An Ontology for Ploke: Rhetorical Figures of Lexical Repetitions

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Abstract

Ploke is a rhetorical device of lexical repetition, with multiple variations contingent on place of occurrence. It is widespread in all natural and artificial languages because it manages stability of reference and predication. Syllogisms, for instance, are heavily dependent on positional repetition. Ploke also influences the reader's/hearer's attention because of its appeal to neurocognitive affinities. A formal knowledge representation of ploke is therefore valuable for any AI/NLP system. This paper proposes an ontological model for ploke. We discuss components of different types of plokes and rhetorical figures in general, in terms of their form, their function, and the associated neurocognitive affinities that affect attention.

Keywords

rhetorical figure, ontology, knowledge representation, computational rhetoric

1. Introduction

Rhetoric is the "ancient study of persuasion, with particular attention to the effects of expressive style on belief, action, and knowledge" [1]. The use of rhetoric affects the style and effectiveness of an utterance; "the meaning of an utterance is communicated through the relations among its constituents, as well as their relations with contextual and cotextual elements" [2]. The incorporation of rhetorical principles in current Artificial Intelligence (AI) and Natural Language Processing (NLP) systems, collectively termed as "AI/NLP systems", is therefore an important area of study [1][2][3][4][5][6][7][8][9][10][11].

Devices of rhetoric called *rhetorical figures* which generate a set of attentional effects such as salience, aesthetic pleasure, and mnemonic effect received by the audience, thus managing the receiver's attention. Common rhetorical figures, such as *rhyme*, *metaphor*, and *sarcasm*, that are encountered in everyday conversations may be noticed easily. Other common rhetorical figures that involve traits, such as repetition, semantic increase, and inverted concepts, may not be as easily noticed. A rhetorical figure creates a "figure-and-ground landscape that focalizes some details and put others in relief" [12]. e.g., communicators are attracted by the sound of the words or phrases with repeated syllables in rhymes and by the connections established between concepts in different domains when metaphors are used. Rhetorical figures are widespread in all registers, genres, and dialects of all languages. There simply does not exist a pure literal

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language [2]. The study of rhetorical figures is multidisciplinary. The stylistic effects of figurative language "are partially explained by semiosis (the relevance of signantia and signata for the basic scheme/trope distinction), by linguistics (the elements focalized by the figure–syllables, and words, for instance), and by cognitive neuroscience (the appeal to pattern biases like repetition and similitude); in turn, they explain the stylistic effects of language" [12].

However, few of even the most ubiquitous rhetorical figures have received attention from computer scientists (or even rhetoricians). One such example is *ploke*[1], rhetorical figures of lexical repetition. That is, whenever a word, word string, or entire phrases or clauses is repeated, it is a ploke, e.g., "very, very big"; "easy come, easy go"; "waste not, want not". Rhetorical figures code much valuable information at syntactic, semantic, and pragmatic levels. This information can be incorporated to facilitate a wide range of AI/NLP applications such as conversational agents, machine translation, authorship attribution, genre detection, sentiment analysis, etc. This paper proposes an *ontology* for ploke and other rhetorical figures of lexical repetition in terms of class, subclass, and their relations. We also represent concepts related to ploke and rhetorical figures in general, e.g., form, function, neurocognitive affinity, etc., Section 2 describes the current state of research and applications of rhetorical figures in AI/NLP. Then, Section 3 presents classes and relations that capture the high level concepts of rhetorical figures in general. Section 4 discusses detailed concepts related to ploke in ontological terms. Section 5 concludes the paper with a discussion potential future research directions.

2. Related Work

Although rhetorical figures have been studied for millennia, the establishment of the subfield *Computational Rhetoric* was fairly recent, where the importance of a computational model for rhetorical figures was highlighted for various NLP applications such as argument mining, authorship attribution, automated rhetorical figure detection, etc [3][4]. The idea of construction an ontology for rhetorical figures was delivered more than a decade ago by Harris and Di Marco [1][2] and has inspired a line of research of ontological models of rhetorical figures [9][10][11][13][14][15][16] including research presented in this paper.

Ontologies are formal knowledge representation models that enable sharing of reusable and inferable knowledge structures and data. The most cited definition of an ontology is from Gruber: "An ontology is a formal, explicit specification of a shared conceptualization" [17]. In simple words, an ontology is a set of axioms that define some commonly agreed concepts (i.e. classes and their instantiation) and relations among them (i.e. object and datatype properties). Harris et al. stated that rhetorical figures are "prime candidates for a cognitive ontology. They are both richly, demonstrably cognitive, and richly, demonstrably valuable for NLP tasks like argument mining" [2].

In previous work of O'Reily et al. [13] and Black et al. [14], an ontology was developed for the rhetorical figure *climax*, a compound figure of *gradatio* and *incrementum*. A gradatio features a sequence of words or phrases repetition at clause boundaries, i.e., *anadiplosis*. The sequence of repeated words or phrases form an incrementum such that there is a semantic increase along the repeated words or phrases [13]. Anadiplosis and gradatio are both rhetorical figures of lexical

[1]Also spelled as *ploce* or *ploche*.

repetition. The authors defined anadiplosis in terms of *elements*, *colons*, and *tokens*. Gradatio is a sequence of anadiploses. This paper extends their model to other rhetorical figures of lexical repetition and incorporates notions of neurocognitive affinities such as repetition and position.

The goal of this paper is not about the details of a detection algorithm for rhetorical figures, but rather to develop a unified ontological representation that facilitates various NLP applications, one of which is the automatic detection and annotation for rhetorical figures. Existing detection tools uses methods such as regular expressions [18], shallow parsing [5], machine learning classifiers [19][20], ontologies [15][16], and hybrid approaches [6][7], almost all of which cover implementation details related to ploke detection such as recognizing repetitions of a word or phrase, positions, sentence boundaries, intentionality etc. within a given passage or corpus. Although this paper treats all lexical repetitions as plokes, some detection tools treat repetition of function words, stop-words, etc. as accidental or false-positives which are filtered according to specific algorithms of the detection tools [2][12]. This line of work also sheds light on various applications such text summarization [8], argument mining [11][21], authorship attribution [6][7], and machine translation [22].

3. Rhetorical Figures and Attention

This section describes a general level ontological model for rhetorical figures. The ontology includes a classification of rhetorical figures as well as related concepts such as linguistic elements, neurocognitive affinities and attentional effects. This model is not intended to be comprehensive but rather as a collection of upper level classes and relations that encapsulate concepts of ploke presented in the next section. We use a capitalized word in a sans serif font to indicate a class name, e.g., Ploke; a capitalized word in a typewriter font to indicate a relation, e.g., `Contain`; a serif font with quotation marks for an example quotation of a rhetorical figure or a part thereof, e.g., "All for one"; and text in a serif italic font for a variable denoting an arbitrary instance of a class, e.g., *passage1*.

To the center of the ontology is the class Rhetorical Figure. A Rhetorical Figure, contained in a Passage, causes the Passage to have Attention Effects on the Passage's Receiver, as is shown by the bolded path in Figure 1. A conventional classification of rhetorical figures is to classify figures as schemes and tropes. A Scheme is a subclass of Rhetorical Figure that is characterized by form such as phonology, morphology, lexis, and syntax. A scheme can be formed by, for instance, an effective repetition or alternation of position of a word or phrase in a passage. A Trope is a class in which the figures are heavily characterized by the semantics within the passage. The following example demonstrates an instance of Scheme:

"All for one, one for all"[23] (Example 1)

Example 1 contains multiple rhetorical figures, including several plokes. A Ploke is a subclass of Scheme whose form is a repetition of words. In this example, the repeated words are "all", "for", and "one". While Example 1 is most famous as an exemplum of antimetabole, reverse lexical repetition ("all" and "one" repeat in reverse order), rhetorical figures often work together to maximize cognitive appeal and constrain the range of rhetorical functions [24], and Example

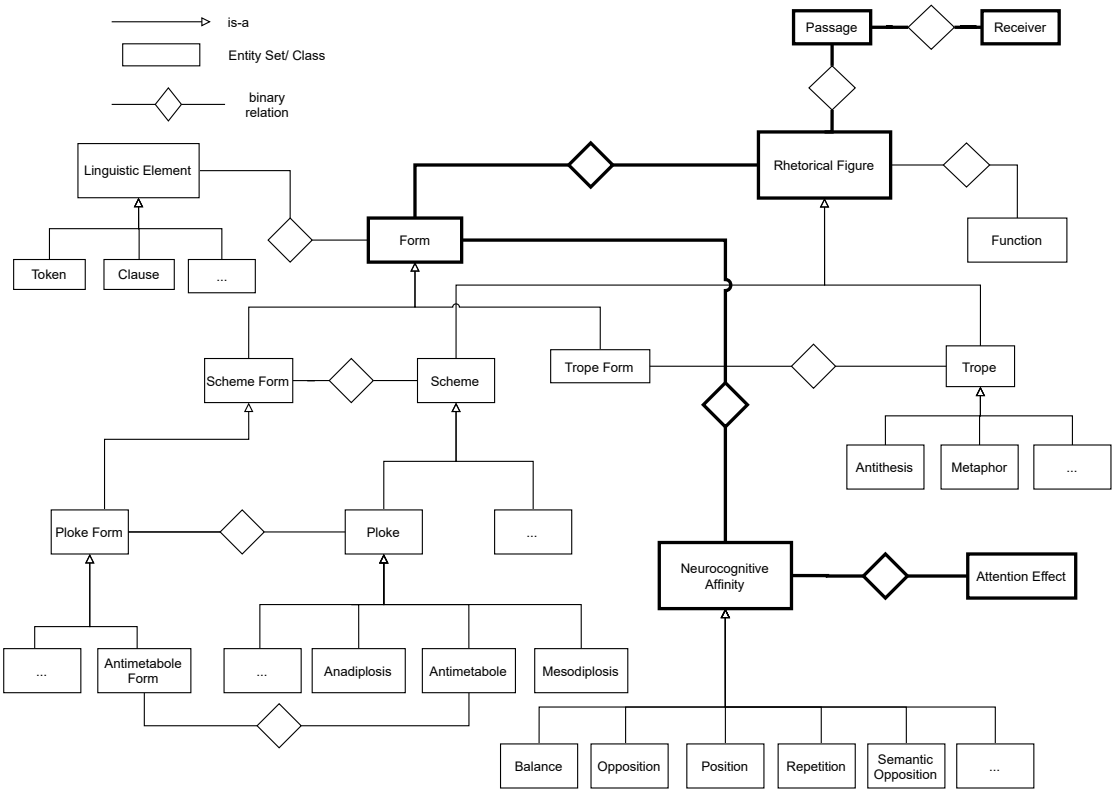

Figure 1: Rhetorical Figure Ontology general overview

1 is no exception. It consists a number of different types of scheme in addition to antimetabole, including mesodiplosis, anadiplosis, and others, which will be discussed in the next section.

A Rhetorical Figure consists of a Form and a Function[2]. The Form of a Rhetorical Figure consists of a set, possibly ordered, of Linguistic Elements. A linguistic element is one of a word, syllable, phrase, clause, phoneme, lexeme, morpheme, sememe. Since this paper focuses on ploke, we will omit details of other linguistic elements and focus our discussion on Token only, which is defined in this paper as one word or a sequence of words, minimally interrupted. Token is a subclass of Linguistic Elements. The Form of a Rhetorical Figure `Triggers` one or more neurocognitive affinities. A Neurocognitive Affinity is a pattern recognized by a receiver's brain [2], e.g., Symmetry, Balance, Opposition, Position, Repetition, Semantic Opposition, autc[3]. These neurocognitive affinities, individually or conjointly, will generate Attention Effects such as salience, aesthetic pleasure, or increase memorability [2].

The connection made by the neurocognitive affinities creates a coupling between a rhetorical figure's form and its function. The function becomes predicable when the form of a rhetorical figure is recognized [2]. For example, lexical repetition of Token (i.e., the form) in Example 1 functions to stabilize reference for the concept conveyed to ensure that "all" and "one" refer

[2]Also referred to as *rhetorical function*

[3]Just as "etc." = "and others", so do "autc." = "or (exclusive) others" and "velc." = "or (nonexclusive) others".

to the same entities [25]. The reversed repetition (i.e., the form) of antimetabole in Example 1 generates a focus on the reciprocal relationship (i.e., the function) [25]. The form of Example 1 triggers a balance (of structure), an opposition ("all" and "one"), and repetitions ("all", "for", and "one") each of which is a neurocognitive affinity. All figures present in Example 1 harmoniously generate attentional effects such as salience, aesthetic pleasure, and memorability, thus a famous quote was created [26]. There are other rhetorical figures such as parison and isocolon that contribute to the attentional effects of Example 1. This paper focuses on ploke, rhetorical figures of lexical repetition.

4. An Ontology for Ploke

4.1. Ploke: Figures of Lexical Repetitions

The terminological and conceptual history of rhetorical figures is uneven at best, and ploke is a case in point. It is traditionally defined as "the intermittent or unpatterned reappearance of a word" [27], distinguished from figures like antimetabole or anadiplosis, in which words do exhibit patterns in their occurrences. But as Harris [12] argues, Ploke is better viewed as a class of lexical repetition figures (otherwise unconnected in the classical tradition). To this end, we follow Harris et al. [2] in making the distinction between Simple Ploke and Complex Ploke. Simple Ploke is the unpatterned default repetition of words and Complex Ploke is the class of figures, like Antimetabole and Anadiplosis, in which multiple occurrences of words are positionally patterned, either with respect to each other (antimetabole) or to larger units of discourse (anadiplosis). Simple Ploke has only one member (Conduplicatio, one of the many synonyms used to designate unpatterned lexical repetition). Complex Ploke has many members as shown in Figure 2. Definitions and examples of subtypes of Complex Ploke are shown below, with the repeated tokens bolded. The definitions and examples are based on Harris and Di Marco (2017) [28].

Anadiplosis: lexical repetition of a Token on both side of a clause or phrase boundary.

> "… you won't prevent **poverty**. **Poverty** being more than income …" [21]

Antimetabole: lexical repetition of two Tokens in reverse orders.

> "Ask not what **your country** can do for **you**. Ask what **you** can do for **your country**." [29]

Epanalepsis: lexical repetition directly across phrasal or clausal boundaries.

> "**Boys** will be **boys**."

Epanaphora: lexical repetition of a Token at the beginning of clauses or phrases, a synonym to anaphora.

> "That's **one** small step for man, **one** giant leap for mankind." [30]

Epiphora: lexical repetition of a Token at the end of clauses or phrases, a synonym to epistrophe.

"If I lend you money, I'm taking a **risk**. And I should carry that **risk**." [21]

Epizeuxis: immediate lexical repetition of a Token.

"**Long**, **long** ago."

Gradatio: A sequence of anadiploses.

"Man behaving strangely is confronted by **police**. **Police** shoot **man**. **Man** dies." [31]

Mesodiplosis: lexical repetition when of a Token in the middle of clauses or phrases.

"We were elected to **change** Washington, and we let Washington **change** us." [32]

The use of these rhetorical figures generates a set of attentional effects linked to a number of neurocognitive affinities of human mind such as balance and symmetry, and to its core, repetition and position.

4.2. Form and Function of Ploke

Recall that a Rhetorical Figure consists of a Form and a Function. Ploke as a subclass of Scheme which in turn is a subclass of Rhetorical Figure, inherits this property. The form of a ploke, i.e., PlokeForm, a subclass of Form, `Triggers` a set of subclasses of Neurocognitive Affinity such as Repetition, Position, Balance, Opposition, autc. Each subclass of Ploke has a specific form which triggers a set of neurocognitive affinities. For example, the form of an antimetabole such as Example 1 is:

$$\ldots A \ldots B \ldots B \ldots A \ldots$$

where A and B are Tokens being repeated ($A =$ "all" and $B =$ "one"). The form of antimetabole demonstrates a balanced structure with the reversed repetition of A and B, therefore triggering neurocognitive affinities of a reversed repetition which in turn contributes to affinities such as balance and opposition. We will discuss the relations between forms and neurocognitive affinities with details in the next section.

The most important functions of ploke are to stabilize reference and emphasize the concept conveyed by the repetition. Repetition of a Token in a passage or speech stabilizes the reference to increase its clarity in context. Fahnestock's analysis suggests that repetitions are crucial in scientific writings where it is important to reduce or eliminate ambiguity [25]. Another function of ploke is to emphasize the concept conveyed by the repeated Token. The more a word, phrase or clause is repeated, the more it stands out from a sentence or a passage. Both stabilizing reference and emphasizing concept conveyed are functions related to ploke. In addition, subclasses of ploke have specific functions such as to increase the significance of quantity, reciprocality, and irrelevance of order, etc. which will be discussed in the following paragraphs.

An antimetabole has several functions. A function of antimetabole is to convey the idea of irrelevance of order, that is, the order or rank of A and B does not matter. For example, "Ladies

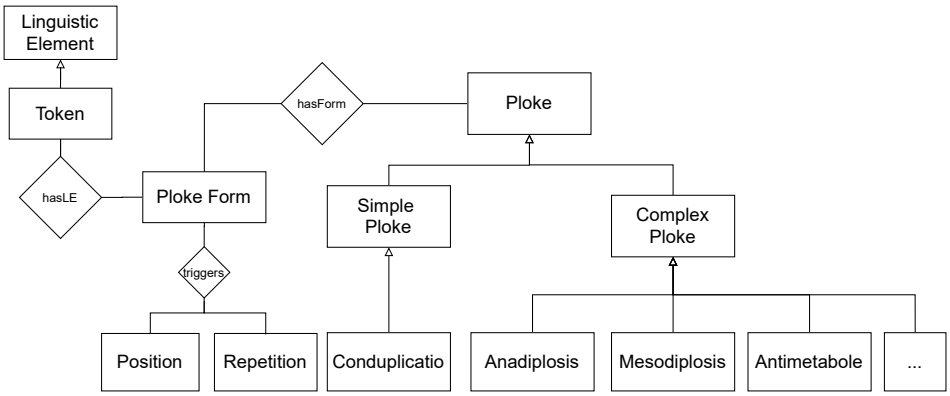

Figure 2: Ontological view of Ploke

and gentlemen, gentlemen and ladies". Another function of an antimetabole is to generate a focus on reciprocal relationship [25]. The reversed repetition often suggests a reciprocal relation between the repeated words A and B. For example, in propositional logic, the equivalence relation $A \leftrightarrow B$ is expressed as: $A \rightarrow B \wedge B \rightarrow A$, which indeed is an antimetabole, i.e., it has the form of $\ldots A \ldots B \ldots B \ldots A \ldots$. More generally, let R_1 and R_2 be binary relations, A and B be atomic concepts, then a reciprocal relation between A and B can be represented as

$$R_1(A, B) * R_2(B, A)$$

where the $*$ can be any binary connective, e.g., $\wedge$, $\vee$, $\rightarrow$, or $\leftrightarrow$, which does not affect the antimetabole. This is represented graphically in Figure 3.

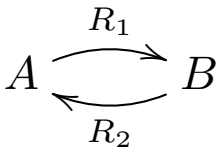

Figure 3: Reciprocal relation between A and B

In Example 1, the reversed repetition suggests an equivalent reciprocal obligation between "all" and "one", i.e., an entity of group, organization, or community supports an individual while an individual contributes to that entity. Thus, let `For` be a binary relation, we have

$$\texttt{For}(\text{“all”}, \text{“one”}) \rightarrow \texttt{For}(\text{“one”}, \text{“all”})$$

Note that the symmetrical case in which $R_1 = R_2$ is achieved in combination with mesodiplosis, i.e., the medial repetition of the word "for". The function of irrelevance of order or rank also applies in Example 1, thus the rank of "one" and "all" does not matter. Therefore Example 1 may also be expressed as:

"One for all, all for one"

Combining the expression above with the original Example 1 results in an equivalence relation

$$\texttt{For}(\text{“all”}, \text{“one”}) \leftrightarrow \texttt{For}(\text{“one”}, \text{“all”})$$

Consider the following example in which R exists between A and B but not equivalent.

> “Anyone who thinks he **has a solution** does not **comprehend the problem** and anyone who **comprehends the problem** does not **have a solution.**” [33]
>
> (Example 2)

where A = “has a solution” and B = “comprehends the problem”. Converting it to propositional logic we have,

$$(A \rightarrow \neg B) \wedge (B \rightarrow \neg A)$$

We cannot conclude the opposite, i.e., $\neg B \rightarrow A$, anyone who does not comprehend the problem has a solution. The formula above also resembles the form of an antimetabole. If we abuse the notation and define an arbitrary relation `IF-Then-Not` such that

$$\texttt{IF-Then-Not}(A, B) \equiv A \rightarrow \neg B$$

Thus, the reciprocal relation conveyed is the `IF-Then-Not` relation between A and B.

$$\texttt{IF-Then-Not}(A, B) \wedge \texttt{IF-Then-Not}(B, A)$$

Note that $\texttt{IF-Then-Not}(A, B) \equiv \texttt{IF-Then-Not}(B, A)$ since $(A \rightarrow \neg B) \equiv (B \rightarrow \neg A)$, and can be reduced to $\neg(A \wedge B)$. Example 2 basically repeated $\neg(A \wedge B)$ in different forms, one starts from A and ends at B, one starts from B and ends at A. The function of *completeness* is evoked by the antimetabole in the sense that: doesn't matter where you start, whether you think you have a solution or you comprehend the problem, a solution does not exist.

$$\texttt{IF-Then-Not}(A, B) \equiv \neg(A \wedge B) \equiv \texttt{IF-Then-Not}(B, A)$$

An antimetabole usually conveys a relation R_1 and R_2 between A and B. Usually a mesodiplosis suggests that $R_1 = R_2$. Recall the formula with an abstract binary connective,

$$R_1(A, B) * R_2(B, A)$$

The binary relation $*$ can be simple logical connectives such as $\vee, \wedge, \rightarrow, or \leftrightarrow$. In some cases $*$ is explicit as in *Newton's third law of motion*, i.e., “If you press a stone with your finger, the finger is also pressed by the stone” [34]; and in other cases it is implicit as in Example 1 and Example 2. The functions of plokes, or any rhetorical scheme, are best achieved when accompanied by forms that evoke or trigger neurocognitive affinities that harmonize with the functions.

4.3. Cognitive Affinity: Repetition and Position

Repetition is an important and fundamental aspect of language and cognition. It is possibly the most fundamental neurocognitive affinity that builds the foundation of brain activities and thus human minds [12]. Repetition emphasizes and stabilizes a sequence in memory and thus is essential for memorization. Most people tend to repeat a formula or a phone number in order to remember it [28]. Ploke is the repetition of Tokens. In terms of attentional effects of ploke, it is the repetitions that generate the salience effect on the repeated Tokens. That is, the more a Token repeats, the more noticeable it becomes, and thus the concept conveyed by that Token becomes more memorable. As stated previously, the form of an antimetabole, i.e., $\ldots A \ldots B \ldots B \ldots A \ldots$ triggers a reversed repetition of A and B that resembles a balanced structure as shown in Figure 4a.

(a) (b)

Figure 4: (a) The form of antimetabole generates a point balance structure; (b) The form of anadiplosis generates a step-wise energy flow. Modified based on [12][35]

Another example is the form of anadiplosis, i.e., $\ldots A.A \ldots$, which generates a focus point that serves as a transition point of a step-wise energy flow as shown in Figure 4b. The repetition at the final position of the boundary acts as the goal of the first clause, then the repetition at the initial position of the successive clause acts as the source of that clause [12].

The position affinity is triggered by repetitions of a Token at different positions within a phrase or clause. Positions can be immediately followed as in an epizeuxis, reversed as in an antimetaoble, or proximal with respect to another token in a passage. A position can also be the initial, medial, or final position with respect to a clause with in a passage.

Traditionally, neurocognitive affinities are viewed as independent entities. However, following the ontological representation of concepts related to Ploke presented in this paper, it is reasonable to view repetition and position as two primary neurocognitive affinities triggered by the form of a ploke. That is, Repetition and Position are subclasses of Neurocognitive Affinity. All other neurocognitive affinities triggered by forms of subclasses of Ploke are subclasses of Repetition linked with specific orientation of positions that are subclasses of Position.

Repetition is the reoccurrence of an Element. The Element in this context may be referred to as a Token, phrase, clause, or a repetition, e.g., figures such as antimetabole and gradatio have nested repetitions. A Repetition consists of at least two Elements that refer to the same instance of a Token. In this case, an Element can be viewed as an occurrence of a Token. An Element has a Position which can be `Before` or `After` another Position. Thus the Elements' Positions impose some order, i.e., `Before`(*position(e1)*, *position(e2)*) for Elements *e1* and *e2*. Note that *position(e1)* and *position(e2)* are functions which are in turn instances of the Position class. A Repetition can be defined as follows:

$$\forall rep, e1, e2.\mathsf{Repetition}(rep) \wedge \mathsf{Element}(e1) \wedge \mathsf{Element}(e2) \wedge \texttt{ElementOf}(e1, rep) \wedge \texttt{ElementOf}(e2, rep)$$

$$\rightarrow \texttt{RefersTo}(e1, w) \wedge \texttt{RefersTo}(e2, w) \wedge \text{Token}(w)$$
$$\wedge \texttt{Before}(\textit{position(e1)}, \textit{position(e2)})$$

A Repetition can be an Unpatterned Repetition, Relative Repetition, Respective Repetition, or a Nested Repetition. An unpatterned repetition is triggered by the form of a Conduplicatio, a sublcass of Simple Ploke, in which repetitions are not constrained by position. Other subclasses of Complex Ploke such as Epanaphora, Mesodiplosis, and Anadiplosis further restrict positions of their elements with respect to the clauses that contain them[4]. The form of each of these figures triggers Constituent-Initial, Constituent-Medial, and Constituent-Final Repetition respectively, all of which are subclasses of Relative Repetition. The form of Epizeuxis tirggers Immediate Repetition, whille the form of an Antimetabole triggers Reversed Repeition. Both are subclasses of Respective Repetition. Organization of sublcasses of Repetition is shown in Figure 5.

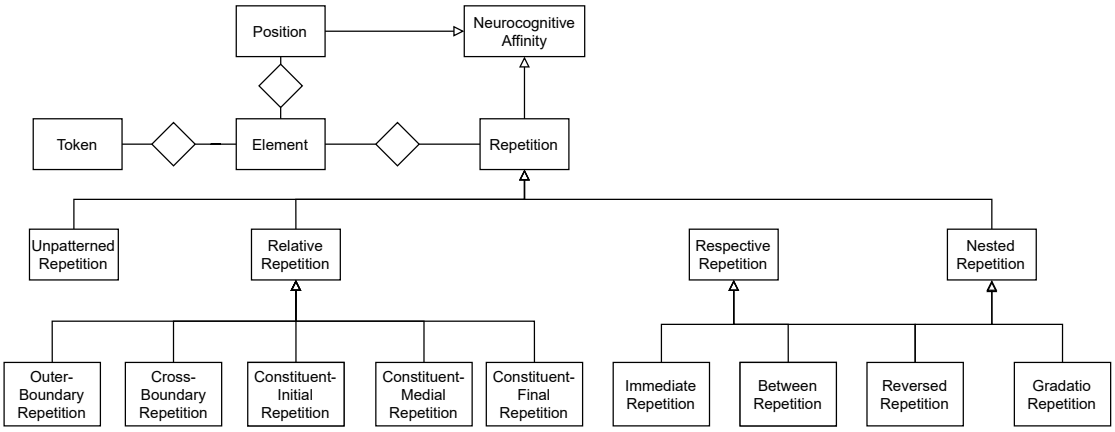

Figure 5: Ontological view of Repetition, a neurocognitive affinity

In Example 1, repetition of the word "all" can be represented by referring both *e1* and *e2* to the word "all" as in Figure 6. Similarly, the repetition of the word "one" can be represented using different sets of instances of Element referring to the word "one". Both repetitions of "all" and "one" are triggered by forms of subclasses of Ploke, more specifically, an Epanalepsis[5] and an Anadiplosis. Another repetition in Example 1 is formed by the word "for", a Mesodiplosis. Each of these three plokes triggers a subclass of Relative Repetition, i.e., Outer-Boundary Repetition, Cross-Boundary Repetition and Constituent-Medial Repetition. Figure 7 demonstrates the Cross-Boundary Repetition as an example.

The form of an Anadiplosis triggers the neurocognitive affinity of Cross-Boundary Repetition, a subclass of Relative Repetition. Let there be an arbitrary instance *c-b-rep1* of Cross-Boundary Repetition that has Elements *rep1e1* and *rep1e2*, each having its own instance of Position, i.e.,

[4] A position can be an absolute position (e.g., position 0, 1, etc.) or a respective or relative position with respect to another element, e.g., immediately after a word, beginning of a clause, etc. For simplicity, position refers to the latter unless otherwise stated.

[5] Let's treat $A \ldots, \ldots A$ as epanalepsis for now, although it refers to the repetition at the beginning and the end of the same clause.

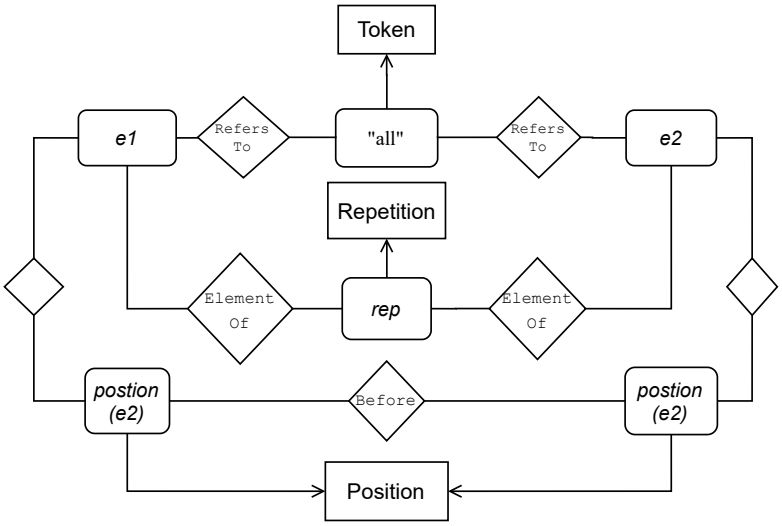

Figure 6: Example of Repetition using Example 1

position(rep1e1) and *position(rep1e2)*. The elements of *c-b-rep1* not only specify the order of their positions with respect to each other, but also with respect to the clauses. A Clause is a Linguistic Element that `Contains` Token. A Clause is connected to a Relative Position which is a subclass of Position that represents a position within a clause. Other subclasses of Position are Unpatterned Position and Respective Position. A Relative Position can be either Initial, Medial, or Final. A Clause `Precedes` or `Follows` another Clause. A Clause can also be `Proximal` to another Clause. Graphically, the classes Clause and Position can be represented as in Figure 8. The positions of elements of *c-b-rep1* must be instances of Final and Initial of the clauses in which the anadiplosis is contained in. For example, let *c1* and *c2* be instances of Clause and `Precedes`(*c1*, *c2*). The positions of elements *rep1e1* and *rep1e2* are located in *c1* and *c2* respectively. In terms of Example 1, the string values of *c1* and *c2* are "All for one" and "one for all" respectively. Both *rep1e1* and *rep1e2* refer to the word "one". In this case, the position of *rep1e1* must be an end position of *c1*. Thus *position(rep1e1)* is an instance of End that is linked to *c1*. Similarly, *position(rep1e2)* is an instance of Initial that is linked to *c2*. Another relation between the clauses is the `Proximal`(*c1*, *c2*) to indicate proximity between the clauses. Similarly, a Constituent-Initial, Constituent-Medial, and Constituent-Final Repetition triggered by Epanaphora, Mesodiplosis, and Epiphora respectively, has both elements with positions that are instances of Initial, Medial, and Final respectively. In the case of Epanalipsis, positions of elements are the opposite of that in the case of Anadiplosis, i.e., *rep1e1* and *rep1e2* are instances of Initial and Final respectively.

Another subclass of Repetition is Nested Repetition, in which its elements are themselves instances of Repetition. In other words, a Nested Repetition is the repetition of Repetitions. This paper demonstrates Reversed Repetition, a subclasses of Nested Repetition while also a subclass of Respective Repetition, triggered by the form of an Antimetabole.

The form of an antimetabole triggers a Reversed Repetition, which is a subclass of Repetition. The elements of Reversed Repetition are Repetitions. Let *rep1* and *rep2* be instances

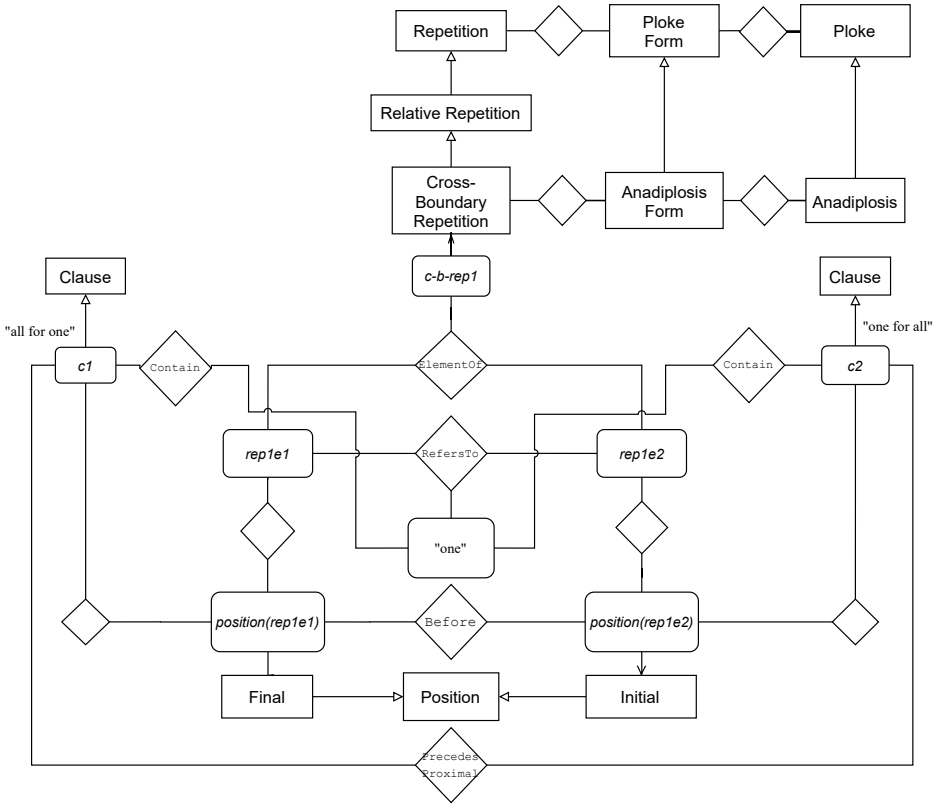

Figure 7: Example of Cross Boundary Repetition using Example 1

of Repetition and *rep1e1*, *rep1e2*, *rep2e1* and *rep2e2* be elements of *rep1* and *rep2* defined as in Figure 6 accordingly, then an instance *revRep1* of Reversed Repetition can be defined as follows and graphically in Figure 9:

$$\begin{aligned}\text{ReversedRepetition}(\textit{revRep1}) \wedge\ & \texttt{ElementOf}(\textit{rep1}, \textit{revRep1}) \\ & \wedge\ \texttt{ElementOf}(\textit{rep2}, \textit{revRep1}) \\ & \rightarrow\ \texttt{Before}(\textit{position(rep1e1)}, \textit{position(rep2e1)}) \\ & \wedge\ \texttt{Before}(\textit{position(rep2e1)}, \textit{position(rep2e2)}) \\ & \wedge\ \texttt{Before}(\textit{position(rep2e2)}, \textit{position(rep1e2)})\end{aligned}$$

In Example 1, *rep1e1*, *rep1e2* both refer to the word "all" and *rep2e1*, *rep2e2* both refer to the word "one". The order of positions of the elements is, in conventional notation, $rep1e1 < rep2e1 < rep2e2 < rep1e2$. Note that in this case the positions are not instances of Relative Position, but of Respective Position with relations `Before` and `After` representing the order of the position of each element with respect to each other. Since relations `Before` and `After` are transitive, the relation `Before`(*position(rep1e1)*, *position(rep1e2)*) defined as part of the definition (i.e., the dashed line in Figure 9) of *rep1* is implicit from the definition of *revRep1*.

What about the other neurocognitive affinities such as balance, opposition, etc.? These neu-

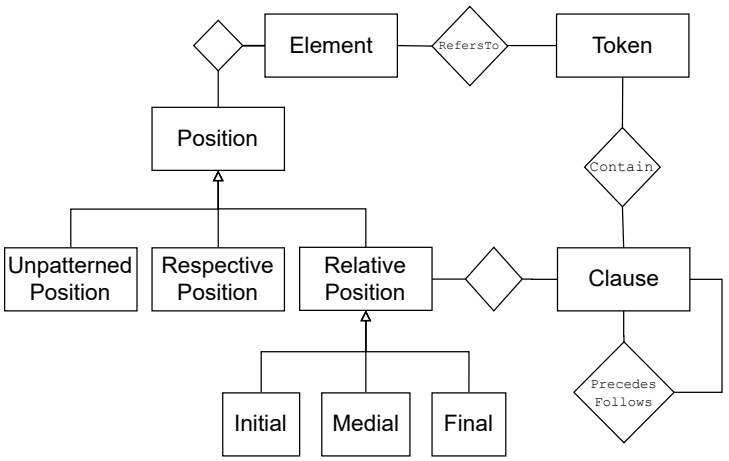

Figure 8: Classes and relations of Clause and Position

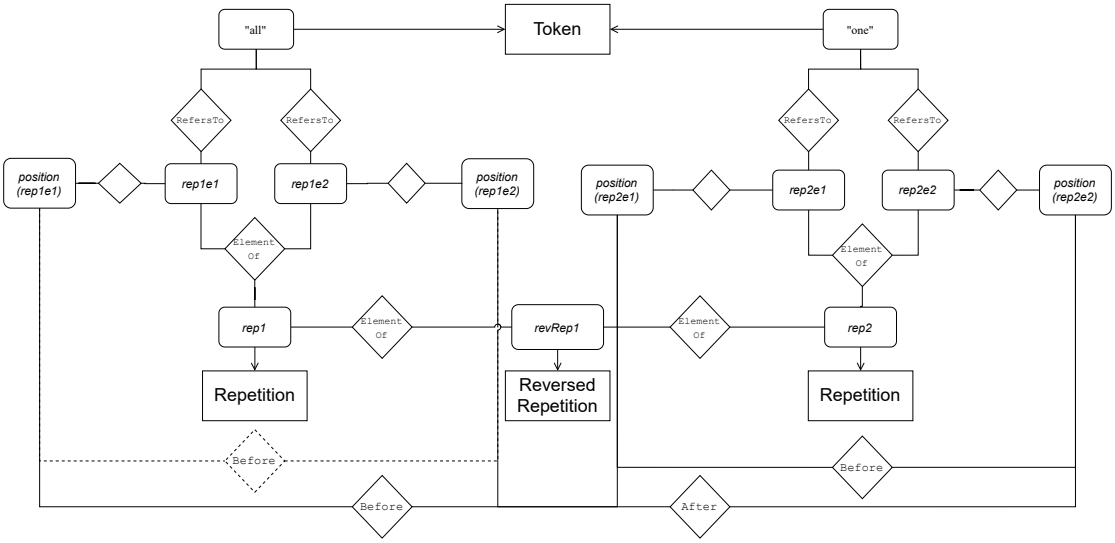

Figure 9: Example of Reversed Repetition using Example 1

rocognitive affinities are the results of multiple rhetorical figures working together [26]. In the scope of Ploke, they are certainly contributed by the subclasses of Repetition. A Clause-Medial Repetition contributes to balance, a Clause-Boundary Repetition contributes to opposition, a Reversed Repetition together with a Clause-Medial Repetition contribute to both balance and opposition, etc. In the case of Example 1, the combination of antimetabole and mesodiplosis produces a stronger balance. Thus, the forms of plokes do not trigger balance and opposition directly, but contribute through combinations of Repetition and Position and their subclasses. That is, repetition and position are the primary neurocognitive affinities triggered by the form of a ploke.

5. Conclusion and Future Work

We have proposed an ontology for ploke which treats ploke as a class of figures rather than an isolated figure. The ontology outlines the subclasses of Ploke which includes rhetorical figures of lexical repetition such as Anadiplosis, Epanaphora, Antimetabole, etc. The ontology also models the path of the attentional effect a rhetorical figure has on a receiver. That is, Rhetorical Figure → Form → Neurocognitive Affinity → Attention Effect as in Figure 1.

Another important contribution of the proposed ontology is the classification and representation of repetition and position, both are primary neurocognitive affinities triggered by the form of a ploke. In summary, Anadiplosis triggers the Cross-Boundary Repetition, a subclass of Repetition in which positions of elements are specified as instances of Relative Position, a subclass of Position. Similarly, Epanaphora, Mesodiplosis and Epiphora trigger specific types of repetitions in which positions of the elements, e.g., *position(rep1e1)* and *position(rep1e2)*, are instances of classes Initial, Medial, and Final respectively, all of which are subclasses of Relative Position. As demonstrated by the Antimetabole in Figure 9, reversal is the alternation of positions of Elements that is part of Reversed Repetition, a subclass of Nested Repetition, in which the Elements are Repetitions.

All neurocognitive affinities triggered by forms of plokes harmoniously generate attentional effects such as salience, aesthetic pleasure, and increase memorability. Therefore it is crucial to have a formal knowledge representation model for ploke that includes concepts of neurocognitive affinities in order for AI/NLP systems to take advantage of rhetorical information embedded in rhetorical figures. The next step is to extend and construct ontologies for other rhetorical figures, including other schemes, phonological and morphological figures, in similar manner. It is also possible to incorporate the proposed ontology with existing rhetorical figure detection tools [5][6][7][19] and other existing rhetorical figures ontologies [10][11][13][14][16][21] to facilitate NLP applications such as argumentation mining and authorship attribution, etc. For example, Strommer [6] classified whether an epanaphora is accidental or intentional and used the result as a metric of author's intent. The ontology in this paper is a potential extension to such a system by connecting detection results as instances of classes defined in the ontology, e.g., repeated words or phrases are instances of Element. All other rhetorical information can be automatically inferred, which in turn can facilitate the classification of intentionality.

Another possible direction of research is to explore the connection between neurocognitive affinities and the function of a rhetorical figure. We have already expressed a number of functions of ploke in First Order Logic. For example, in Figure 9, the proposed ontology is able to infer that an arbitrary relation R exists between the elements *rep1e1* and *rep2e1* of the Reversed Repetition, triggered by the form of an Antimetabole, whose function is to convey a reciprocal relation. However, contextual information is required to instantiate R. Because functions of rhetorical figures are loosely researched in the field of rhetoric, it would greatly benefit the field if the connection between neurocognitive affinities and functions can be established formally. New discoveries of functions will return the favor to Computational Rhetoric and AI/NLP with potential rhetorical figure ontologies that are more comprehensive and robust. We also proposed that repetition and position are the primary neurocognitive affinities that contribute to other compound affinities such as balance and opposition. We are interested in the formal representation of how each variation of repetition contributes to the compound neurocognitive

affinities. Therefore, formalizing the connections between these neurocognitive affinities is another research direction in future.

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