

THE MATRIX ANALYSIS OF THE STRUCTURE OF

SMALL GROUP DISCUSSION

A B S T R A C T

This paper describes a new method of analysis for small group discussion called "Matrix Analysis". The author then shows how it was applied to the comparison of differences between 26 small group discussions of 9-13 year old students.

Comparisons are made between three groups of students :

- (A) groups trained in thinking skills and group discussion,
- (B) groups with practice in group discussion,
- (C) untrained groups.

Restricting the analysis in this paper to one feature of the discussions (the extent to which different groups develop ideas according to a "spiral" pattern) the author shows that differences were significantly affected by practice in discussion and training in thinking skills.

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The evaluation of the de Bono (1973) curriculum project to teach thinking in schools through small group discussion required the analysis of a large number of discussions with regard to a number of different features. As the evaluator, when I began the task I found that most previous research on group discussions involved an initial verbatim transcript of the discussions, followed by an intuitive search for pattern and meaning expressed in selected quotations and abstracted totals. For example, Barnes (Barnes, Britton and Rosen, 1969) examines teacher questioning strategies, expressing his finding in tables and illustrating the categories of the tables by direct quotation. Three major disadvantages of this method were perceived :

1. A transcript is lengthy and expensive to produce, both in time and cost. If all the data has to be transcribed, it severely limits the amount of data used.
2. Whilst the transcript provides too much information the findings and totals provide too little. For instance, in the perception of a spiral pattern, Britton (Barnes, Britton and Rosen, 1969) can only give us selected quotations to illustrate his findings. Flanders (1970), Sinclair and Coulthard (1975), and Schlessinger (1974) are limited by the use, either of a full verbatim transcript, or of totals abstracted from that transcript. The problem with totals is that it is impossible to check any or all of the individual items that make up that total, and impossible to see how they relate to other items in other totals, unless the author has already done it by selected quotation, or having the transcript before us, we are prepared to devote the time to tease out the information from the raw data for ourselves. Even having done that, there is no better way to communicate our conclusions than by the totals or selected quotations available to the author in the first place.

Furthermore, as it is impossible to relate all aspects to all other aspects, the investigation of patterns of interaction must largely be predetermined by the particular patterns the researcher or reader had previously decided to investigate. It is difficult to identify new, important or related variables without an overall model of the discussion.
3. But the greatest disadvantage of a transcript is that it can never be made to model the discussion. A tape is sounds in linear time and a transcript signs in linear space. Either way, features and events are only proximal if they happen to have occurred proximally in time, whilst for the perception

of the inter-relation of aspects one needs to be able to see all the essential features of the whole discussion simultaneously. Thus a model is necessary, and a transcript will never do.

The method then developed is simply a number of conventions to enable the content (what was said) and the form (how it was said) to be coded or "logged" into an analysis matrix modelling the discussion. The reason for including form, content and analysis on a single matrix is to enable the researcher or reader to simultaneously observe what a particular point¹ is, when and how it is made, how it is analysed and how it relates to the form, content and analysis of any other point in the discussion. In all the example below the content and analysis of a ten minute discussion between four participants has been coded into a single matrix.

PRIMARY MATRIX																				
"Should pupils be paid a small wage for going to school?"																				
Group 3.																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
1. School is for learning								7												
2. Pupils need for money		2	3		5			8						14						
3. Needs depend upon job or expenses			3	4																
4. ie. travel to training away from home				4																
5. Pupils need money, but less than teachers					5								12							
6. To pay would cost too much.						6							12							
7. Pupils learn for themselves without money							7													
9. Teachers would not like and object								9				11								
11. Teachers would strike											11									
12. (5) would be too much												12	13							
13. Even if payment less than £1 per week													13							
14. Pupils do not need money at school														14	15			18		
15. Money needed later for marriage															15					
16. Parents could pay instead																16	17			
17. Parents should be consulted																	17			
18. Pupils need money to travel to school																		18		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
+ , -, 0.		-	+	+	0		-	+	-		-	-	-	-	-	-	0	+		
* New Topic / Development		X	X	1	3	2	X	1	2	X		9	5	12	2	14	X	16	14	
Repeat / digression																				
Counter								7											14	
Specification													12						X	
Example				3															X	
Judgement		X					7		X										X	
OPV		X	1	2			1	2	X		9		2	2					X	2
C&S									X		9	X								
APC																				X
* Speaker	1	1	1	1	1	1	1	3	1	2	1	1	1	3	4	2	1	2		
* Tape Reference	3	9	11	17	20	31	32	38	46	48	58	60	62	74	76	91	93	97		
* Time (by 15 secs.)	1	3	4	6	9	10	12	13	15	16	19	20	21	24	25	30	34	33		

* Features referred to in this summary account. Other features are concerned with the analysis of thinking in the group discussion, and are dealt with in Tripp, 1976.

Logging the Points

Points are placed in the matrix reading in chronological order of occurrence from left to right. This means that "point number" is synonymous with "column number". Content is summarised in the rows, and the rows are numbered according to the number of the point containing the new content. Were a discussion only to contain points using new content, there would be as many rows as points. But in practice people repeat themselves (see point 8) or just make judgements (see point 10) which means that there are more columns (points made) than rows (new content).

A point employing new content alone will have only one number in the column, and that number will be opposite the row summarising the new content. But often a point will be made referring to, employing or developing content already mentioned in a previous point, in which case the column number will also be placed in the row where that previous content is summarised. Thus, in the example, the first point is logged in column 1 and its content summarised in row 1. Point 2 is independent of point 1 and so refers only to new content which is summarised in row 2. Point 3, however, develops from point 2 and is so logged with reference to point 2, as well as having a summary of its new content on row 3. Similarly point 4 refers to rows 3 and 4. Later, point 8 simply repeats point 2, so it is logged only in row 2, there being no new content.

¹

For the purpose of this brief account a "point" is the smallest unit of a comment, containing a single idea, development or example.

- Point 1 No not really, because they've got to go to school to learn and if they're going to get money it's not worthwhile the teachers teaching them.
- Point 2 It would be worth it if you need the money for things you had to do.
- Point 3 That depends on what job you're training for, what expenses you have.
- Point 4 Like if you were training to be a teacher in Southampton and you had to get there.
- Point 5 You'd need some money, but not so much as the teachers, because the teachers teach you at school so you can learn.

The reason for the input of content rows is to make the matrix intelligible, so one can deduce the content of a point registered in the matrix. The rows therefore contain all the content of the ideas expressed, including all the variations of the ideas.

Recording the position of points on the tape

One of the advantages of the matrix is that it obviates a verbatim transcript of the discussion because the content of the point made is summarised. One does, however, sometimes wish to know what was actually said, in which case it is important to be able to quickly find the precise position of the point on the tape. Although it is easier to find this from a transcript, the transcript will only contain the words used; there is much more information on the tape, and the subtleties of intonation, pace or expression are relevant. So, even though a transcript may have been made, the position of each point on the tape must be known. There are two ways to locate it: "Tape Reference" and "Time".

Tape Reference The Reading of the counter on the recorder is set to zero at the start of the discussion, and the reading at the end of every point logged.

Time Because the counters are different on different machines (even on the same make and model) a second reference is made. Having completed the matrix and analysis by listening to the tape at least twice, it is listened to again with a stopwatch to record the quarter minute in which each point was completed. This not only gives an indication of the position of the point, but the length of time for expression and the chronological frequency of points at any stage in the discussion. Furthermore, it allows the position of a point to be found on a different machine simply by leaving the tape to play to the required quarter minute.

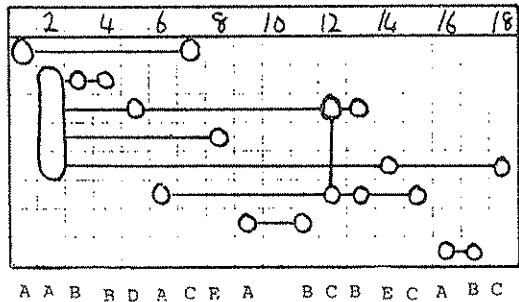
Speaker With a good stereo recording it is often possible to tell which point is made by which speaker. In the example Speaker 'I dominated the discussion, under which circumstances speaker identification was particularly easy. When it is difficult a teacher who knows the students can usually identify them all.

If one is interested in the comparison of individuals' participation then it is appropriate to compare their contribution in different discussions, as in a pre-test/post-test comparison, for instance. Note that it is the pupils who actually contributed the words of the point recorded who are logged as "the speaker". This is an example of the inevitable loss of information that takes place when the full discussion is coded onto the matrix. For this reason it cannot be assumed that because a pupil has made few points he has actually said little, hence frequencies recorded on the matrix should be checked against the recording.

New Topics and Developments: the "X and N" Convention In the analysis of points it will be noticed that sometimes a cross (X), sometimes with a number (N) is registered. The convention is that the "X" indicates a reference either to the point being scored or to the question under discussion. The "N" always refers to another point, and is the number of that point. In the "Example" for instance, an X means that the point contains an example of what the point is about, e.g.: "I think children would waste the money, they'd just buy sweets". The topic (waste) is given with an example (sweets). Were "I think children would just waste the money" an input from speaker D, and "Yes, they'd just buy sweets" a development from speaker E, then they would be logged as separate points, and E's contribution would be recorded with the number of D's point in the Example row, for E's point would be an example of D's point. In the analysis above point 4 is an example of point 3, and so it registers with a 3.

Due to the constraint of length it is not possible to discuss all the features of the analysis here. The example matrix above was an analysis of a group discussion for the evaluation of certain thinking skills. The relevant row of the analysis so far as this paper is concerned is the "X and N" row, which differentiate between points introducing new topics and points developing earlier ones. New topics, according to the convention, register with an "X", developments register with the "N" of the previous point to which they logically or contextually relate. In the example above, note points 1 to 4. 1 and 2, being new topics without antecedents in the discussion, register with "X's", points 3 and 4, being developments, register with the "N" of the point from which they are derived.

Taking the data from this row, it is possible to express the development of points in a flow diagram.



The points are simply plotted column by column in the way that they were originally logged on the Matrix. Point 1 will be found in Column 1 and point 16 in Column 16 of the flow diagram. A new point (logged as an "X" in the "X and N" row) is given a new row and relations between the rest of the points are shown by connecting horizontal lines. Where a point has only one other point directly derived from it, it will appear as a circle, for only one line is needed for the single derived point. When a point (such as point 2) has a number of other points derived from it, it is extended so all the derived points can be connected to it directly.

Where a point is derived from more than one other point, or simply relates two previous points, (see point 12) the connection is shown with a vertical line.

The appearance of the diagram is totally dependent upon the relations that are made by the analyst, and as such there is always the danger of unintentional bias. Great care was therefore taken over the formulation of the rules applying to these relations (See Tripp, 1976). For example, when I dealt with the "X and N convention" above, readers may have noticed that in the analysis I separated points 3 and 4 although 4 was an example of 3 and could have been analysed as a single point. The reason for the separation was a long pause (contextual feature) between points 3 and 4.

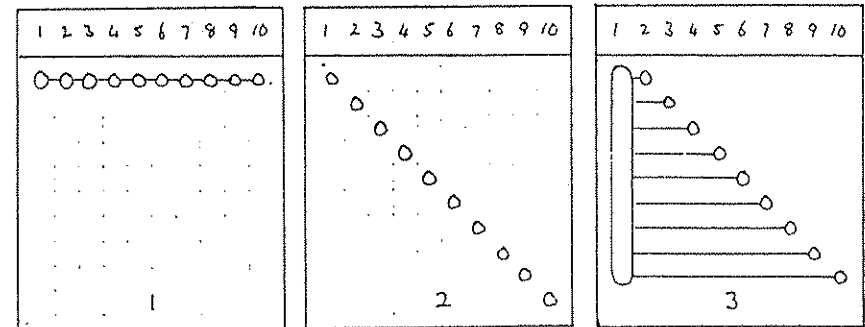
Differences of style within a discussion may thus be revealed by the diagram. In this example the proportion of points derived from the key idea in relation to the total number of points is about a third. But a group generating many new topics will contrast sharply with a group developing a few new topics.

Three basic patterns have so far been identified, each characteristic of a different style :

1. "Point-to-Pointing", where each point made is the basis for a single developing point.
2. "Breadth Exploration", where each point introduces a new aspect unrelated to any previous point.
3. "Depth Exploration" where a point is multi-developed by subsequent points.

The following diagrams illustrate the appearance of ten points developed exclusively by each style :

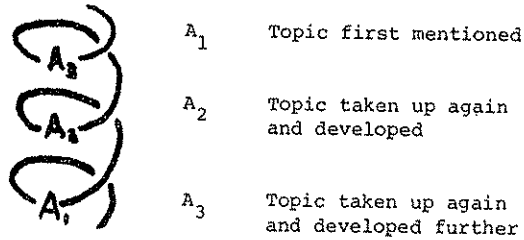
Discussion Styles



Naturally, every discussion reveals a mixture of all three. In the example above there is very little "point-to-pointing", the longest chain being points 2,3 and 4.

The Spiral Pattern

These diagrams are important for they make explicit hitherto intuitively perceived patterns. The first pattern of development within a group discussion perceived was Britton's (1969) spiral form. He noticed that a topic was not much developed before other topics were introduced, the original topic being returned to again and again as the discussion developed. He likened this process to a spiral because the discussion progressed through various topics, returning to develop them at a higher level, thus :

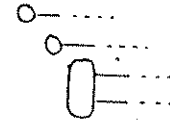


It is not, however, possible to map this recursive pattern directly onto a spiral, for, apart from the difficulties of 3 dimensional diagrams, it suggests an orderly development A,B,C,A₁,B₁,C₁,A₂, etc. whereas points actually tend to go : A,B,B₁,B₁₁,B₂,C,A,B₃,D,D₁,C₁,B₂₁,C₁₂,B₁₂₁,E,E₁,B₄₁, etc. This pattern can be mapped onto the point diagram, though, because it is shown in the way the points are connected. The topic of point 1 (above) is displaced by the topic of point 2, which is in turn displaced by the topic of point 6 before the topic of point 1 is again resumed in point 7. The degree of spiral development is shown visually as a function of the number and length of lines connecting points of a row.

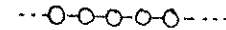
In order to identify patterns which are not so obvious visually, or to compare the extent to which different groups have used a particular pattern, it is necessary to reduce the whole pattern to elements which may be handled numerically. This has been done with the identification of five types of point representing different elements of the three discussion styles.

It is necessary to distinguish between developments of the immediately previous point and developments of a different point: the former are termed "consecutive", the latter "switch". It is also necessary to distinguish between a single development of a point (termed "development") and the further or multiple development of a point (termed "further development"), a distinction made clear below.

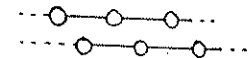
Point Type A: New Points



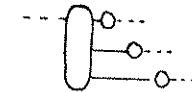
Point Type B: Consecutive Developments



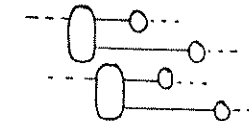
Point Type C: Switch Developments



Point Type D: Consecutive Further Developments



Point Type E : Switch Further Developments



A simple frequency count can reveal the precise degree of "spiralling" in different groups. A comparison of four groups in an experiment (Tripp,1977) will illustrate the method.

Group	Total points	A	Type of Point				Spiral Factor
			B	C	D	E	
1	45	15 (33%)	16	7		7	73
2	40	14 (35%)	10	7	2	7	80
3	11	6 (55%)	4		1		0
4	19	7 (37%)	8	1	1	2	25

Groups 3 and 4 are very slightly inclined to produce a greater percentage of new points, and these points, when developed, tend to be developed consecutively (Types B and D). Groups 1 and 2 have a marked tendency to "Spiral" i.e. to "switch" from point to point developing each in turn (types C and E). As the number of new points can mask the relation between consecutive and switch points when the discussion has few points in total (for many of these are inevitably new points) consecutive and switch developments are compared as percentages of the total number of points less new points. This factor, calculated as

$$\frac{(C+E)}{(B+C+D+E)} \times 100,$$

is called the "spiral factor". In the above analysis it was $\frac{6}{12} \times 100 = 50$

Having isolated the spiral, and found a means of quantifying it, still leaves open the question as to whether the spiral pattern is a beneficial feature of discussion or not. There are several reasons for suggesting that it is a good feature: the most obvious of these is implicit in a point made by Britton (1969):

"...guilt had been hinted at. E's behaviour might suggest - though nothing can be said for certain - the gestation of an idea. Silent for some minutes she then produces, rather belatedly, her contribution to the "I remember" series: and when it comes it breaks defences that none of the group has yet dared to breach - and goes the whole way ... E, if I am right about her, would indicate that there is here more than the laying out of the elements of the problem: something is done with them. There is a spiral movement in all that circularity".

Spiralling is not possible unless the idea has first been attended to, for sustained concentration on, and development of, the idea leads the participant to express his thoughts to the group at an inevitably later point. Unless there is silence in the interval, a spiral pattern will be the result.

It is important to stress that spiralling is a natural pattern when children are concentrating on an idea. Evidence for this was found by Tripp (1977), both in his experiments with small group discussion and in the teaching

of whole-class lessons, where the pattern appeared as a "virtuous error". On one occasion for instance, the teacher has been discussing with the students the priorities that principals might have in different schools. At one point the idea that students might be given a choice of teacher was suggested. The question was soon finished, and the teacher moved on. It was a further 4 minutes before one boy put up his hand and said :

"I don't think you should have a choice of teacher because the ones that're a bit grumpy, like, they'd think, 'No one will choose me. That's it. I'm resigning.'"

It was interesting to note that the teacher admonished the boy for not listening to what he'd been saying since he had moved onto a different topic, instead of praising him for his sustained concentration on the original idea. An understanding of the process leading to the boy's belated comment may well have led the teacher to respond differently.

With regard to the evaluation of the de Bono Thinking Project for which this method of analysis was developed, it was found that training in group thinking skills significantly increased the degree to which discussions exhibited this spiral pattern. Pooling the results of seven different experiments performed between January and July, 1977, in U.K. schools, (Tripp, 1977) enabled the comparison of the following groups of discussions :

<u>Experimental Group A</u>	<u>Control Group B</u>	<u>Control Group C</u>
(Thinking lessons by the group discussion method)	(Small group discussions without thinking lessons)	(Neither discussions nor thinking lessons)
N = 13	N = 4	N = 8
Spiral Factor Mean = 44.2 (S.D = 15.19)	Spiral Factor Mean = 33.5 (S.D= 23.61)	Spiral Factor Mean = 19.83 (S.D = 20.84)

<u>Groups Compared</u>	<u>Probability</u> (Mann Whitney)
(A) v (B) + (C)	0.01
(A) v (B)	> 0.05
(A) v (C)	0.01
(B) v (C)	0.05

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The conclusion drawn from these results was that, whilst the teaching of the de Bono thinking skills did produce an increase in the spiral pattern, simple practice in discussion produces a similar, though less intense effect.

In this paper it has been possible merely to describe the nature of the analysis and show a single application. The method is still being developed, however, and a manual will be available from the author early in 1979.

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THE SCHOOL AND THE COMMUNITY:

THE CASE OF JERVIS BAY

Noel Vanzetti

A Paper Presented to the Conference of the Australian
Association for Research in Education.

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