

## Conjunction as Cohesive Devices in the Writing of Mathematicians

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**Abstract:** The present study investigates the use of conjunction in the mathematics books. Authors developed a database of conjunction to study the uses and effects of conjunction in Mathematicians writing. 'A Course of Pure Mathematics', a work by great English Mathematician G. H. Hardy is compared with a book 'Topics in Algebra' by another famous mathematician I. N. Herstein in the perspective of used conjunctions. Frequencies of various categories of conjunctions are counted and each category is given with a weight and highest weight category is identified. A visual representation of analysis through graphs is given.

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### I. Introduction

Halliday and Hasan (Halliday M. A., 1976) used the term cohesion to refer to non-structural text forming relations. They played a special role in creating a text, but they did not constitute structure. Text-forming relations are properties of a text. They serve to link information within a text. This is achieved through relations in meaning. "The significant property of the cohesive relation is the fact that one item provides the source for the interpretation of another". Most of the known study in the realm of cohesion includes work by Halliday and Hasan (1976). They argue that cohesion is expressed partly through the grammar and partly through the vocabulary. According to them "It is necessary to consider that cohesion is a semantic relation but, like all the components of semantic system, it is realized through the lexicogrammatical system. The lexicogrammatical system includes both grammar and vocabulary.

Cohesion as major component of language plays a significant role in connecting the sentences and paragraph of text together. Cohesive relation fits into the overall pattern of languages. Cohesion established grammatical and lexical relationship in both text and sentences. Cohesion expresses the continuity that exists between one part of the text and another one. This continuity is significant in two aspects. The one is that in discourse, continuity is showed by the points of the relation or contact with what has been said before. On the other hand, the continuity provided by the cohesion helps the readers to fill in the gap in the discourse, to supply all the components of the message which are not present in the text but are important and necessary to its interpretation. There are two main types of cohesion: grammatical, referring to the structural content, and lexical, referring to the language content of the piece. The purely linguistic elements which make a text coherent are included under the term cohesion.

Indeed, cohesive devices connect the linear sentences in a text together in order to make it coherent. There are two approaches to analyze cohesion in a text: first is the taxonomy of cohesive devices by Halliday and Hasan (1976) and second is the lexical analysis by Hoey (1991) which stresses lexical cohesion. Conjunctions are one of the most important explicit markers of cohesion.

According to Halliday and Hasan (1976), the categories and subcategories of cohesive devices are as follows:

(1) Grammatical cohesive devices including:

(i) **Reference:** Personal reference, Demonstrative reference, Comparative reference.

(ii) **Substitution:** Nominal substitution, Verbal substitution, Clausal substitution.

(iii) **Ellipsis:** Nominal ellipsis, Verbal ellipsis, Clausal ellipsis.

(iv) **Conjunction:** Appositive, Clarification, Additive, Variation, Temporal, Comparative, Causal, Conditional, Concessive.

(2) Lexical cohesive devices including: Repetition, Collocation.

The present study is limited to conjunctive elements. Conjunctions are resources for making transition in the unfolding of text. Conjunctive relations specify the way in which what follows in a text is linked to what has gone before, based on their specific meanings. Hasan and Halliday (1976) adopt a scheme of four categories, namely additive, adversative, casual and temporal conjunction. In some Conjunctive relations, the semantic relation is clearly felt to be present but is unexpressed, possibly as a result of the presence of other cohesive

elements. These types are called implicit conjunctions. However, conjunctions should not be assumed where they are not expressed. In English the presence or absence of explicit conjunction is one of the principal variables of English discourse, both as between registers and as between texts in the same register. Thus variation is obscured if conjunction is assumed where it is not expressed. Halliday (1994, 2004) proposes some headings which are useful in analysis purposes. Generally, the conjunctions are classified into the three main categories: Elaboration, Extension and Enhancement.

(1) Elaboration: Elaboration means one clause that expands another by elaborating on it by restating in other words, specifying in greater detail, commenting, or exemplifying. There are two categories of elaborative relation, namely apposition and clarification for the purposes of discourse.

(2) Extension: Extension means one clause expands another by extending beyond it by adding some new element, giving an exception to, or offering an alternative (Halliday, 1985) Extension involves additive and Variation.

(3) Enhancement: Enhancement means one clause expands another by embellishing around it by qualifying it with some circumstantial feature of time, place, cause or condition (Halliday, 1976). There are five categories of enhancement: Temporal, Comparative, Causal, Conditional, and Concessive.

## **II. Literature Review**

Halliday and Hasan (1976) explained that linguistics in text is any written or spoken passage that form a unified whole. Applications of cohesive devices have been studied from contra positive points of view. A significant number of researchers have found their work valuable in advancing further research related to cohesion. Cohesion was once known as a predictor of textual coherence but this idea was later rejected by empirical studies and theoretical works in early 1980s ((Carrell, 1982), (Mosenthal, 1984)). A more conservative idea is that cohesive ties can contribute to textual coherence through they do not guarantee it. However, in pedagogical atmosphere there is a belief that cohesive devices are the major means to make writing clear.

Brown and Yule (Brown, 1983) pointed out that any of formal markers does not stand in simple one to one relationship with a particular cohesive relation. Tierney and Mosenthal (1984) viewed the effect of cohesion in essays written by students of 12<sup>th</sup> class students. Halliday (1985) and Hasan (1984) the type, number and degree of utilization of cohesive devices used in the text contribute to the cohesiveness of a text. In written and spoken English discourses, grammatical connections links individuals' clauses and utterances that make a text cohesive. With the help of cohesion property certain grammatical or lexical features of the sentences of the text connect them to other sentences in the text. Further, Bamberg ((Bamberg, 1984)) developed four-point holistic coherence scales. M. C. Culley in 1987 investigates a random sample of persuasive papers written by 17-years olds during the writing evaluation. (Wikborg, 1990) found that Swedish students had cohesion problems related to misusing or misleading sentence connection, malfunctioning cohesive devices, and finally using too great a distance between the cohesive items in a cohesive chain. Field and Yip (1992) obtained that on an average, Hong Kong students used more connectors (cohesive devices) than Australian students.

According to Baker (1992), cohesion is the network of grammatical, lexical, and other relations which links various parts of the text together. Milton (1999) in a study compared the use of cohesive devices by nonnative and native speakers of speakers of English. The text consisted of examination papers of Hong Kong and UK students. Meisuo (2000), following the finding of previous studies, conducted a research investigation on cohesive devices in the writing of Chinese undergraduate EFL students in two PRC universities. In another study by Hinkel (2001), NS and NNS students' use of sentence-level and logical-semantic conjunctions were investigated. Some English essays from Japanese, Korean, Indonesian, Arabic and English students were collected. The findings revealed that all of the four NNS groups used sentence transition more frequently than the NS group. Bolton, Nelson, and Hung (2003) examined the use of connectors in Hong Kong students' writings.

In the paper (Rahman (2013)) authors have studied examiner college-level Arabic L1 user command of cohesive devices by exploring the extent to which Omani student-teachers of English and native English speakers differ in their use of cohesive devices in descriptive. A qualitative research methodology was utilized to analyze the writing of the two groups to reveal the points of strengths and weaknesses in their writing. In the article by Ayyash (2013), cohesive devices have been used as an instrument of analysis in a plethora of research papers that have investigated a variety of textual types. The reason behind using the 1976 model of cohesion in textual analysis is that it is probably the most comprehensive account of cohesive ties to date of equal importance are the notion of theme and Rhyme since the interplay of these components has a major effect in analyzing different genres.

Recently in the paper (Ali, 2016), authors investigated the use and misuse of cohesive by 4<sup>th</sup> year students. The primary aim is to investigate the teachers' role in encouraging the students to write well tided

writing using cohesive devices in classes naturally when they perform their lectures. Yin (Yin, 2015) also discussed the use of cohesive devices in news language.

The study in the paper (Yeibo, 2012) showed some linguistic strategies used by the poet of achieve inter-sentence connection in the poetry. It also shows the network of interdependencies among linguistic and non-linguistic features, which give the poetry a thoroughly cohesive structure. In (Yang, 2012), authors comparatively investigated the difference and similarities in the (incorrect) use of cohesive device by second year and fourth year undergraduate chinese EFL learners in their argumentative writing. Also, various researchers have explored the connection between the use of cohesive devices and the qualities of the writing (see, (Ghasemi, 2013), (Cox, Shanahan, & Sulzby E., 1990) and reference therein)

### III. Research Procedure

In this section we develop a database of types of conjunctions and some articles has been considered to pick used conjunctions for various categories (see,...) and the analysis was done with the help of searching tools of Microsoft Pdf Program for counting the total frequency of all conjunctions in two books of higher mathematics i.e. ‘Topics in Algebra’ by I. N. Herstein (say, Book 1) and ‘A Course of Pure Mathematics’ by G. H. Hardy (say, Book 2). Next we develop a weighting mechanism based on these frequencies.

Each category of conjunctions has been assigned a weight to get the proportional results on analysis. The weights are simply taken as the ratio of frequency of conjunctions of a particular category to the number of conjunctions in that category. For instance, we have 22 conjunctions in extension category in our database. The overall frequency of these 22 conjunctions is found to be 4034 in Topics in Algebra. Therefore by taking the ratio of 4034 to 22, we get weight of 183.36 to Extension conjunction. Hence the determination of weights provides the adequate ratio of the conjunction used in the writings. If we have less number of conjunctions in any category it does not necessarily imply that they will get more weight. For instance it is evident from Table 1 that 30 Elaboration conjunctions weights 36.93 whereas 49 Enhancement conjunctions weight only 56.35.

**Table 1:** Weights calculated for types of conjunctions in Topics in Algebra.

S. No	Conjunction category	No. of Conjunctions	Total Frequency	Weight
1	Elaboration	30	1108	36.93
2	Extension	22	4034	183.36
3	Enhancement	49	2761	56.35

Now we compare the weights calculated for various subcategories of conjunction in the following tables.

**Table 2:** Weight calculated for subcategory of conjunction in Topics in Algebra.

S. No	Elaboration subcategory	No. of Cohesion	Total Frequency	Weight
1	Appositive	9	861	95.67
2	Clarification	21	247	11.76

S. No	Extension subcategory	No. of Cohesion	Total Frequency	Weight
1	Additive	18	4015	223.06
2	Variation	4	19	4.75

S. No	Enhancement subcategory	No. of Cohesion	Total Frequency	Weight
1	Temporal	20	1113	55.65
2	Comparative	4	68	17.00
3	Causal	8	359	44.88
4	Conditional	8	980	122.50
5	Concessive	9	241	26.78

**Table 3:** Weights calculated for types of conjunction in A Course of Pure Mathematics.

S. No	Conjunction category	No. of Conjunctions	Total Frequency	Weight
1	Elaboration	30	537	17.90
2	Extension	22	5049	229.50
3	Enhancement	49	1970	40.20

**Table 4:** Weight calculated for subcategory of hedges in A Course of Pure Mathematics

S. No	Elaboration	No. of Conjunctions	Total Freq.	Weight
1	Appositive	9	369	41.00
2	Clarification	21	168	8.00

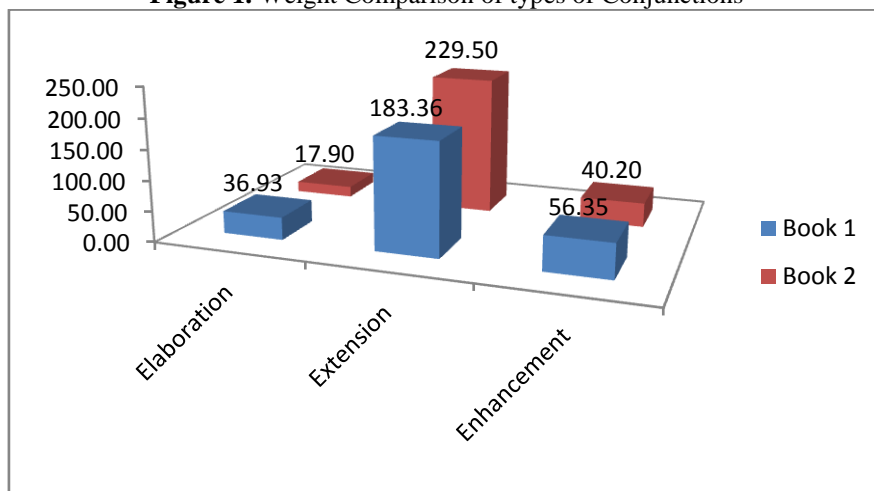
S. No	Extension	No. of Conjunctions	Total Freq.	Weight
1	Additive	18	5023	279.06
2	Variation	4	26	6.50

S. No	Enhancement	No. of Conjunctions	Total Freq.	Weight
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1	Temporal	20	744	37.20
2	Comparative	4	93	23.25
3	Causal	8	315	39.38
4	Conditional	8	656	82.00
5	Concessive	9	162	18.00

In the Figure 1 above, we present weights calculated for all categories of conjunction in the form of bar diagrams. The blocks presented in blue belong to Topics in Algebra (i.e, Book 1) whereas the red blocks belong to A Course of Pure Mathematics (i.e, Book 2). It is evident from the Fig 1 that conjunctions are used in the same manner in both books. It can be further observed that the pattern of usage is almost same by both the authors. The difference is that the use of Appositive and Conditional conjunction is least frequency by G. H. Hardy whereas Comparative and variation type conjunction is least used cohesion by I. N. Herstine.

**Figure 1.** Weight Comparison of types of Conjunctions



**Figure 2.** Weight Comparison of subcategories of Elaboration category

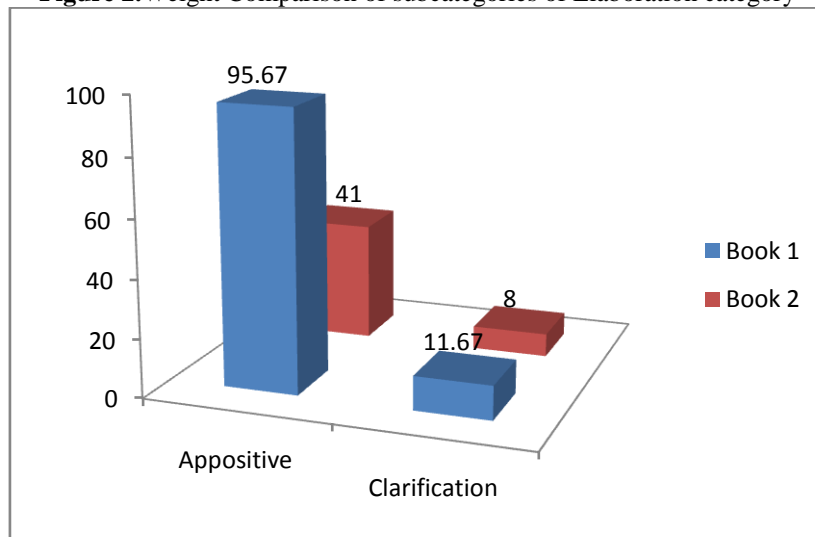


Figure 3. Weight Comparison of subcategories of Extension category

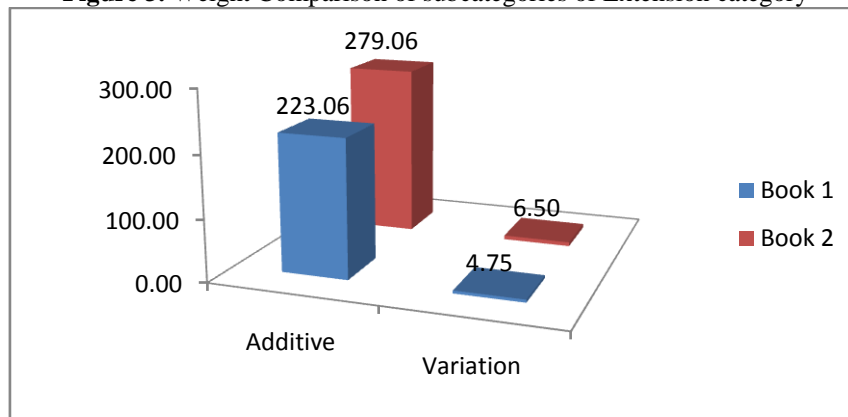
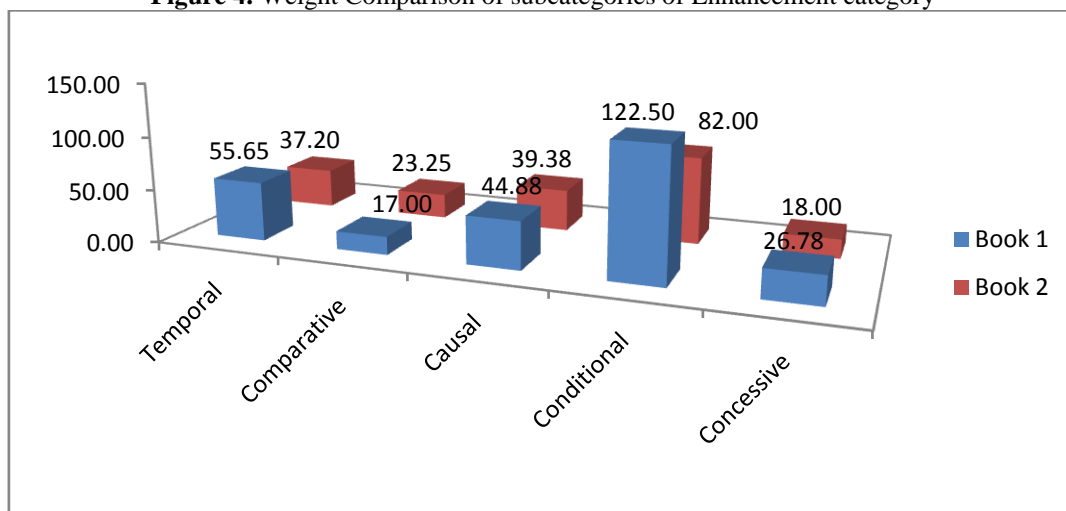


Figure 4. Weight Comparison of subcategories of Enhancement category



#### IV. Conclusion

While comparing both books, it is found that the conjunctions were used in almost the same order by both the authors. All categories and subcategories of conjunctions have been found to have more weights in Book 1 as compared to Book 2. Further, almost the same usage of conjunction (on the basis of weights) suggests the choice of same style of writing by both authors.

Extension (4034 in Book 1 and 5049 in Book 2) is the mostly used conjunction in both books. The use of ‘and’ is most frequent in both books (3197 in Book 1 and 4020 in Book 2). The other most frequent extensive words used by both mathematicians are ‘but’, ‘also’, ‘next’ and ‘important’.

Enhancement (2761 in Book 1 and 1970 in Book 2) is the second most used category of conjunctions in both books. The most frequent words of enhancement conjunctions are: ‘then’, ‘next’, ‘just’ and ‘finally’ from temporal; ‘all the same’ and ‘similarly’ from comparative; ‘hence’, ‘therefore’ and ‘because’ from causal; and ‘however’ from concessive subcategory.

Elaboration (1108 in Book 1 and 537 in Book 2) is the least used category of conjunctions by both authors. Some conjunctions ‘thus’ and ‘that is’ from appositive; and ‘in fact’, ‘in particular’ and ‘at least’ from clarification subcategory are frequent in both books.

It is further concluded from the results that different authors use same pattern of conjunctions if the writing belongs to same field. The most used conjunctions used in the mathematics books are ‘and’, ‘but’, ‘also’, ‘then’, ‘next’, ‘just’, ‘hence’, ‘therefore’, ‘because’, ‘thus’, ‘that is’, ‘in fact’, ‘in particular’ and ‘at least’. These conjunctions help to explain the terminology of mathematicians in the both books. These results also help to improve crisp and concise writing skills of other mathematicians in book writing process.

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## Appendix- Database of Conjunctions

### (i) Elaboration

(a) **Appositive:** in other words, that is to say, that is, for example, for instances, thus, to illustrate, i mean, to put in another way

(b) **Clarification:** rather, at least, by the way, in any case, anyway, in particular, more specifically, more especially, in short, to sum up, actually, to be more, incidently, leaving that side, as I was saying, to resume, to get back to the point,in conclusion, briefly, as a matter of fact, in fact

### (ii) Extension

(a) **Additive:** and, also, moreover, but, yet, however,and then, likewise, besides, equally, important, finally, further, furthermore, in addition, next, second, still too, on the other hand

(b) **Variation:** instead, on the contrary, apart from that, alternately

### (iii) Enhancement

(a) **Temporal:** in the first place, then, next, just then, hitherto, previously, finally, in the end, soon, after a while, next time, that morning, until then, at this moment, before that, at first, formerly, at once, soon, to sum up, in conclusion

(b) **Comparative:** likewise, similarly, in a different way, all the same

(c) **Causal:** hence, consequently, because of that, as a result, on account of this, for this purpose, therefore, because

(d) **Conditional:** then, in that case, otherwise, if not, even so, nevertheless, in that respect, in other respect

(e) **Concessive:** yet,still, however, under the circumstance, ever so, in that case, in that event, despite this, elsewhere

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