RESEARCH ARTICLE

Effect of brain damages on logical inferences of depressive adults

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Abstract

Objective: To examine the immediate and mediate inferences among depressive adults with and without brain damage.

Methods: The descriptive, comparative study was conducted from November 6 to June 19, 2019, in Sargodha, Pakistan, and comprised depressive adults of either gender enrolled from various local mental health facilities. After applying Stroop test to identify brain damage, the subjects were divided into adults with brain damage in group A, and adults without brain damage in group B. Logical inferences of both groups were identified using three decision situations, and the findings were compared between the groups. Data was entered in SPSS V-26 for analysis. Chi-Square Test was applied to test the hypotheses.

Results: Of the 170 individuals approached, 120(70.5%) were included; 60(50%) in each of the two groups. Overall, there were 76(63%) males and 44(37%) females. The overall age range 18-60 years, with 105(88%) being young adults aged 18-49 years. Findings revealed that Group A exhibited higher frequency of immediate inferences on three conditions of certainty (55, 53, 58) as compared to Group B (23, 21, 20) while group B exhibited higher frequency on mediate inferences on the conditions of certainty (37, 39, 40) as compared to Group A (5, 7, 2). Group A exhibited higher frequency of immediate inferences on three conditions of risk (54, 55, 56) as compared to Group B (14, 23, 22) while group B exhibited higher frequency on mediate inferences on the conditions of risk (46, 35, 38) as compared to Group A (6, 7, 4). Group A exhibited higher frequency of immediate inferences on three conditions of uncertainty (53, 55, 55) as compared to Group B (14, 23, 22) while group B exhibited higher frequency on mediate inferences on the conditions of uncertainty (43, 40, 33) as compared to Group A (7, 5, 5).

Conclusion: In the light of the findings, it is inferred that adults with brain damages are unable to consider multiple perspectives while making decisions and consequently they consider one or two perspectives (immediate inferences) irrespective of the decision situation. However, adults without brain damages consider multiple perspectives while making decisions (mediate inferences) in all types of decision situations.

Keywords: Brain damages, Logical inferences, Immediate inferences, Mediate inferences, Depressive adults.

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Introduction

Decision-making is a process that involves a choice or a course of activities to select one option from a lot of options based on given criteria.[1] Decision-making is one of the major cognitive processes demonstrated in the Layered Reference Model of the Brain (LRMB).[2] Decision-making is a well-researched domain as quite a few studies are conducted on the factors which influence decision-making, like psychological informatics, software engineering, financial aspects, humanism, political theory and measurements, but with respect to individual decisions, the most sophisticated brain research is evident on the role of cognition in decision-making.[2-4] Cognition is the information-processing aspect of the mind, and decision-making requires sound cognitive functioning. However, depression is one of the leading disorders that can cause cognitive impairment. Apart from depression, there are also some other factors that can cause cognitive impairment, like alcohol abuse, insufficient vitamin B12 and folic acid, diabetes, cardiovascular diseases (CVDs) and many more.[5] Although cognitive strategies can be used to cope with depression, like Cognitive Behavior Therapy (CBT), but sometimes depression causes cognitive dysfunctions like Non-Traumatic Brain Injury (NTBI).[6]

Historically speaking, Aristotle considered individuals sane or normal on the basis of their capacity to reason.[7] Cognitive researchers generally aim at identifying the types of cognitive procedures and how those mental procedures are used in different scenarios in general, and in the decision-making process, in particular. Researchers have built up three powerful realities about human thinking, like people with slight rational thinking can make consistent conclusions regarding different day-to-day matters of life.[8] Also, the capacity to reason corresponds to the proportions of scholastic accomplishments (intermediaries for proportions of

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knowledge).[9] Third, practically a wide range of thinking, from two-dimensional (2D) spatial inductions[10] that help make superior choices and stem from superior functioning of the human cerebrum.

Keeping in view the dynamics of cognitive functioning, the easiest meaning of the judgment expresses that it is an intentional and non-arbitrary decision of one out of something like two choices, called immediate inferences, while decision-making is a procedure that includes different mental capacities, including different parts of memory, such as working memory, long-term memory or critical thinking abilities, and numerous other cognitive abilities involved in judgment and activity, which is together referred to as mediate inferences.[11]

Depression causes biochemical changes in the brain which lead to cognitive impairment or brain damage (BD) which impairs reasoning ability to draw logical inferences in daily-life scenarios. Moreover, it explains that individuals with BD are unable to consider the multiple perspectives, or mediate inference, in decisions and they usually restrict their choices to a single aspect, meaning immediate inference.[12] BD involves problems in cognitive processing, brain dysfunctions and cognition impairment.

The current study was planned to examine the inferences of adults with and without BD. It was hypothesised that in the conditions of certainty, risk and uncertainty, depressive adults with BD are likely to make more immediate inferences compared to mediate inferences, and that depressive adults without BD are likely to make more mediate inferences compared to immediate inferences.

Subjects and Methods

The descriptive-comparative study was conducted from November 6 to June 19, 2019, in Sargodha, Pakistan. The sample size was calculated on the basis of power analysis using G-power.[13] The sample was raised using purposive sampling technique from among depressive adults of either gender aged 18-60 years under treatment for depression at Fountain House, Aleez Neuro-Psychiatric Centre and District Headquarter Hospital (DHQ) after permission from the respective administrations. A neuro-psychiatrist facilitated the process. Adults with depressive symptoms along with other comorbid psychological problems and those having traumatic brain injuries (TBIs) were excluded.

After applying Stroop test[14] to identify brain damage, the subjects were divided into adults with BD in group A, and adults without BD in group B.

Among other assessment tools, the Stroop Colour-Word Test[13] is a constructive and reliable tool in the field of psychology. The test is popular in research and clinical settings.[15] There are also some gender differences in Stroop performance.[16] The age range for the test is 18-79 years, with two cut-off scores. The cut-off scores for those aged 18-49 years, the young adults, is 99 to discriminate normative (= / > 99). For those aged 50 years and older, the middle adults, the cut-off score is 62 to discriminate normative or BD participants (61 or below) It is also reported that education has a positive correlation with the performance on Stroop test, and the test-retest reliability is 0.90, with no evidence of its validity.[16]

To assess independent variables, like intentions, attitudes and behaviours, Experimental Vignette Methodology (EVM) offers the subjects carefully constructed and realistic scenarios.[17] In the past, it was the alternative method in survey research and in laboratory experiments in different disciplines.[18]

EVs are systematic combination of characteristics which are short and cautiously constructed description of individual, object, or situations.[19] Vignettes are mostly in a text format.[20] The aim of the vignette is to estimate the difference between the actual situations and assumed ones, in which the objects changed systematically in some way.[19] The subjects are asked to visualise themselves in some situations and they have to tell what they will do in those hypothetical situations. Alternatively, vignettes have some advantages over survey research methodology, like being more realistic and concrete, and vignettes increase experimental pragmatism.[17] They can assess different factors at the same time and avoid socially desirable responses of the subjects.[18]

In the present study, vignettes related to decision situations were developed. In order to assess the validity of the vignettes, a committee approach was adopted, and the experts selected 12 vignettes out of 20. The vignettes consisted of situations related to uncertainty, risk and certainty. These vignettes were presented to the participants and they were asked to choose either one option from perspective, course of action, and alternative, or more than one options for each vignette. Each situation had three different vignettes in order to avoid the impact of the diversity of the scenario within a decision situation. Each participant responded to 9 decision scenarios. The responses were compared between the groups.

Ethical Considerations

Ethical principles of psychological research devised by American Psychological Association were followed in the present study. Firstly, the research proposal was reviewed by the Board of Studies (BoS) and its sub-committee (ERC).

After approval from ERC and BoS, the present study was reviewed and approved by Board of Advance Studies and Research (BASR) of the University of Lahore. Thus, along with BoS (ERC), BASR allowed to conduct this study after reviewing it on the basis of ethical codes of conduct. Secondly, the anonymity of the participants' identities was ensured by giving them option; either to disclose or not disclose their identities. Thirdly, the participants were ensured regarding the confidentiality of information and the data was kept under lock and key and not shared with any irrelevant person. Fourth, the participants were given the right to withdraw the information at any stage and they were requested to sign informed consent. Participants were informed (provided complete information about research) and they were asked to give their consent (willingness) on informed consent form for participation in research. Thus, informed consent was signed by all participants. Finally, the research was deception free as no deception tactic was used in the present study to collect information from participants.

Data Analysis

Data were entered into SPSS-26. Frequencies and percentages of participants were computed. Chi-Square Test was applied to test the hypotheses. Phi-correlation was computed to study association between brain damages and logical inferences.

Results

Of the 170 individuals approached, 120(70.5%) were included; 60(50%) in each of the two groups. Overall, there were 76(63%) males and 44(37%) females. The overall age range was 18-60 years, with 105(88%) being young adults aged 18-49 years (Table-1).

Chi-Square Test of Independent revealed significant association between brain damage and logical inferences on first condition of certainty, χ^2 (1, N = 120) = 37.59, p = .000, Φ = .56. Group A exhibited higher frequency of immediate inferences on first condition of certainty (55) as compared to Group B (23) while group B exhibited higher frequency on mediate inferences (37) as compared to Group A (5). The value of Φ was .56 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on second condition of certainty, χ^2 (1, N = 120) = 36.09, p = .000, Φ = .55. Group A exhibited higher frequency of immediate inferences on second condition of certainty (53) as compared to Group B (21) while group B exhibited higher frequency on mediate inferences (39) as compared to Group A (7). The value of Φ was .55 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on third condition of certainty, χ^2 (1, N = 120) = 52.90, p = .000, Φ = .65. Group A exhibited higher frequency of immediate inferences on third

Table-1: Demographic characteristics.

Variables	n	%
Adults in Terms of Brain Damages (BD)		
With BD	60	50
Without BD	60	50
Gender		
Men	76	63
Women	44	37
Age		
Young Adults	105	88
Middle Adults	15	13
Literacy		
Literate	112	93
Illiterate	8	7
Birth Order		
First Born	42	35
Second Born	24	20
Last Born	27	22
Only Child	10	8
Family System		
Nuclear	73	61
Extended	47	39
Residential Origin		
Urban	72	60
Rural	45	38
Marital Status		
Married	38	32
Unmarried	82	68

Table-2: Logical inferences of depressive adults with and without brain damage under the conditions of certainty.

		Brain Damages				
Conditions	**Logical Inferences**	**A-With Brain Damages**	**B-Without Brain Damages**	**Total**	χ^2	**p**
Certainty Condition One	Immediate Inference	55	23	78	37.59	.000
	Mediate Inference	5	37	42		
Certainty Condition Two	Immediate Inference	53	21	74	36.09	.000
	Mediate Inference	7	39	46		
Certainty Condition Three	Immediate Inference	58	20	78	52.90	.000
	Mediate Inference	2	40	42		

Table-3: Logical inferences of depressive adults with and without brain damage under the conditions of risk.

Conditions	Logical Inferences	Brain Damages		Total	χ^2	p
		A-With Brain Damages	B-Without Brain Damages			
Risk Condition One	Immediate Inference	54	14	68	54.29	.000
	Mediate Inference	6	46	52		
Risk Condition Two	Immediate Inference	55	23	78	37.50	.000
	Mediate Inference	7	35	42		
Risk Condition Three	Immediate Inference	56	22	78	42.34	.000
	Mediate Inference	4	38	42		

Table-4: Logical inferences of depressive adults with and without brain damage under the conditions of uncertainty.

Conditions	Logical Inferences	Brain Damages		Total	χ^2	p
		A-With Brain Damages	B-Without Brain Damages			
Uncertainty Condition One	Immediate Inference	53	17	70	44.43	.000
	Mediate Inference	7	43	50		
Uncertainty Condition Two	Immediate Inference	55	20	75	43.55	.000
	Mediate Inference	5	40	45		
Uncertainty Condition Three	Immediate Inference	55	27	82	30.19	.000
	Mediate Inference	5	33	38		

conditions of certainty (58) as compared to Group B (20) while group B exhibited higher frequency on mediate inferences (40) as compared to Group A (2). The value of Φ was .65 (>.50) which indicated medium effect size. Thus, Group A exhibited higher frequency on immediate inferences under the three conditions of certainty compared to group B, while group B exhibited higher frequency on mediate inferences under the three conditions of certainty compared to group A (Table-2).

Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on first condition of risk, χ^2 (1, N = 120) = 54.29, p = .000, Φ = .67. Group A exhibited higher frequency of immediate inferences on first condition of risk (54) as compared to Group B (14) while group B exhibited higher frequency on mediate inferences (46) as compared to Group A (6). The value of Φ was .67 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on second condition of risk, χ^2 (1, N = 120) = 37.50, p = .000, Φ = .55. Group A exhibited higher frequency of immediate inferences on second condition of risk (55) as compared to Group B (23) while group B exhibited higher frequency on mediate inferences (35) as compared to Group A (7). The value of Φ was .55 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on third condition of risk, χ^2 (1, N = 120) = 42.34, p = .000, Φ = .59. Group A exhibited higher frequency of immediate inferences on third conditions of risk (56) as compared to Group B (22) while group B exhibited higher frequency on mediate inferences (38) as compared to Group A (4). The value of Φ was .59 (>.50) which indicated medium effect size. Thus, Group A exhibited higher frequency on immediate inferences under the three conditions of risk compared to group B, while group B exhibited higher frequency on mediate inferences under the three conditions of risk compared to group A (Table-3).

Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on first condition of uncertainty, χ^2 (1, N = 120) = 44.43, p = .000, Φ = .60. Group A exhibited higher frequency of immediate inferences on first condition of uncertainty (53) as compared to Group B (17) while group B exhibited higher frequency on mediate inferences (43) as compared to Group A (7). The value of Φ was .60 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on second condition of uncertainty, χ^2 (1, N = 120) = 43.55, p = .000, Φ = .60. Group A exhibited higher frequency of immediate inferences on second condition of uncertainty (55) as compared to Group B (20) while group B exhibited higher frequency on mediate inferences (40) as compared to Group A (5). The value of Φ was .60 (>.50) which indicated medium effect size. Chi-Square Test of Independent revealed significant association between brain damages and logical inferences on third conditions of uncertainty, χ^2 (1, N = 120) = 30.19, p = .000, Φ = .50. Group A exhibited

higher frequency of immediate inferences on third conditions of uncertainty (55) as compared to Group B (27) while group B exhibited higher frequency on mediate inferences (33) as compared to Group A (5). The value of Φ was .50 (= / >.50) which indicated medium effect size. Thus, Group A exhibited higher frequency on immediate inferences under the three conditions of uncertainty compared to group B, while group B exhibited higher frequency on mediate inferences under the three conditions of uncertainty compared to group A (Table-4).

Discussion

Decision-making is an ancient art.[21] Research is clear about the role of personal factors in decision-making.[22] Researchers[23] in decision sciences agreed on the fact that decisions come from the superior brain functioning.[22] Choices of the decision-makers stem from analytical ability and logical interpretation of all possible course of actions.[24] In the same vein, the findings of the present study revealed that in all decision situations, like certainty, risk and uncertainty, adults with BD made more immediate inferences than mediate inferences, whereas adults without BD made more mediate inferences than immediate inferences. In the light of these findings, the hypotheses anticipating that depressive adults with BD are likely to make more immediate inferences compared to mediate inferences, and that depressive adults without BD are likely to make more mediate inferences compared to immediate inferences were supported by the findings of the present study. This indicates that BD limit adults' cognitive abilities to consider all possible perspectives of the decision. Therefore, such adults restrict their choices to the easily available option, or immediate inference.[24]

The current study sheds light on the fact that decision-making is superior cognitive ability which is an outcome of healthy brain functioning. In line with past research, the study confirmed that BD leads to cognitive and decisional impairment.[25] The study was conducted on depressive adults with NTBI, which is a less researched area compared to adults with TBIs although NTBI lead to serious consequences.[26]

Depression and BD lead to impaired reasoning, poor problem-solving, impaired decision-making and faulty judgments.[27,28] Decision-making impairment was found in the subjects with BD compared to adults without BD,[29] confirming that brain functioning is crucial in determining the mediate or immediate inferences of adults. Decisions determine destiny. It is important to note that the brain functioning of individuals making important decisions should be adequately examined. Decisions can be separated into right and wrong decisions. Decision taken by adults ignoring most of the options mostly prove wrong.

The present study has limitations as it was conducted on the patients of depression only, while leaving out other psychological disorders. Secondly, it was limited to depressive patients having NTBI while leaving out TBIs. Finally, an experimental design could have led to more authentic results.

Conclusion

Depressive adults with brain damage made immediate inferences whereas their counterparts without brain damage made mediate inferences in decision situations marked by certainty, risk and uncertainty.

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Conflict of Interest: None.

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