Truth reasoning of incompatible assertions

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ABSTRACT: The current study examined the inferences of alethic reasoning with incompatible assertions among college students. It started with Alethic reasoning of two inferences about assertions that cannot be true at the same time, and the inferences include the deduction of falsity about one from the truth of the other or deduction of truth about one from the falsity of the other. Because they are formally equivalent to discourse manipulation, known as falsity. Falsity occurred when students accepted the third alternative to the premises in an incompatible assertion. Researchers discovered truth-conditional content that leads to student performance with falsity. Furthermore, this truth-conditional content is essentially content that relates variability in conditional reasoning, which may predict how college students deal with incompatible assertions.

The results suggested the tendency to fall into falsity is moderated by the college student's background knowledge and also provided additional evidence for the relationship between deduction and semantic memory retrieval.

KEYWORDS: Alethic Reasoning, Incompatibility, Falsity, Counterexamples, And Background Knowledge.

I. INTRODUCTION

Human reasoning is ubiquitous in everyday scenarios. It is considered a hot topic in academia. Knowing which types of inference are simple and which types are difficult, and especially why these are so, will not only inform the theory of inference but may also have social benefits. Harman, G. (2003) considered alethic reasoning to be one of the principles of reasoning that helps define real inferences. However, two real inferences and assertions cannot be true at the same time; the inferences include the deduction of falsity about one from the truth of the other or the deduction of truth about one from the falsity of the other (Brisson, J., Markovits, H., Robert, S., Schaeken, W., 2018).

Here, reasoners focus on an understudied falsity in alethic reasoning.

Alethic reasoning consists of only truth values in assertions (Walton, D. N., 1990). and that word "alethic" expresses a conception of truth, but the conception of truth is flawed with its clichés and inconsistent senses (Scharp, 2021). Alethic reasoning raises concerns about possible or necessary inferences. It is always concerned with two sets of possibilities with their relationships and always considers dyadic relationships (Johnson-Laird & Ragni, 2019). It also requires the generation of an inference logically derived from the premises; explicitly, if the premises remain true, the inferences must be true. Once inferences are possible, even if they are not necessarily derived from the premises, their truth value is unnecessary, while the premises remain true. Therefore, the ability to distinguish between necessary and unnecessary inferences is a vital knack of deductive reasoning (Brisson et al., 2018). Falsity essentially leads to indeterminate conclusions that remain necessary. It forces the reasoner to build a prime by reducing multiple alternatives to two dichotomies (Hurley, 2014). Although one of those alternatives is unpopular, reasoners are forced to see the third alternative by way of the only remaining inference. Furthermore, suppression effects occur when "an alternative or additional antecedent in the second conditional must change the interpretation of the first conditional "(Byrne, 1989).

When people learn about true conditionals, for example: if he falls into the river then he will get wet. They keep numerous alternate possibilities in mind. Reasoners can express this condition in such a way: M P . . . where "M" means falling into the river, and "p" means getting wet. These three dots represent alternatives that may still need to be explicitly measured, and reasoners have embraced the convention of proposing distinct models on distinct lines (Johnson-Laird & Byrne, 1991). However, a falsity occurs in binary possible means. In the initial variant, the binary options present the ends of a continuum, so everything amid is

considered a possibility. Such as, think of an assertion like: "Either I visit the zoo or I don't go. Alternatively, binary options (which don't suit similar) be present, and 3rd alternatives ignore. Such as, consider a discussion about organizing a doctor's meeting: "Either they increase the meeting fee, or they don't welcome meeting," ignoring opinions such as the doctor is ill or he is out of the city. The current study focuses on the falsity of the second edition and builds on the work of (Brisson et al., 2018) on falsity dichotomies' reasoning in college students. In the 2nd type of falsity dichotomy, the proposed option is bound with an incompatible connective (also known as a NAND [not and] connection or "Scheffer's stroke), which means that the two assertions are mutually exclusive. This connection shows that two assertions cannot be true at the same time, but both can be false at the same time (Rautenberg, 2006). Alethically, the truth of one incompatible assertion contains the falsity of another assertion. However, one person's lie does not automatically involve another person's truth (Brisson et al., 2018).

The purpose of this study is to investigate whether the third alternative to falsity can affect the background knowledge effects with alethic reasoning of incompatible assertions among college students. Furthermore, the more we investigate, the more eagerly third alternatives can enter students' minds, and the more inclined they will be to avoid falsity. Falsity is prevalent in everyday life in a variety of structures. Therefore, understanding how individuals, especially college students, respond to it has important practical implications. Critical assessment of information is a very important life skill. Because many college students have unsupervised Internet access, they can gather both true and false information, and the importance of distinguishing between the two will only grow. This study used paper and pencil experiments.

The importance of our study is to observe that the number of college students' retrievable counterexamples is also a key factor in their performance of invalid inference. O'Brien et al. (1971) showed to provide easily accessible college students (about 16 years of age or elder) helped to correctly respond to uncertainty about invalid inferences. Additionally, children appear to perform better when semantically categorizing premises (Markovits et al., 1998). Thus, there is the first study on college students' reasoning with alethic reasoning of incompatible assertions, we expected college students to exhibit similar patterns of reasoning as adults; that is, the Affirming inference would be easier than the Denying inference, and when there were more counterexamples, and the latter will perform better. We provided college students with three different experiments and got the results, in which similar truth conditional content effects to the previous studies were observed (Brisson et al., 2018).

II. EXPERIMENT

In this study, we have used assertions based on alethic reasoning to express incompatibility. We have started with truth base assertions that have many or few alternative antecedents and have translated them into incompatible assertions. Such as, reasoners have started with conditional assertion, "If I fall into the river, I will get wet" This assertion has different true counterexamples (can die, dive, plunge, swim, survive, etc.) these are the inferences of Affirmation of the Consequent inference (ACi) and Denial of the Antecedent inference (DAi). they have constructed the incompatible assertion: "Falling into the river has incompatibility with death." Although expressed differently, the possibility of an alternative antecedent as a condition is now the third alternative for incompatible assertions, this is the condition where neither A nor B exists. This argument is based on the laws of classical logic, which determine the equivalence among incompatibility and conditional assertions and antecedents and denials results, namely $(A \rightarrow B) \equiv (A \mid \neg B)$ ($\models$ Sheffer incompatibility stroke).

Affirmation of the Consequent inference (ACi)

$(A \rightarrow B)$

B (B is true; therefore, A is true)

Denial of the Antecedent inference (DAi)

$(A \mid \neg B)$

$\neg A$ (A is False; therefore, B is False)

The law of causality expresses the idea about truth-conditional content relation is equivalent to a relationship that cannot have causality and its effects at the same time. According to this law, we can also convert the previous replacement item into the third alternative and the disablers item into the "exemption" of the incompatible assertions. Assuming that the alternative assertion is that A is false and B is true, the law shows that the same condition where both assertions (namely A and Not-B) are both false.

$(\neg A \rightarrow B) \equiv (A \mid \neg B)$

This is exactly the definition of the third alternative of falsity. Moreover, if the disabling condition where A is true and B is false, considering the same truth-conditional reasoning that can lead to the condition where both assertions (i.e. A and Not-B) are considered to be true as the "exemption", that will be indeed the theorem of the incompatibility among these assertions. The logical consistency of truth-conditional relations converts into incompatibility have chosen to use several alternations and some are disablers.

III. PARTICIPANTS AND PROCEDURE

A total of 150 college students (80 men, 70 women, average age: 20 years, 11 months, age range: 16– 21) at Punjab College have taken part in the experiment. All are Urdu speakers but their study medium is in English. The following instructions have been given by the students:

✓ Each participant has randomly allocated one of the booklets.
✓ Instructor told them to take time as much as they needed.
✓ Students must be taken part in the experiment individually.

IV. DESIGN AND MATERIALS

Reasoners have constructed four booklets (paper and pencil). The first question contained three sets of reasoning inferential based on the main assertions, with many counterexamples. For each of the main assertions, college students have experienced problems corresponding to the Affirming 1, Affirming 2, Denying 1, and Denying 2 inferences. These sequences have been determined randomly for each main assertion, and the order is as follows:

1 Falling into the river has incompatibility with death.
2 Having a bachelor's life has incompatibility with married life
3 Being taller naïve has incompatibility with Valley ball players.

In the second booklet, three sets of reasoning inferences are raised, based on assertions, and there are few counterexamples. For each main point of assertions, we will use the same reasoning inferences sequence as in the 1st booklet. These assertions have been constructed in the following order:

1. Old computer system has incompatibility with a new computer system.
2. Religious beliefs have incompatibility with the political system.
3. Private business affairs are incompatible with government offices.

These two booklets have alternative versions that will construct on the bases of inverting the order of the main assertions. College students will be asked to provide their demographics (gender, age, and grade) on the first page of each booklet. Then they will be provided with the following instructions: "On the next page we show you rules that you must assume to be true. You have to accept that the rules are always true. For each line, we will also show you some observations. Your task is to choose a logical inference from the rules and the given observations.

An assertion of incompatibility will be displayed at the top of each page. On the same page, four logical assertions are proposed that correspond to the conclusions Affirming 1, Affirming 2, Denying 1, and Denying 2 inferences. For each assertion, the participant must choose from three possible conclusions. The following are examples of such assertions and a Denying 1 conclusion problem:

Assume it is always considered to be true that:
Falling into the river has incompatibility with death
For each of the following observations, select the conclusion that follows logically from the rule and the given observation:
Pam didn't fall into the river. One can conclude that:
1. Pam died because of thalassophobia.
2. Pam did not die.
3. One cannot conclude whether or not Pam died.

Concluding, in Logical forms, Inferences-type (Affirming 1, Affirming 2, Denying 1, and Denying 2) will be "within-subject" variables and premises-type (Many, Few) will be "between-subject" variables.

V. RESULTS

Preliminary analysis revealed that some college students gave unexpected answers to valid or invalid forms. In other words, they do not approve valid or invalid inferences, but also suppress the opposite of the invited conclusion, namely Affirming 1: B is true; Affirming 2: A is true; Denying 1: B is false; Denying 2: A is false.

Of these, ten college students produced close to or more than 3 standard deviations from the mean number of unexpected responses (three or more responses out of 12). They were thus eliminated from further analysis. Of these ten, six were from the Many conditions and four were from the Few conditions. Among these participant's students, ten college students generated approximately or more than 3 standard deviations from the mean number of unexpected responses (3 or more responses out of 12 responses). Therefore, they were deleted from further analysis. Of these ten, six come from the state of "Many" conditions and four from the state of "Few" conditions. All further analyses were conducted on the 100 remaining college students (50 in the Many, 50 in the Few condition). We then calculated the percentage of logically correct responses out of three conclusions for each of the four logical forms (see Table 1).

Firstly, A 2 (validity: valid, invalid) × 2 (Inferences-type: 1, 2) × 2 (Premises-type: Many, Few) × 2 (order: 1, 2) mixed-design ANOVA showed no significant order effect $F (1, 92) = 0.68$, $p = 0.41$. Next, reasoners performed an analysis of variance, with validity (valid, invalid) and Inferences-type (1, 2) as repeated measurements, and the Premises-type (Many, Few) as variables between subjects. It does not give the main effect of validity, $F (1, 94) = 0.01$, $p = 0.7$, inferences-type, $F (1, 94) = 3.8$ $p = 0.07$, and nor Premises-type, $F (1, 94) = 0.32$, $p = 0.73$. The results also show that there is a positive interaction between validity and Premises-type $F (1, 94) = 7.63$, $p <0.05$, partial eta squared $(\eta2) = 0.065$, and there is a significant difference between validity, Inferences-type, and premises-type, three-way interaction type $F (1, 94) = 5.563$, $p <0.05$, $\eta2 = 0.057$, there is no significant interaction between the Inferences-type and premises-type, $F (1, 94) = 3.4$, $p = 0.09$, nor between Validity and inferences-type, $F (1, 94) = 0.63$, $p = 0.53$.

The Tukey process was used for Post hoc comparisons with $p = 0.05$. We first analysed the Validity × inferences-type interaction. For the invalid forms, this showed that the number of logically correct responses was greater for the Many, $M = 0.60$; $SE = 0.05$ than for the Few assertions, $M = 0.53$; $SE = 0.05$. The analysis of the three-way interaction showed that this difference was maintained between the Many assertions, $M = 0.71$; $SE = 0.05$, and Few assertions, $M = 0.49$; $SE = 0.05$, for the Denying1 form as well as between the Many, $M= 0.68$; $SE = 0.05$, and Few assertions, $M = 0.54$; $SE = 0.05$, for the Denying 2 form. For the valid forms, there was no significant difference between the number of logical responses for the Many and the Few premises. However, analysis of the three-way interaction revealed that the difference was significant for the Affirming 2 form, $M= 0.52$; $SE = 0.05$; $M= 0.67$; $SE = 0.05$, but did not reach significance for the Affirming 1 form.

Table 1: Mean percentage of the four inferences-types generated from the logical forms (Affirming 1, Affirming 2, Denying 1, and Denying 2) by Premises-Type (Many, Few) in Experiment 1.

TYPE	Denying 1	Denying 2	Affirming 1	Affirming 2
MANY	0.71 (0.42)	0.68(0.41)	0.70 (0.40)	0.52(0.41)
FEW	0.49 (0.32)	0.52(0.41)	0.69 (0.39)	0.67 (0.43)

VI.

VII. GENERAL DISCUSSION

All the results of this study have accepted the given hypothesis. They illustrate the tendency to accept two invalid forms ofconclusion for the invitation and fall into the falsity that is directly related to the relative number of the third alternative. If college students have access to a few assertions of such options, they will show a greater tendency to accept the conclusion of the invitation if it is not worth it. The results also expressed the unexpected truth-conditional content for the form of Affirming 2, "Many" assertions are rejected more than a few assertions. This was surprisingly stirring because both the assertions "Many" and "Few" plots have the same low number of exemptions (see Table 2). The literature on the suppression effect of conditional reasoning does show that this truth-conditional on effective reasoning is driven primarily by disabled conditions rather than alternative assertions (Byrne, 1989; Cummins, 1995; Thompson, 1994). Therefore, suppression of effective inferences through incompatibility must be driven by exemptions rather than by the third alternative. However, previous studies on conditional reasoning have observed the indirect effects of alternative assertions on the suppression effect of valid conclusions. Moreover, some studies are revealed the alternative antecedents of conditioning assertions that can lead to the retrieval for disabling conditioning. It is noteworthy that the alternative antecedents of generation and college students (Janveau-Brennan &Markovits, 1999) and adults (De Neys et al., 2002; Markovits & Potvin, 2001) have more inferences about effective modus ponens and/or modus tollens to be relevant. Similarly, the third alternative for retrieving Many incompatible assertions may help detect exemptions. However, this debate is still controversial, because if college students are explicitly provided with alternative antecedents, these suppression effects on valid conclusions are not repeated (De Neys et al., 2003). Nevertheless, the suppression effect found in this study is not clear and very small and does not affect the support for our main hypothesis. Therefore, the possible suppression of valid conclusions that affect incompatibility can be investigated in further research.The falsity is a common reasoning error. This can be seen as a wrong interpretation of the situation as a dichotomy between two options, when in fact it is loosely bound by incompatible connections. This alteration considers a rhetorical technique that emphasizes that two options cannot be true in the same situation and puts the possibility that both are not true in the background. The results of the two studies can show the strength of this effect. These studies show that even when emotionally neutral Premises-types are used, the overall falsity in thinking showed at its high level of 70%.

Table 2: Mean number of Third alternatives and Exceptions created (maximum of 5) for Premises-Type (MANY, FEW).

MANY Alethic Third alternatives	Third alternatives	Exemptions
Falling into the river has incompatibility with death Causal content: If one has fallen into a river, then one will be diedbecause of thalassophobia.	3.98	1.84
Having a bachelor's life has incompatibility with married life. Causal content: If one has a bachelor's life, then one will like to live asingle life.	3.80	1.90
Being a taller naïve has incompatibility with Valley ball players. Causal content: If one has a taller naïve, then one will like basketball.	3.62	1.90
FEW Alethic Third alternatives	Third alternatives	Exemptions
The old computer system has incompatibility with a new computer system. Causal content: If one has an old computer system, then one will be an expert.	2.44	1.01
Religious beliefs have incompatibility with the political system. Causal content: If one has Religious beliefs, then one has no interest in politics.	2.6	1.84
Private business affairs are incompatible with government offices. Causal content: If one has Private business affairs, then one has no interest in government offices.	2.6	1.43

VIII.

IX. CONCLUSION

The results have shown the degree of variability in which college students have made falsity. Our main assumption here is that an important part of this variability is the result of repeated failures, the probability of which is related to the amount of information stored in semantic memory retrieval. In other words, a key factor in understanding the strength of the falsity considered the vital role of the semantic memory retrieval process in reasoning (Markovits, 2014). In the case of alethic reasoning of incompatible assertions, reasoners believe that the key information is related to the possible third alternatives. In these cases, the two options presented are not true or false. The semantic memory retrieval model allows general predictions that the degree to which students make falsity is inversely proportional to the number of possible third alternatives that are easily available in semantic memory retrieval.

The experiments' results are consistent with its prediction. The experiment has shown that the number of third alternatives either increases the main premise or increases the unnecessity of invalid forms. In experiment 1, reasoners transformed the truth-conditional contents into incompatible assertions with suppression effects (many and a few third alternatives). As predicted, compared with the premise that contains suppression effects, when the few-third alternatives are greater than many third alternatives, the approval of Denying 1 and Denying 2 is greater.

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