Clique: Structure and significance

A Clique is a structure that arises when resonance chains (Rez chains) become intertwined, overlapping in the stream of discourse. Narrowly construed, a Clique is a set of Rez chains which have overlapping membership, as defined by the lines that contain the rezonating words. This kind of connection arises whenever a resonating word in one Rez chain is part of a unit or line which contains another word that is present in a different Rez chain. Membership in a Clique is transitive, so cliques can become quite large. A Clique is itself a chain, so it can be considered a chain of chains.

The shared line is what intertwines multiple Rez chains. Although a Rez chain directly links only words to words (or phrases), the indirect consequence of such links is that each resonating word brings along with it the rest of its line (e.g. its intonation unit or clause). The direct and indirect forms of linkage combine to create the Clique. In effect, Cliques are formed by the interaction of strong bonds and weak bonds between words. The strong bonds are created by the rules of linear syntax, between the words in a given sequence (word order) *within* the clause. The weak bonds are created by the resonance relations of dialogic syntax, that go *across* lines. When a Clique is formed, the fates of its Rez chains become intertwined. In particular, the alignment of any Rez chain may be affected by the alignment of the other Rez chains in the same Clique, and vice versa.

The Clique is closely related to the diagraph (Du Bois 2014), enough so that it can be considered a precursor or even a prototype of the diagraph. Cliques change with each new increment of perceived resonance, which may be affected in turn by other resonances in the immediate context. The influence between intertwined Rez chains goes both ways, so that Cliques become dynamic structures. The mutual feedback relations give them interesting properties both in terms of their structural and their functional consequences. The dynamic character of the Clique can create challenges for solving the alignment equation, so they should be monitored carefully and analyzed accordingly.

Energy and alignment

Once a Clique arises, it dramatically changes the equation for the alignment of resonance. It does so by linking the fate of resonating elements in multiple Rez chains. To be sure, a key goal of resonance analysis is to identify the most efficient configuration of the resonating elements that make up a Rez chain. By the conventions of Rezonator, the representation of the most efficient resonance configuration entails that a chain of resonating words should be aligned vertically, with each word falling within a single column. This is the simplest, "crystalline" structure. But for some Clique configurations, this straightforward solution can be difficult or impossible to achieve. What is called for is some form of adjustment that departs from the simplest structure.

Theoretically, a key point of interest is how to calculate the information, entropy, or energy of a Clique, drawing on insights from information theory (cf. the thermodynamics of protein folding). Cliques involve two kinds of bonds. The first is strong bonds, based on the rules and structures of linear syntax. These strong bonds largely determine the order of words within a syntactic unit (at least in languages like English). They are represented in the structures of dependency syntax or phrase structure syntax. (Even when these structures are not depicted explicitly, their powerful effects can be seen in the linear ordering of words within units.) The second kind of bond is the weak bond. According to the theory of dialogic syntax, weak bonds are created by resonance relations between elements, and typically arise *between* two parallel structures.

The resonance alignment problem can be considered a way of finding the lowest energy state of a Rez chain, and by extension, a Clique. For Cliques the solution must be dynamic and non-linear, given the possibility of modifying a Clique by the addition of a single resonating word to the discourse,

and the mutual influence of Rez chains within the Clique. Because of how Rez chains are intertwined, the solution for the configuration of some Cliques may be far from obvious.

It is of considerable theoretical interest that in naturally occurring discourse, many Cliques can be efficiently aligned without the need for any ad hoc adjustments to the straight-line verticality of their multiple parallel Rez chains. Nevertheless, some Cliques are not so simple in their structure. They present one or more challenges to solving the alignment equation. In practical terms, this becomes a problem for representing and visualizing the configuration of resonance.

Practically speaking, to gain perspective it is best to begin with a simple (even simplistic) measurement of the superficial features of the Clique. We postpone the more challenging calculation of Clique entropy, structural tensions, and so on, until the configurational structures themselves are better understood.

Quantifying the Clique

A Clique can be quantified in terms of its measurable properties, which can be approached from a theoretical perspective, as is hinted at above, or from a superficial perspective. Superficially, the measurable properties of a Clique include its height, width, range, density, purity, gaps, flaws, intensity, and so on.

An important point is that the measurement of a Clique's dimensions and energy depends critically on its alignment. Changing the alignment changes the dimensions, reflecting a change in the (presumed) energy or entropy of the structure.

To understand what to measure, and how to do it, some definitions are in order, beginning with the Clique concept itself.

Clique. A Clique is a set of resonance chains (Rez chains) which overlap in the stream of discourse. The overlap that defines a Clique occurs whenever a line from one Rez chain is also line in another Rez chain. Overlap between Rez chains in a Clique is transitive, so Cliques can expand by incorporating a succession of overlapping Rez chains in a discourse. The Clique is a chain of chains; in turn, each of its component Rez chains is a chain of words. The Clique Set (the set of lines in a Clique) can be built by summing the lines from the component Rez chains, while ignoring duplicates.

How a Clique should be represented follows largely from its structure. Following Rezonator conventions, the representation of a Clique begins with a set of lines or units, known as the Clique Stack (or simply as the Clique, for short):

Clique Stack. A Clique Stack is the set of lines in a Clique.

Clique Zone. A Clique Zone is the stretch of discourse enclosed between the first and last lines of a Clique. The Clique Zone may be further delimited by including only the columns that appear between the first (leftmost) column and last (rightmost) column containing resonating elements in the Clique.

Having defined the nature and scope of the Clique, we can now take its basic measurements:

Range. The Range of a Clique extends from the first line of any Rez chain to the last line of any Rez chain in the Clique, including all the lines in between.

Length. The length of a Clique is the number of rows in the Clique proper (i.e. in the Clique Stack; the Length is less than or equal to the Range).

Width. The Width of a Clique is the number of columns in the Clique proper (i.e. excluding its Flanks see below).

Area. The area of a Clique is the number of cells within its scope: the product of length times width.

Density. Density is a the proportion of cells in the area of the Clique Zone that contain resonating words.

Depth. Depth is a function of the surprisal or entropy of each cell in the Clique; it may be summarized at the level of the Clique as a whole. This calls for a more complex algorithm (to be developed in due course).

The above factors define the broad outlines of the Clique. The following factors concern various modifications and limitations of the Clique, reflecting factors that may reduce its effective scope and influence.

Gaps. The Gaps value represents the number of lines/units completely omitted from a Clique, because they contain minimal or no resonance.

Flank. The Flanks are columns which are excluded from the Clique, appearing to the left of the leftmost column in a Clique (Left Flank), or to the right of the rightmost column in a Clique (Right Flank).

Flaw. A flaw is a column within the Clique Zone that contains no resonating words; that is, no portion of any Rez chain.

Break. A Break is an anomaly: a column within the Clique Zone that contains no words at all (that is, an empty column). Break columns of this kind are generated by a problematic alignment algorithm (for example, the so-called "Race to Infinity"). Break columns should be marked in red, or simply eliminated by improving the algorithm.

The existence of flaws and breaks within the Clique may trigger a process of repairing or fixing the Clique. Specifically, Zig-Zag is a strategy for repairing or avoiding a Break in a Clique.

Zig. A Zig is a deflection of the alignment of a Rez link away from the standard vertical alignment. Each link in a Rez chain has a value for Zig (default = 0 meaning no deflection; Zig right = ;, Zig left = -1).

Zag. A Zag is when a Rez link returns to the standard vertical alignment of a Rez chain from a previous Zig (deflection). Each link in a Rez chain has a value for Zag (default = 0; Zag right = 1; Zag left = -1). (In some cases, such as question words equivalent to "who", "what" etc., the Zig and Zag values can be greater than 1, e.g. +5 and -5.)

Monitor and fix

To monitor Cliques, maintain a list of them in a Clique grid. Each row of the Clique grid represents one Clique, with its own unique CliqueID. The Clique grid has a RezChains column which contains a list of Rez chains. In this respect, the Clique grid is similar to the Stack grid. Updating of the Clique grid should be handled in ways similar to updating of the Stack grid.

In addition, the Clique grid contains several columns representing measurements of various properties of the Clique (range, length, width, area, density, purity, flaw, break, zig, energy...)

As noted above, problems can arise in creating an efficient representation of resonance relations, triggered by feedback loops within the Clique that lead to a dynamic process such as the "Race to Infinity". In broad outline, the strategy for dealing with the "Race to Infinity" is as follows.

First, Cliques should be closely monitored, and the Clique grid should be updated whenever a user modifies any Rez chain (by adding or removing a resonating element, etc.).

Second, to identify a potential Race to Infinity, test for Breaks within the Cliques.

Third, if a Break is identified, stop pushing the relevant words (words to the right of the Break).

Fourth, institute a repair strategy (e.g. the "ZigZag" strategy) to eliminate the alignment pressures that triggered the Break in the first place.

Details follow.

Clique test

Whenever a user modifies a Rez chain (adds or deletes a link), test to see if the change modifies the Clique membership, and update the Clique grid.

For each affected Rez chain, test whether it is part of a Clique.

If a Rez chain is part of a Clique, decide which Clique it belongs to.

Break test

Whenever a user modifies a Rez chain (adds or deletes a link), test the Cliques or Cliques that are modified by this change.

Test for the presence of a Break (empty column in the Clique Zone).

If a Break is found:

update the entry in the Clique grid to show the presence (and location?) of the Break

display the Break in red (i.e.g mark the relevant cells within the Clique Zone that fall in the Break column)

stop pushing any words to the right of the Break

institute a repair strategy (ZigZag)

Zig test

Step through each link in the affected Rez chains of the affected ("Broken") clique.

Remove the link from the Rez chain (temporarily)

Test if that removes the pressure to create a Break

If the Break remains (Break = TRUE), make no change in the link (i.e. keep the default of Zig = 0, Zag = 0)

If the Break disappears (Break = FALSE), assume that this link is the source of the problem; change the Zig value for the link (i.e. Zig = 1, Zag = 0; that is, Zig to the right by one column; don't Zag).

For the next link, Zag back to return to the standard vertical alignment (i.0e. Zig = , Zag = -1; that is, Zag to left by one column; don't Zig.

When drawing and pushing words, and assigning them to display columns (in the WordShow grid, a.k.a. DynamicWord grid), look up their Zig and Zag values, and adjust their position accordingly.

For example:

	Rez Chain 1	**Rez Chain 2**
Word:	*I*	*did*
Link: **No Zig**	0	0
Word:	*You*	*didn't*
Link: **Zig**	1	-1
Word:	*Did*	*you*
Link: **Zag**	1	-1
Word:	*I*	*did*
Link: **No Zig**	0	0
Word:	*You*	*do*

A more complex example, with Question words (for later development):

			Rez Chain 1	**Rez Chain 2**	**Rez Chain 3**	**Rez Chain 4**
Word:			*I*	*lost*	*it*	***somewhere***
Link: **Zig**			0	0	0	-5
Word:	***Where***	*did*	you	find	*it*	
Link: **Zag**	5		0	0	0	
Word:			*I*	*found*	*it*	***here***

Display

Whenever a user clicks on a word in a Rez chain, use the space next to the Nav window (where the large Search icon currently is) to display whether it is in a Clique or not.
If it is, display the main properties of the Clique: Range, Length, Width, Gaps, Area, Density, Break, ZigZag. etc.