosn,[14] as well as Loewestein.[4]

IMPLICATIONS FOR CLASSROOM PRACTICE

These findings have implications for classroom teacher-student interaction. First, with specific reference to individual dispositional tendencies, many studies highlight the critical importance of epistemic curiosity in the students' intellectual achievements. This is especially so in self-directed learning.[15-17] Self-directed learning is not unrelated to the development of curiosity in students, which in turn enhances inquiry and critical thinking[18] especially in teacher education. Thus, epistemic curiosity precipitates inquiry attitude, especially when a teacher is expected to cultivate this attitude, and is constantly questioning whether or not his teaching and classroom interaction with students, and in the school induce in students, such curiosity as inquisitiveness and critical reflection.[19,20] With specific reference to exploratory behavior, it is theorized that openness to knowledge and epistemic curiosity are the driving forces that trigger the human desire to search for knowledge and therefore assumed to be theoretically connected to inquiry attitude.[21,22] Hence in terms of teacher education for example, it is related to the teacher's professional development.

CONCLUSION

Interest and deprivation-type curiosity in humans appear to be the leading predictor inducing humans to search for answers to bridge the gap between cognition and cognition dissonance, between cognitive conflict and knowledge, as well as between cognitive ambiguity and information. Human cognitive architecture seems to have been structured to avoid cognitive ambiguity. This is especially so, when one is pretty sure that information/knowledge already encoded into the LTM can be retrieved with ease. When the intensity or the confidence level of such FOK is high, humans are naturally predisposed to a heightened stimulation towards exploratory behavior. The major findings from the study are as follows: a) there appears to be greater recognition memory, when there is a feeling of knowing, for all who feel that they have an access to knowledge. This is evident in this study when the scores were more favorable to the '*I know*' state in relation to FOK; b) the participants in this study, who indicated '*I know*', appeared to have experienced more of a heightened stimulation and high intensity level than those who showed '*I don't know*' and c) for all the three study variables, namely, epistemic curiosity, feelings of knowing state and exploratory behavior, the scores of participants in this study who indicated '*I know*' correlated more positively with exploratory behavior for all the FOK states. These findings are consistent with the psychological behavior of humans when faced with interest on hand, and deprivation-type curiosity on the other. Additionally, these findings have implications for classroom teaching especially in the area of enhancing inquiry and critical attitude as well as self-regulation in the students' intellectual development.

ACKNOWLEDGEMENTS

The research was conducted with the approval of the University Institutional Review Board. We are a faith-based university so we are particularly sensitive to ethical issues.

CONFLICTS OF INTEREST

This author declares having no conflict of interest in this study. All students who participated in this study did so voluntarily without any coercion. No funding was obtained for this research.

REFERENCES

1. Berlyne DE. *Conflict, Arousal and Curiosity.* New York, USA: McGraw-Hill; 1960. doi: 10.1037/11164-000

2. Berlyne DE. A theory of human curiosity. *Br J Psychol*. 1954; 45: 180-191. doi: 10.1111/j.2044-8295.1954.tb01243.x

3. Berlyne DE. Curiosity and exploration. *Science*. 1966; 153: 25-33. doi: 10.1126/science.153.3731.25

4. Loewenstein G. The psychology of curiosity: A review and reinterpretation. *Psychol Bull.* 1994; 116: 75-98. doi: doi: 10.1017/thg.2012.11

5. Litman JA, Spielberger CD. Measuring epistemic curiosity and its diversive and specific components. *J Pers Assess*. 2003; 80(1): 75-86. doi: 10.1207/S15327752JPA8001_16

6. Litman JA, Jimerson TL. Curiosity as a feeling-of-deprivation. *J Pers Assess*. 2004; 82: 147-157. doi: 10.1207/s15327752jpa8202_3

7. Brown R, McNeil D. The 'tip-of-the-tongue' phenomenon. *J Verbal Learning Verbal Behav.* 1966; 5: 325-337. doi: 10.1016/S0022-5371(66)80040-3

8. Eysenck MW. The feeling of knowing a word's meaning. *Br J Psychol.* 1979; 70: 243-251. doi: 10.1111/j.2044-8295.1979.tb01681.x

9. Hart JT. Memory and the feeling-of-knowing experience. *J*

ISSN 2380-727X http://dx.doi.org/10.17140/PCSOJ-3-135

Educ Psychol. 1965; 56: 208-2216. doi: 10.1037/h0022263

10. Berlyne DE. The influence of complexity and novelty in visual figures on orienting responses. *J Exp Psychol*. 1958; 55: 289-296. doi: 10.1037/h0043555

11. Henderson B, Moore SG. Measuring exploratory behavior in young children: A factor-analytic study. *Developmental Psychology*. 1979; 15: 113-119. doi: 10.1037/0012-1649.15.2.113

12. Woodcock J. *Test Guide.* Florida, USA: Riverside; 2017.

13. Jordan L, Tiffany H, Ryan R. Epistemic curiosity, feeling-of-knowing, and exploratory behavior. *Cogn Emot*. 2005; 19(4): 559-582. doi: 10.1080/02699930441000427

14. Keller H, Schneider K, Henderson B. Preface: The study of exploration. In: Keller H, Schneider K, Henderson B, eds. *Curiosity and Exploration*. Berlin, Germany: Springer-Verlag; 1994: 199-212. doi: 10.1007/978-3-642-77132-3_1

15. Litman JA, Museel P. Developmental and validation of German translations of interest and deprivation-type curiosity scales. *J Individ Differ.* 2013; (34): 59-68. doi: 10.1027/1614-0001/a000100

16. von Stumm S, Hell B, Chamorro-Premuzick T. Curiosity predicts academic performance. The hungry mind: Intellectual curiosity as third pillar of academic performance. *Perspect Psychol Sci*. 2011; 6(6): 574-588. doi: 10.1177/1745691611421204

17. Marco L, Jordan AL, Patrick M, Riccardo DS, Howard, MC, Robert RH. Epistemic curiosity and self-regulation. *Pers Individ Dif.* 2015; 202-207. doi: 10.1016/j.paid.2015.04.017

18. Cochran-Smith M, Lytle SL. *Inquiry as Stance, Practitioner Research for the Next Generation*. New York, USA: Teachers College Press; 2009.

19. Leeman Y, Wardekker W. *Leren Door een Onderzoekende houding*. Zwolle, Netherlands: Hogeschool Windesheim Lectoraat Pedagogische kwaliteit van het onderwijs; 2008.

20. Leeman Y, Wardekker W. Teacher research and the aim of education. *Teachers and Teaching.* 2014; 20(1): 45-58. doi: 10.1080/13540602.2013.848516

21. Berlyne DE. An experimental study of human curiosity. *Br J Psychol.* 1954; 45: 256-265. doi: 10.1111/j.2044-8295.1954.tb01253.x

22. Litman JA. Interest and deprivation factors of epistemic curiosity. *Personality and Individual Differences* 2008; 44(7): 1585-1595. doi: 10.1016/j.paid.2008.01.014