# Measuring Narrative Cohesion: A Five Variables Approach

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## ABSTRACT

In this paper we present a five variable approach to measuring narrative cohesion. Increasingly narratives are dynamically adapted for presentation to enhance personalisation or fit different presentational objectives. Narrative generation systems seek to either automatically generate stories from scratch or, create stories from predefined conditions. With the rise of machines as co-authors it is important to consider what the affect is upon the cohesion of the narratives represented or created in this way. Typically, in existing work, this is limited to an analysis of the use of textual language within the narrative to communicate a coherent message. However we find that beyond linguistic connections narrative elements are coherently bound together through other concepts and structures such as themes, genre, narrator, and style. We present these variables, and features that may be used to identify their presence, as an alternative approach to measuring narrative cohesion and demonstrate their application on two generated narratives.

## Categories and Subject Descriptors

H.1 [**Models and Principles**]: General

## General Terms

Standardization, Human Factors, Experimentation

## Keywords

Narrative, Narrative Systems, Narrative Metrics, Narrative Cohesion

## 1. INTRODUCTION

Narrative systems, such as narrative generation and adaptive hypermedia projects with narrative elements, are often concerned with the literal content of the story such as the plot [18] or the language used within its presentation [5]. However, the literal content gives rise to more complicated subtle structures and factors within the narrative such as themes [20], authorial voice [3], and cohesion. Collectively such inexplicit structures could be called the narrative subtext. While seeking to improve narrative generation, analysis, and presentation with better models of narrative content it is also important to consider how to model the subtext of a narrative and make it machine understandable.

In previous work we have explored the concept of modelling themes in narrative [8][9][10] and how we might model individual motifs and their connection to different themes to enable embedding themes in narrative generation or thematic analysis. Part of the motivation behind this is to improve the thematic cohesion of generated narratives or alter and emphasise themes in a presented narrative. Further to our own work on thematically adaptive or generated narrative, there is a variety of different systems that work in adaptive narratives (such as projects in the field of adaptive hypermedia [4][17]), computationally generating media for users through dynamic adaptation of existing narratives.

As use of adaptivity and automatic generation increases so does the need to understand the effect of the adaptivity on the narrative. Narrative cohesion refers to the way in which the component elements of a narrative are bound together in a discourse through the coherent use of language, consistent underlying concepts (such as themes), and a consistent relationship between author and audience. With existing narrative systems primarily concerned with content it is possible that adaption may damage the cohesion of presented narratives or that generated narratives could be incoherent.

In this paper we present an investigation into how narrative (not purely linguistic) cohesion may be measured. We identify, based on existing work, key variables associated with cohesion and how they could be used to measure narrative cohesion with regards to the effect of adaptation or the result of generation.

## 2. NARRATIVE COHESION

The idea of cohesion as a way of tying text together to aide flow and understanding has been explored in a range of research fields, and we can use this work to identify some important variables related to narrative cohesion.

Narrative cohesion is explored by Hudson from the perspective of investigating children's understanding of narratives based on what a child can explain or recall [11]. The work compares straightforward stories with a high cohesion to more difficult incoherent stories, and analyses the coherence of stories constructed by the children. Hudson's 'cohesive devices' are largely centred around the logical sense


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of the narratives and are partly based upon the coherence categories of John-Steiner and Panofsky in their work on children's narratives [12]. Hudson measures the logical sense that a narrative makes through the presence of conjunction (connective terms in four categories ranging from the simple such as 'and' to the temporal such as 'then'), prepositional phrases and relative clauses (relative explanations triggered by words such as 'who' and 'that'), and anaphoric reference (referring to earlier imparted information). It is clear from Hudson's work that how much logical sense a narrative makes is an important aspect of its cohesion, whether it be temporal, referral, or explanatory in nature.

As well as the specifics of the language used it is possible to consider the coherence of a narrative's subtext. Tomashevsky discussed in his essay on 'Thematics' the importance of themes to narrative [20]. He explains that narratives are given meaning by themes and that themes unite the separate elements of a narrative giving it cohesion. Work by Ferret in [6] also explores the link between themes and cohesion, demonstrating how lexical coherence based on collocation can be used to show thematic coherence in segments of narrative. The collocation network based upon earlier machine readable dictionary work by Kozima using lexical similarity [13] allows Ferret to measure the cohesion between terms in a section of text in order to infer the discussion of a similar concept and infer thematic cohesion. The network Ferret uses is similar to the thematic definitions used by our own thematic prototype [9] in that it is a collection of terms and relationships that can be used for understanding thematic content. However, it is based on co-location (co-occurrence) not semiotics, which we have found to be less effective in the cases we have tested. The notion of theme is core to cohesion from the structuralist point of view in that it binds the narrative together with meaning. It is also possible it could be closely connected with the coherent use of language and the logical sense of the narrative as demonstrated by Ferret.

Genre is a common classification of narrative based upon a set of reoccurring features drawn from content and plot that position a narrative culturally within the context of other narratives. Tomashevsky pointed out that the motifs present that lead to the presence of a theme are intrinsically connected to the genre of a narrative, suggesting that the genre of the narrative limits the available motifs. The Coh-Metrix project worked towards creating a system for analysing the coherence of texts through several metrics [7]. The metrics used were a variety of text based lexical analyses such as latent semantic analysis, term frequency and density, and concept clarity. The measuring of these metrics however was intrinsically based upon the pre-identified genre of the narrative which they identified in their initial Coh-Metrix report as important to coherence [15]. The work done by the Coh-Metrix project supports the importance both of logical language used and identifiable genre to measuring the coherence of narrative.

There are other aspects of narrative we have not yet considered that could play an important factor in narrative cohesion. Booth explains how the authorial voice may be used either implicitly of explicitly to deliver plot and build a relationship of short or long distance with the reader [3]. As the narrator is core to the telling of the story, coherence in how the narrator is presented is also important to the cohesion of the story itself. McAdams explains from the perspective of modern psychology that people become narrators in order to make sense of a series of events or stories, thus it is the presence of a narrator that leads to coherence in a story [14]. The consistency with which a narrator is presented in a story effects how the story is perceived as being communicated and may be used to build a relationship with the narrative's audience. As such, the strength of a narrator's presence in a narrative could be considered as a variable that affects that narrative's coherence.

We have already discussed how the logical use of language may affect the coherence of a narrative however there are other linguistic choices made in the telling of a story that might affect its coherence. Structuralist works, such as in work by Barthes [2] and Bal [1], have considered narrative to be comprised of layers, often of story and discourse (or a close to equivalent model). Story models the collection of elements that comprise content and discourse for how the story is told through the selection and presentation of elements. Features of discourse have been already been identified here; themes, genre, narrator, but these cannot be said to completely account for the language choices made in a narrative's discourse through the presentation of individual elements. The way different narrators approach and use a style of language can have an effect on its coherence. Style can be said to be a composite of attitude, tone, and mood of a narrative, representing decisions made on the presentation of elements at the discourse level. But also style represents the conventions an author has set for themself either in previous narratives or earlier in the narrative in question. The stylistic cohesion of a narrative could be said to be in part the extent to which an author when making decisions about language used convenes to their own conventions.

## 3. COHESION VARIABLES

From our above investigation we can identify five key variables for measuring cohesion.

- **Logical Sense:** the connective language used to explain the content of the narrative.
- **Themes:** the concepts communicated implicitly throughout the narrative.
- **Genre:** the presence of reoccurring features that culturally contextualize the narrative.
- **Narrator:** the presence of an identifiable storyteller communicating the narrative.
- **Style:** the way narrative elements are presented within the discourse.

Measured appropriately, and considered together, these may be used as a basis to understand the level of cohesion within a narrative. However, in order for such a series of variables to be effective we consider the features that would suggest evidence towards the value of each variable. These features might be specific ways of formally measuring a value for each variable or less formal feature lists that may be spotted by hand and might later have more formal systems of measure developed for them.

Table 1 lists positive and negative features for each variable; each feature is based upon either existing work exploring the area or our own definitions of these variables. The presence of a positive feature within a narrative can be considered evidence to suggest strength for the relevant variable

whereas the presence of a negative variable could be considered weakness. It is to be noted that some parts of this could potentially be automated, in particular Coh-Metrix [7] might provide a way for several measures of logical sense and perhaps genre cohesion. However for the purposes of this paper we present the root features that could be identified by hand connected to each cohesion variable

The features presented in table 1 should be considered examples as a starting point, and by no means exhaustive definitions. Each of them represents evidence that as a starting point eludes to positive or negative reflection within a given variable. It can also be said that the inverse of a feature has inverse effects; for example the absence of a positive feature is in itself a negative feature, and vica versa.

# 4. EXAMPLE ANALYSIS

In this section we demonstrate how these variables might be applied to narratives created from narrative generation in order to capture an impression of the narrative cohesion of these stories. For the purpose of this exercise we use an early but prominent character centric narrative generator; TaleSpin [16], and a more modern author centric narrative generator; ArtEquAKT [21]. TaleSpin generates stories about predefined characters with predefined goals in predefined settings. The system resolves a simple assessment of each characters actions in turn and reports on each as a sentence in a simplistic manner until their goals are resolved, it is in a sense simulating the characters actions and exposing them to form an emergent narrative. ArtEquAKT on the other hand automatically generates biographys on artists by linking together relevant narrative segments taken from web resources into a biography structure. For the purpose of this paper we used a TaleSpin story about 'George Ant' as shown in figure 1 and an ArtEquAKT biography of Rembrandt as shown in figure 2.

'George Ant' shows some of the limitations often seen in early text generation systems in that outside of the structure, sentences are generated regardless of the content in each other. It cannot be said to make good use of conjunction with sentences kept entirely separate when they might be more coherently joined. However it is chronological, there is no contradiction, and the content is not only not obfuscated but directly explicit. Thematically speaking the story exudes no core themes, except for possibly 'survival' or 'debt' (which are very weakly exposed). The story does conform to the genre of a 'fable' in that it anthropomorphises animals/insects and has a moral lesson, and this is present through out. There is no identifiable storyteller process and indeed the disjointed way the text is presented gives it a very inhuman feel. Finally stylistically the story is consistent and its disjointed style is coherent with other works by TaleSpin. Based on the presence of these features 'Geroge Ant' could be considered to have a high genre and style cohesion, a mixed logical sense cohesion, and very low thematic and narrator cohesion.

The ArtEquAKT biography of Rembrandt has some similar traits but also demonstrates some differences. It has good use of conjunction but is not chronological (presenting a paragraph on his later works before his earlier works) and missuses anaphoric reference by referring to a 'capitulation of the ideals [in his] first ten years' without expressing what these are. The content couldn't be considered obfuscated but a few text generation errors make parts slightly unclear. The piece is absent of themes, though in maintaining the factual voice of a biography this may be deliberate. The narrative does strongly conform to the conventions of a biography with initial details of key dates, a discussion of his early life, and then the details of his work, for which the system has been purposely designed. There is no key identifiable storyteller presence tying the work together, though again this could be said to be a deliberate feature of the genre where the presence of a personal perspective might compramise the biographies impartial nature. Stylistic choices are coherent throughout and consistent with what is expected from ArtEquAKT. Based on our summary of these features we might find this story similar to 'George Ant' (High genre and style, mixed logical sense, and low thematic and narrator) however there are some differences to consider. First of these is that the genre of the ArtEquAKT narrative (biography) predisposes it to be weakly themed and without the presence of a narrator to maintain its factual nature, as supposed to the TaleSpin story whose genre (fable) might of benefited the active inclusion of themes and a storyteller. Secondly though both had mixed features for logical cohesion each demonstrated different features, TaleSpin's more simplistic style avoiding the need for more complicated back reference or structure (on which ArtEquAKT's story failed) but at the same it lacked the flowing sentences and conjunction ArtEquAKT demonstrated (thanks largely to its use of preconstructed prose).

What this process demonstrates to us is that an evaluation of different generated narratives cohesion is possible using our five variable approach. The listed features allow for the spotting of individual parts of a narrative that might cause the story as a whole to be coherent or incoherent. However the incomplete, example, nature of such a list demonstrates there is further work and discussion to be done on the identification of cohesion features. As part of the analysis the fact that high cohesion is not always positive was demonstrated; a lack of lower presence of particular cohesion variables can be used for specific narrative effect or as part of the conventions of a genre. The cohesion evaluation of ArtEquAKT could be considered near perfect for that narratives objectives as its factual nature and style could be weakened by the presence of heavy themes or a narrator perspective. Where as the evaluation of TaleSpins story, despite being similar, is less ideal as the objectives of the narrative might of been enhanced by the presence of both themes and a storyteller. How these different variables of cohesion are connected to different genres, and purposes of writing is a connection yet to be clearly established, and key to detailed evaluation of the role of cohesion within a narrative.

From this process we can draw some observations on the cohesion of generated narratives, though it is to be noted these observations are based only on what we have seen from two systems and do not represent a complete survay. What has been shown is that automatically generated narratives can demonstrate similar traits, as both were shown to have high genre and style cohesion and low thematic and narrator cohesion. Stylistically speaking a generated narrative is likely to show high cohesion as each passage of text is generated with a similar, if not the same, method. However it is possible that systems which rely on resources written else where, such as ArtEquAKTs use of online material, might experience a collision of styles in some cases where material from two very different writers is used. It is also possible that

| Variable | Positive Features | Negative Features |
|---|---|---|
| Logical Sense | - Correct use of conjunction<br>- Correct use of preposition and anaphoric reference<br>- Story is chonologically presented | - Content is Obfuscated<br>- Content is contradictory/not causal |
| Theme | - Core themes are identifiable<br>- Core themes are present throughout | - Sub-themes conflicts with core themes |
| Genre | - Story fits conventions of an identifiable genre<br>- Story follows genre conventions throughout | - Story fits multiple genres |
| Narrator | - Story has dramatised/explicit/identifiable implicit storyteller<br>- Storyteller is present throughout | - Storyteller changes character/personality |
| Style | - Language and Style used fits authors own previous conventions<br>- Tone and mood of each scene is relevant to its content | - Style is not identifiable |

**Table 1: Cohesion metric variables and features**

ONCE UPON A TIME GEORGE ANT LIVED NEAR A PATCH OF GROUND. THERE WAS A NEST IN AN ASH TREE. WILMA BIRD LIVED IN THE NEST. THERE WAS SOME WATER IN A RIVER. WILMA KNEW THAT THE WATER WAS IN THE RIVER. GEORGE KNEW THAT THE WATER WAS IN THE RIVER. ONE DAY WILMA WAS VERY THIRSTY. WILMA WANTED TO GET NEAR SOME WATER. WILMA FLEW FROM HER NEST ACROSS THE MEADOW THROUGH A VALLEY TO THE RIVER. WILMA DRANK THE WATER. WILMA WASN'T THIRSTY ANYMORE.
GEORGE WAS VERY THIRSTY. GEORGE WANTED TO GET NEAR SOME WATER. GEORGE WALKED FROM HIS PATCH OF GROUND ACROSS THE MEADOW THROUGH THE VALLEY TO A RIVER. GEORGE FELL INTO THE WATER. GEORGE WANTED TO GET NEAR THE VALLEY. GEORGE COULDN'T GET NEAR THE VALLEY. GEORGE WANTED TO GET NEAR THE MEADOW. GEORGE COULDN'T GET NEAR THE MEADOW. WILMA WANTED TO GET NEAR GEORGE. WILMA GRABBED GEORGE WITH HER CLAW. WILMA TOOK GEORGE FROM THE RIVER THROUGH THE VALLEY TO THE MEADOW. GEORGE WAS DEVOTED TO WILMA. GEORGE OWED EVERYTHING TO WILMA. WILMA LET GO OF GEORGE. GEORGE FELL TO THE MEADOW. THE END.

**Figure 1: A TaleSpin narrative.**

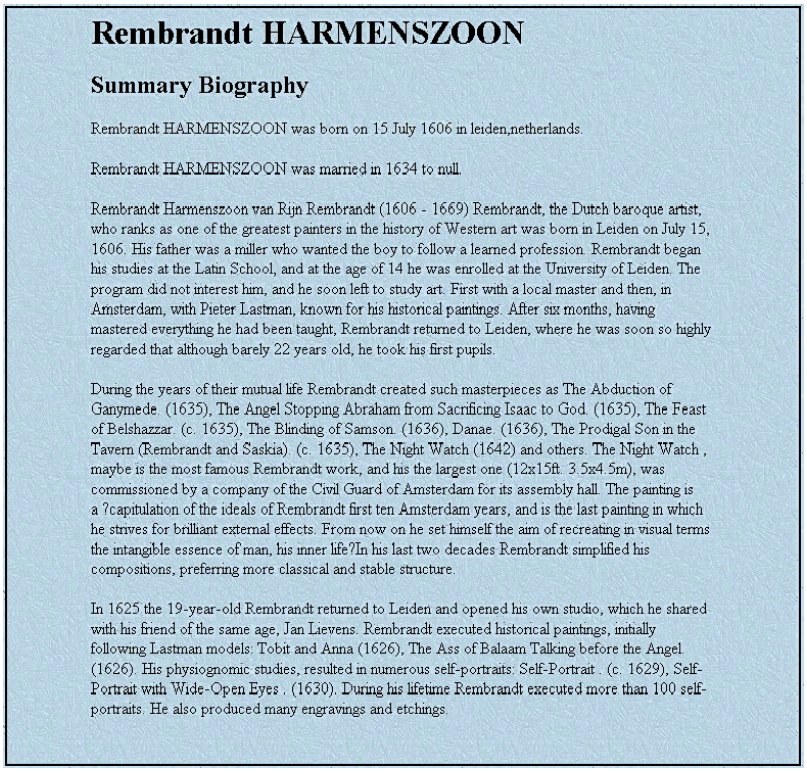


**Figure 2: An ArtEquAKT narrative.**

the conventions of a genre are easier to capture then that of the presence of a narrator (as suggested in our findings) but this is too simplistic an analysis to make such a claim and it is important to consider that one of the systems used is purposely built to follow the conventions of a genre and that we might of found something similar for the narrator variable had we used a system that has purposefully considered narrator presentation such as the virtual storyteller [19]. Thematics however, is an aspect largely un-modelled by most narrative generation systems and as such something we would expect to score lowly, we are pursuing this area in our own work elsewhere [8][9][10].

## 5. CONCLUSION AND FUTURE WORK

In this paper we have presented a series of variables for measuring the narrative cohesion of stories that might be

used to get a measure of the effect on cohesion of adaptive presentation of narrative or of the cohesive qualities of generated narratives. Narrative cohesion goes beyond linguistic cohesion and includes devices and concepts such as themes and genre that can be used to unify the elements of a narrative and promote a flow in storytelling. Our identified variables are based upon a combination of existing research both in cohesion and narrative and existing attempts by systems to capture the cohesion of a narrative. We have loosely defined our variables thus far using example features that could be identified within a narrative to demonstrate positive or negative cohesion within each area. Using two stories from two different narrative demonstrators we then provide an example of how our variables might be applied to evaluate narrative cohesion.

To conclude we find that while linguistic cohesion is a key element of a cohesive story there are other significant concepts that can be used to bind a story together which may be affected by dynamic presentation or generation of narrative. While these can be identified from existing work and arguably classified into different variables measuring these accurately can be difficult in part due to the subjective nature of identifying the presence of each variable. By identifying features for each variable we can begin to form a method where we consider what evidence is present within a narrative to suggest positive or negative cohesion.

To begin to apply these variables as a metric of cohesion a formal process of measurement needs to be defined. Future work should aim to identify complete sets of formally defined features for each variable and systematic methods for measuring each. This may lead to a formal process of cohesion assessment or potentially to a tool for the automatic measurement of narrative cohesion. Furthermore the effect of different genres and narrative forms (which might deliberately avoid particular forms of cohesion) on each variable must be ascertained and appropriately considered when measuring the effective cohesion of different narratives.

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