CORPUS-BASED MODELLING OF LEXICAL CHANGES IN BIPOLAR DISORDERS: THE CASE OF EDGAR ALLAN POE

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ABSTRACT. *Bipolar disorders affect the mind and are probably caused by a biological imbalance in the brain. Language, a reflection of thought and ideas in the mind, and a vehicle for communication among human beings is an excellent display of potential mental disorders. In this study we hypothesize that Poe's bipolar disorders could be reflected in his literary production. Our research will be based on the analysis of the lexical profile obtained out of 42 randomly selected tales by Poe from his total of 69. For that purpose, we have selected standard lexical variables, common in many corpus-based lexical studies. Specifically, we have selected eight lexical variables, grouped into three categories: (i) lexical richness, (ii) lexical features of the mental lexicon, and (iii) lexico-semantic text difficulty. The results reveal significant abnormal linguistic fluctuations, very much in concord with cyclothymic fluctuations in Poe's mood.*

KEYWORDS. *Bipolar disorders, mania, euphoria, literary corpus-based research, lexical analysis.*

RESUMEN. *Los trastornos bipolares afectan a la mente y se deben probablemente a ciertos desequilibrios biológicos localizados en el cerebro. El lenguaje, reflejo del pensamiento y de las ideas, y vehículo de comunicación entre los seres humanos, es un claro expositor de los trastornos que pueden darse en el cerebro. En este estudio consideramos que los trastornos bipolares de Poe podrían reflejarse en su producción literaria. La investigación se basa en el análisis del léxico contenido en 42 de sus 69 cuentos. Con este fin, nos valemos de variables léxicas estándares, típicamente usadas en los estudios léxicos realizados con técnicas de corpus. Hemos seleccionado ocho variables léxicas, agrupadas en tres categorías: (i) riqueza léxica, (ii) rasgos léxicos del lexicón mental, y (iii) la dificultad textual de carácter léxico-semántico. Los resultados obtenidos revelan que existen fluctuaciones lingüísticas anormales que son significativas, y que avanzan paralelamente a los trastornos ciclotímicos de Poe.*

PALABRAS CLAVE. *Trastornos bipolares, manía, euforia, investigación literaria basada en corpus, análisis léxico.*

1. SOME PRELIMINARIES ON BIPOLAR DISORDERS AND EDGAR ALLAN POE

1.1. *Bipolar disorder*

Bipolar disorder, also known as manic-depressive illness, is partially a self-explaining term: it applies to the mental abnormalities of people shifting from one

extreme in their mood condition –excess of euphoria and energy– to the opposite one –depression, externally perceived as anxiety, hopelessness, irritability, and morbid suicidal ideation (Valciukas 1995; Sue et al. 2008; Naime 2010; Barlow and Durand 2011). Symptoms of bipolar disorder are severe. They are different from the normal ups and downs that everyone goes through from time to time. Bipolar disorder symptoms can result in damaged relationships, poor job or school performance, and even suicide (Fawcett et al. 2000; Yatham and Maj 2010).

Bipolar disorders affect the mind and are probably caused by a biological imbalance, of a neurological nature, in the brain (Miklowitz 2010). In plain words, the neural network performance of the individual deviates from normal and standard behaviour in certain components. Consequently, specific neural centres are activated in excess and provoke the release of chemicals favouring euphoria or depression (Nybo and Secher 2004).

Bipolar disorders are far from being univocal (Perry 2010). They rather imply a wide spectrum in intensity, from a maximum –*mania*, with possible psychotic symptoms– to a minimum –*hypomania*, with lighter mood episodes. Depressive conditions are externalized through persistent low mood, which is accompanied by low esteem and loss of interest in those activities which one normally could expect to enjoy (Judd et al. 2002). This situation affects the life of the individual in many ways: in his/her work, life, sleep, personal relationships and daily activities. Depressive people may have a tendency to commit suicide (Tondo et al. 2003).

Hypomania, at the other side of the scale, activates an apparently more positive mood. It goes together with euphoria and generates a high degree of energy, while less positive symptoms may accompany, such as the lack of a need for sleep and rest, or a too daring attitude and stand in life (Angst et al. 2003). However, such a euphoric situation may also favour creativity, generate fresh and new ideas and strengthen a permanent drive for success and new horizons (Richards and Kinney 1990). Shifting from one state of mood to the opposite is characteristic of people with bipolar disorders.

1.2. *Some notes on Poe's biography*

Edgar Allan Poe's life was not pleasant, easy or comfortable. Poe was born in Boston, in 1809, and was soon left an orphan: his mother died when he was only two years old, and so did his father shortly afterwards. He was adopted by Frances Allan, a well-to-do merchant, who provided Poe excellent opportunities for education. He attended school in England, where the Allan family moved for several years, but the school did not make him happy. As Poe himself wrote:

> From childhood's hour I have not been / As others were; I have not seen / As others saw; I could not bring / My passions from a common spring. (*Alone*).

Poe entered the University of Virginia to study law in 1926, and stayed there for only one year, leaving with heavy debts. Soon afterwards, he joined the army, which he left before finishing the five-year contract previously subscribed. He was admitted again

at West Point Military Academy, only to abandon once again the institution before his five-year contract was completed. He quarrelled frequently with his adoptive father, he was too often in debts, he never succeeded in earning enough money to afford a comfortable living even when he married Virginia, a 13-year-old girl. Alcohol was often or perhaps frequently the source of problems at home and in his professional life, and he finally found his death, in 1849, in the most sad and deplorable circumstances.

No doubt, Poe's life was rather sad. His literary talent was only partially and moderately acknowledged while he lived. The publication of *The Raven*, in 1845, for example, earned him ample and national recognition in just a few weeks. However, he was not successful enough to provide for a decent living. It contributed to his character, his irritability, his changes of mood, his alcohol problems, his lack of organization and unreliability in his commitments. Was it just bad luck or the result of specific mental disorders? Or, to put it in a more *poetical* way and in his own words, was his life only a dream within a dream?

> All that we see or seem / Is but a dream within a dream. (*A Dream within a Dream*)

It is possible that Poe himself was somehow aware of his mental state. In 1849, he wrote in a letter:

> I was never really insane except upon occasions when my heart was touched.

These words seem to reveal a mental condition far beyond what Poe himself imagined. After all, medicine in general and knowledge on mental disorders was still very limited in the 19th century. Poe may be right: he was *insane* only at times, when his changing and cyclothymic moods fluctuated from normality to irritation, depression or creative hyperactivity. Still, he did not feel *insane* when he was at one of the extremes of the bipolar disorders continuum, that is, when he felt full of energy, inventiveness and creativity. On the other hand, his dependency on alcohol and perhaps on drugs as well, may have increased and contributed to his mental instability.

1.3. *Poe's mental state*

Many people have long shared Poe's suspicion that genius and insanity are entwined (Andreasen 1987; Jamison 1989, 1995; Kaufmann 2003; Perales 2011). Many poets, painters and composers throughout history have had depression or mania, among others, Vincent van Gogh, William Blake, Agatha Christie, Charles Dickens, Paul Gauguin, Federico García Lorca, Francisco de Goya, John Lennon, Mel Gibson, Michelangelo, Miró, Mozart, Otto Klemperer, Rainer Maria Rilke and Leo Tolstoy. It is very likely that Poe could have been one of them.

Of course, it is impossible to diagnose after-the-fact. We would need to examine a living Poe to diagnose his particular mental problem. However, there are evidences of

Poe's life that reflect some psychiatric symptoms that point towards Poe suffering some kind of mental disease.

During his brief time study in the University of Virginia, Poe chose to live an extravagant lifestyle that could not be supported by his means of income resulting in him incurring a lot of debt. People with bipolar disorders are known to live such lifestyles to feel good about themselves and cover up their depression (Zornberg and Pope 1993; Eng et al. 2001; Goodwin and Jamison 2007). Many depressives, like Poe, tend to self-medicate themselves with alcohol and drugs, perhaps temporarily relieving his pain but ultimately exacerbating his condition (Khantzian 1985, 1997; Strakowski et al. 2005; Bolton et al. 2009). Some scholars go even further and suspect that Poe suffered bipolar disorder in an even crueler form, the form of severe depression (Asch 1966; Müller-Oerlinghausen et al. 2002). Severe depression can cloud a person's thinking. This clouded thinking can sometimes make it harder to reach out for help. Severe depression can lead some people to think that life is not worth living. Sometimes depression is so severe, and feelings of hopelessness are so deep, that a person considers and commits suicide (Tondo et al. 2003), as was the case of Poe.

Some other of Poe's behaviour was quite odd as well; when his wife (a 13-year-old cousin) died, he had a strict ritual of walking around her grave a certain number of times each night, perhaps indicating some sort of obsessive-compulsive disorder (Grant and Higgins 2003; Cefalu 2009; Fleissner 2009). Obsessive-compulsive disorder is an anxiety disorder, characterized by recurrent, unwanted thoughts (obsessions) and/or repetitive behaviours (compulsions). Affected subjects perform these "rituals"; however, they provide only temporary relief, and not performing them markedly increases subjects' anxiety (Krishnan 2005).

There is no diagnosis of Poe's insanity; and because we can only examine his work, biographies and auto-biographies, we cannot be exactly sure if this was the case. However, the clinical symptoms mentioned above and the extensive literature and biographies on Poe's, more than likely, mental illness[1], are potential evidences that Poe might have suffered from some sort of mental disease. His mood swings (periods of enormous creativity followed by bottoming lows) would explain the fact that as time grew, his writings became more disturbed, because the affliction worsened with time (Jamison 1995; Marco 2004; Ginsberg 2009). Poe's drinking and drug problems were more than likely a way of self-medication (Khantzian 1985, 1997; Strakowski et al. 2005; Bolton et al. 2009).

1.4. *Bipolar disorders and linguistic production*

Language is the tool human beings have developed for communicating with each other. It is the tool we use in communicative situations, a sophisticated tool indeed, highly complex in its components, structure and functioning, far from perfect in design and accuracy, but flexible enough to allow for all human beings to be able to acquire and use it in multiple circumstances and settings.

Language is also the tool that frames our conceptual world. Thought and language are intimately related and dependent from each other. As a product of our mental activity, language reflects our thoughts and concepts of the world, the information we store and the way we cognitively process it. The analysis of the language an individual uses for transmitting thoughts and ideas might reveal his/her inner world, and indirectly the way his/her brain processes the information transmitted. This is the hypothesis supporting some psychiatric studies centred on the analysis of language and speech disorders (Docherty et al. 2006; Norbury et al. 2008; Sadock et al. 2007; Tasman et al. 2011).

We therefore hypothesize that besides the clinical symptoms, other facts and data may be useful and revealing in order to assess whether a specific individual suffers or not from mental disorder. Among them,

1. Biographical data illustrating somebody's personality and explicit details on the mood conditions that prevail or define the life of an individual.
2. The topics underlying the literary production. It is well known that people suffering from bipolar disorders tend to centre their attention on specific topics –manias–, as a reflection of their state of mind when being depressed or when in euphoric condition.
3. The literary production itself. On the one hand, specific mood conditions will generate specific topics (Ekman and Davidson 1994; Siemer 2001); on the other hand, both the different mood conditions and the related topics will be materialized through the use of specific language outcome (Lorenz 1953; Kerbeshian and Burd 1996; Yu et al. 2009). The analysis of language may therefore become a reliable source of information to detect possible mental disorders.

2. A DATA-BASED STUDY ON POE

2.1. *Research goal*

Our focus is to examine Poe's written work and try to find if specific mood conditions and/or episodes in his life somehow determined his language usage. In order to constrain more our research goal, we shall focus our attention on a specific linguistic level: lexis.

So far, we do not know of any previous research that has ever attempted to find parallelisms or correlations between changes in mood conditions and/or episodes in one's life and lexical usage.

As commented on above, language may reflect the state of one's mind as it is very vulnerable to neurological damage and disorders (Baird 2008; Edwards and Charlton 2002; Zardini 2009). This implies that a thorough analysis of one's language output might provide useful information on one's potential mental state.

Our aim in this research is to trace Poe's lexical changes by means of his literary production and analyse if they somehow run parallel to his venturesome life episodes.

We are confident that scrutinizing Poe's lexis might ultimately reveal positive traces and hints on his cyclothymia along his literary creativity.

2.2. *Hypothesis*

Our hypothesis is that Poe's changing and cyclothymic disorders, fluctuating from euphoria to depression, reflect themselves in lexical change and/or choice along his tales.

2.3. *Methodology*

This research is based on a longitudinal analysis, that is, on repeated measurement over time. This might reveal valuable insights into both:

1. The episodic mood fluctuations and
2. The potential variables that best evidence these fluctuations.

The lexical profile will be obtained from 42 randomly selected tales by Poe (Table 1) from the total of 69. The total tale-selection accounts for 60.87%, ranging from 1831 to 1849. Correlation with manuscripts per year is very high and statistically significant [$\varrho = 0.9681$; *sig. < 0.05*], which proves that sampling is highly representative.

TABLE 1. *List of tales*.

1831 A decided loss	1842 THE BLACK CAT
1831 A TALE OF JERUSALEM	1842 THE GOLD
1831 THE BARGAIN LOST-BonBon	1842 THE MASK OF THE RED DEATH
1832 BERENICE	1842 THE PIT AND THE PENDULUM
1832 MS Found in a bottle	1842 THE TELL tale heart
1832 THE VISIONARY	1843 A Tale of The Ragged Mountains
1835 MORELLA	1843 RAISING THE WIND
1835 SHADOW	1844 SOME WORDS WITH A MUMMY
1837 ARTHUR GORDON PYM	1844 THE ANGEL OF THE ODD
1837 VON JUNG	1844 THE OBLONG BOX
1838 LIGEIA	1844 THE PREMATURE BURIAL
1838 WHY THE LITTLE FRENCHMAN	1844 THE PURLOINED LETTER
1839 THE DEVIL IN THE BELFRY	1844 The System of Doctor Tarr and Professor Fether
1839 THE FALL OF THE HOUSE OF USHER	1845 THE FACTS OF M
1839 THE JOURNAL OF JULIUS RODMAN	1845 THE POWER OF WORDS
1839 THE MAN THAT WAS USED UP	1846 MELLONTA TAUTA
1840 THE MAN OF THE CROWD	1846 The Cask of Amontillado
1841 A DESCENT INTO THE MAELSTRÖM	1849 LANDORs cottage
1841 NEVER BET YOUR HEAD	1849 The Lighthouse
1841 THE ISLAND OF THE FAY	1849 Von Kempelen and his Discovery
1841 THE MURDERS IN THE RUE MORGUE	1849 X-ing a paragrab

2.4. *Variables*

As mentioned above, we have not found in the literature any previous research aiming at correlating mental disorders with lexical usage/choice. This is indeed a pioneering work, bringing together linguistics, literature, psychiatry and medicine.

In order to measure Poe's lexical usage/choice, we need to select relevant linguistic variables. However, due to the lack of literature related to our research topic, this is a most difficult task. The solution we have adopted is to take standard lexical variables related to lexical indices, as our focus is precisely attempting to typify a lexical profile of Poe's literary production, correlating longitudinally this lexical profile with Poe's life episodes, and finally checking whether specific lexical profile sections coincide with some prominent and venturesome episodes of Poe's life.

As this research falls within the domain of corpus-based techniques and methodology, we have selected standard lexical variables that have become typical and normal in many corpus-based lexical studies. Overall, eight lexical variables have been selected and measured, grouped into three categories:

1. Lexical richness,
2. Lexical features of the mental lexicon and
3. Lexico-semantic text difficulty.

More specifically:

1. Lexical richness variables:
    a. Standardized type-token ratio (Tweedie and Baayen 1998);
    b. Content word ratio (Stubbs 2002).

2. Lexical features of the mental lexicon:
    a. Mean word length (Nam et al. 2004);
    b. Long words (>10 characters; Biber and Jones 2005);
    c. Hapax legomena (Oaks 2009);
    d. Exclusive hapax legomena.

3. Lexico-semantic text difficulty:
    a. Mean sentence length (Kelih et al. 2006);
    b. Automated readability index (Bruce & Rubin 1988).

2.5. *Results*

In order to detect abnormal fluctuations and changes in Poe's lexis, we shall measure all eight lexical variables in all 42 tales and normalize the data into *z-scores*. A positive contribution of standardized z-scores is that all values are given in standard deviations (SD). All z-scores higher than +2 SD or lower than –2 SD will be considered abnormal as they fall outside the 96% *normality* range (Figure 1) and will be consequently regarded as potential cyclothymic disorders.
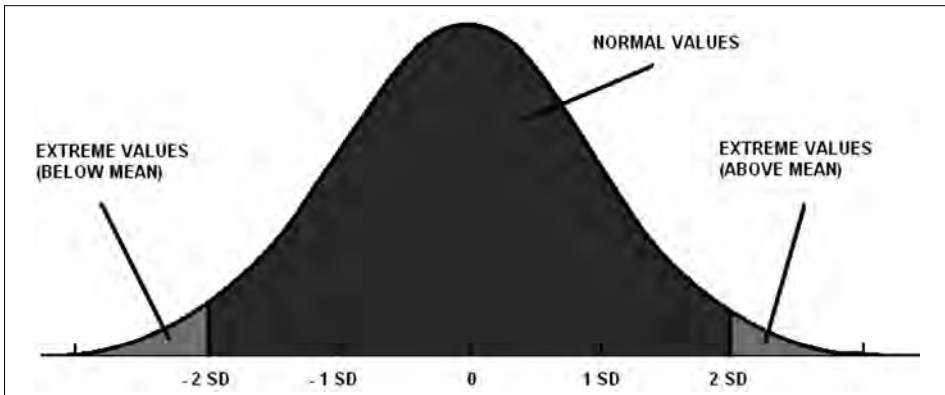

Figure 1. *Normal distribution*.

2.5.1. Standardized Type-token Ratio

Succinctly, the standardized type-token ratio is a measure of vocabulary variation within a written text or a person's speech. It is computed every *n* words. Thus, the ratio is calculated for the first *n* running words, and then calculated afresh for the next *n* words, and so on to the end of the text or corpus. A running average will be later computed, which means that we get an average type-token ratio based on consecutive *n*-word chunks of text.

Data on STTR (Figure 2) evidence abnormalities above mean (> +2 SD) in: (i) 1839-1: *The Devil and the Belfry*; (ii) 1840-1*: The Man and the Crowd*; and (iii) 1843-1: *The Tale of the Ragged Mountains*, and abnormalities below mean (< -2 SD) in: (i) 1838-2: *Why the Little Frenchman*; (ii) 1842-5: *The Tell Tale Heart*; and (iii) 1844-5: *The Purloined letter.*
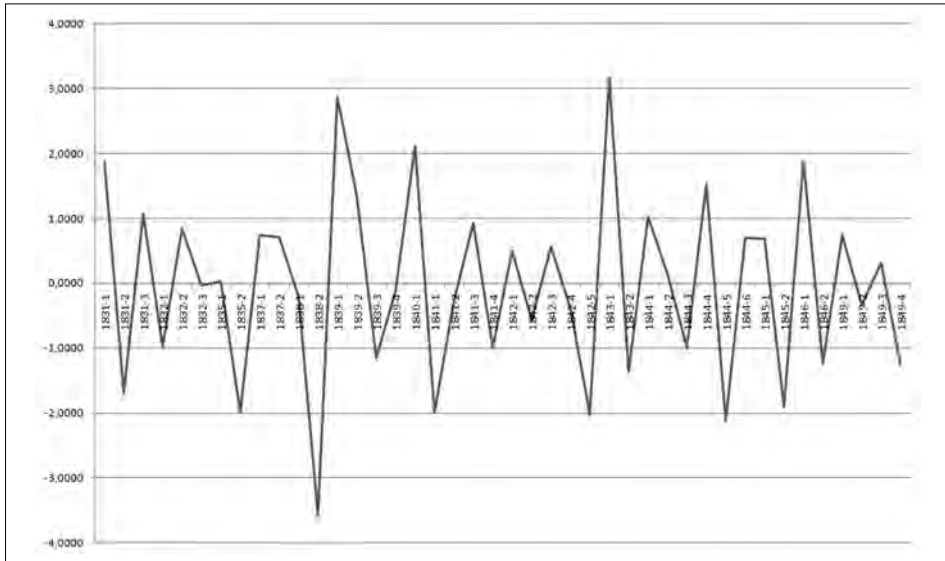
Figure 2. *STTR distribution*.

2.5.2. Content word ratio

The analysis of content words (nouns, main verbs, adjectives and adverbs) indicates only abnormalities below mean (Figure 3) in: (i) 1841-1: *A Descent into the Maelström;* (ii) 1849-2*: The Lighthouse;* and (iii) 1849-4: *X-ing a Paragrab*.
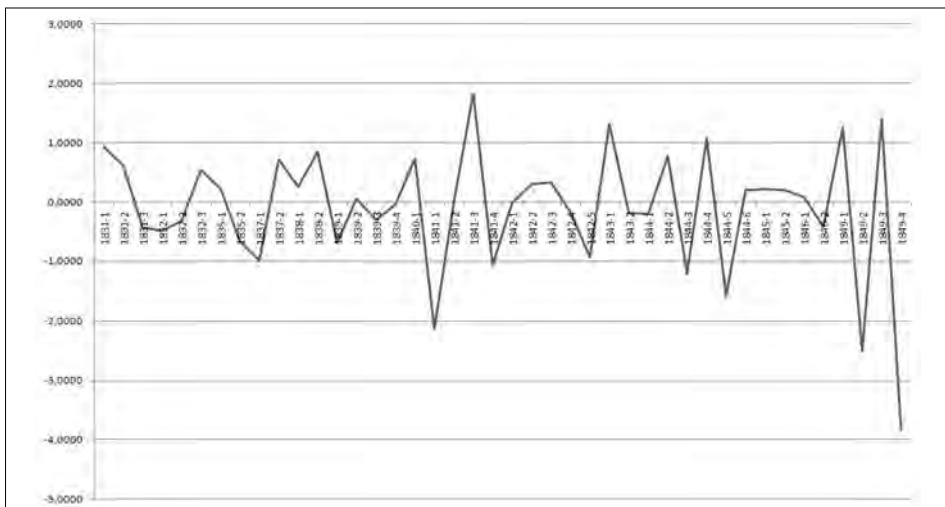

Figure 3. *Content word distribution*.

2.5.3. Mean word length

Regarding the average word length (in characters; Figure 4), abnormalities above mean are given in: (i) 1839-1: *The Devil and the Belfry*; (ii) 1843-1*: The Tale of the Ragged Mountains;* and (iii) 1849-3: *Von Kempelen and his Discovery*, and abnormalities below mean in: (i) 1838-2: *Why the little Frenchman;* (ii) 1842-5: *The tell tale heart*; (iii) 1849-2: *The Lighthouse*, and (iv) 1849-4: *X-ing a Paragrab*.
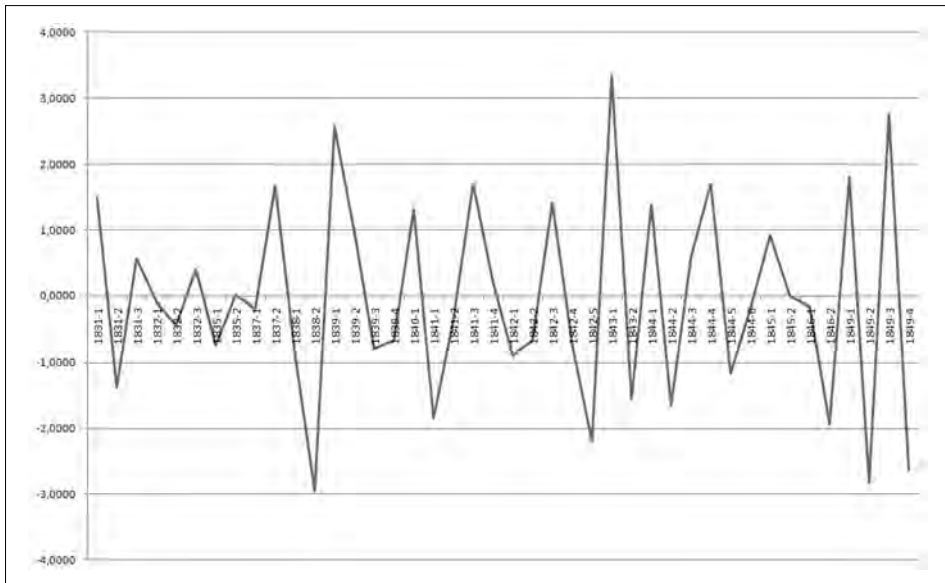

Figure 4. *Mean word length*.

2.5.4. Long words

Poe clearly overused (abnormalities above mean) long words, words with 10 or more characters (Figure 5), in: 1831-1: *The Decided Loss;* in contrast, he underused (abnormalities below mean) long words in: (i) 1840-1: *The Man of the Crowd*; and (ii) 1842-5: *The Tell Tale Heart*.
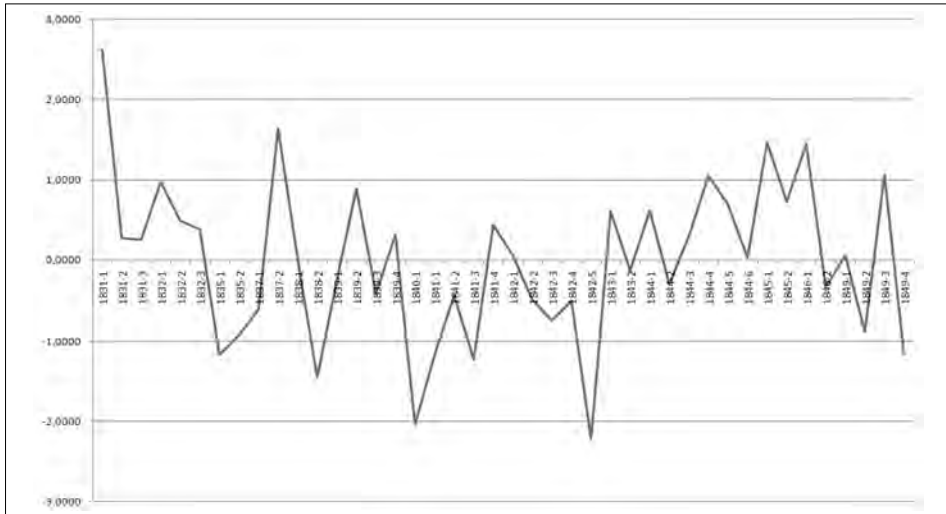
Figure 5. *Long words*.

2.5.5. Hapax legomena

Hapax legomena are words which occur only once within a context. In this research we have measured two types of hapax: (i) general hapax legomena: words occurring only once in Poe's tales (Figure 6) and (ii) exclusive hapax legomena: tale-specific words occurring a single time (Figure 7).

General hapax legomena are overused in: 1842-3: *The Mask of the Read Death;* and underused in: (i) 1837-1: *Arthur Gordon Pym*, (ii) 1841-4: *The Murders in the Rue Morgue*, (iii) 1842-2: *The Gold Bug*; and (iv) 1842-4: *The Pit and the Pendulum*.
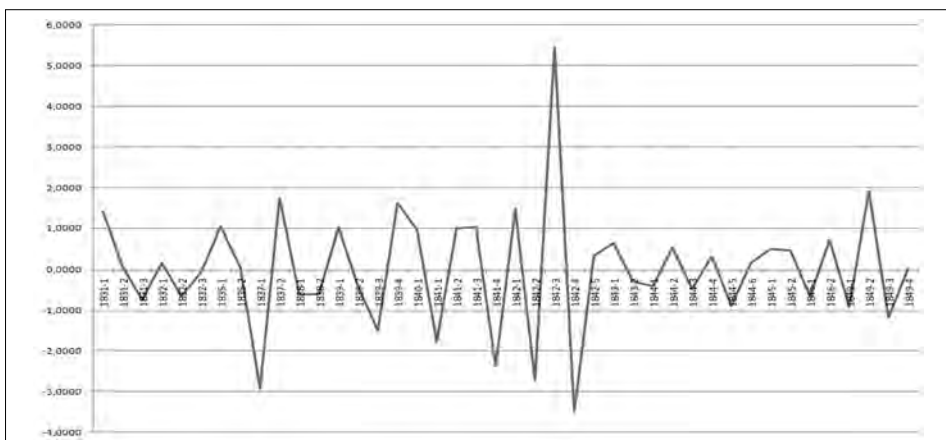

Figure 6. *General hapax legomena*.

Poe overused exclusively once-occurring words in: (i) 1837-2: *Von Jung*; (ii) 1838-2*: Why the Little Frenchman*; (iii) 1841-2: *Never Bet your Head*; and (iv) 1842-3: *The Mask of the Read Head*. In contrast underuses are given in: (i) 1841-1: *A Descent into the Maelström*; and (ii) 1844-3: *The Oblong Box*.
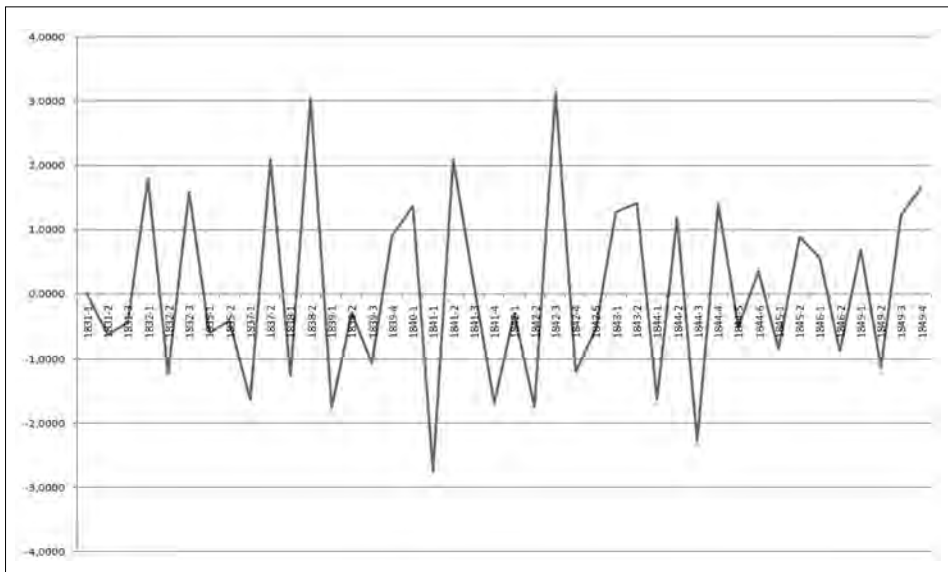
Figure 7. *Exclusively used hapax legomena*.

2.5.6. Mean sentence length

Some Poe's tales entail significantly longer and more complex sentences (Figure 8) in: (i) 1840-1: *The Man and the Crowd,* (ii) 1841-3*: The Island of the Fay;* (iii) 1849-1: *Landors Cottage*, and (iv) 1849-3: *Von Kempelen and his Discovery*; whereas significant shorter sentences (abnormalities below mean) are evidenced in: (i) 1839-1: *The Devil and the Belfry*, (ii) 1839-4: *The Man that was used up*, (iii) 1841-2: *The Gold Bug*, (iv) 1846-2: *The Cask of Amontillado,* (v) 1849-2: *The Lighthouse* and (vi) 1849-4: *X-ing a Paragrab*.

Figure 8. *Mean sentence length*.

2.5.7. Automated readability index

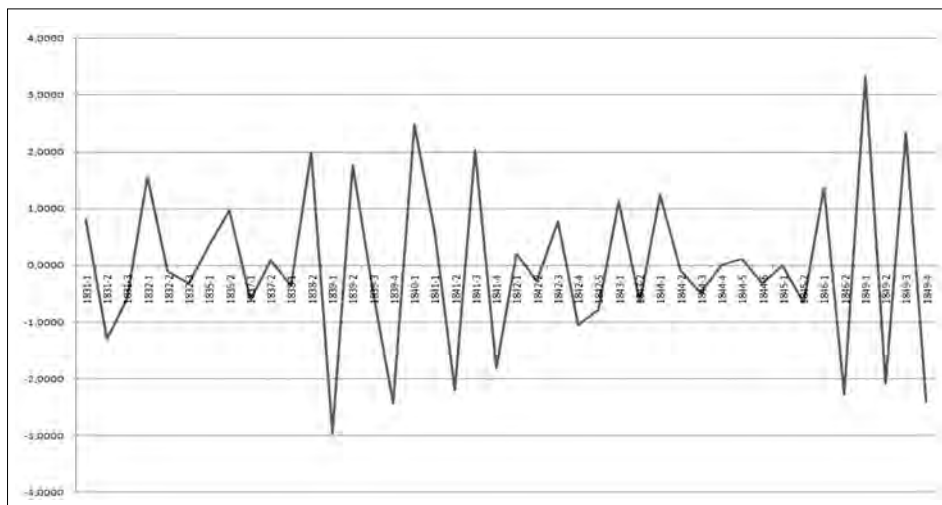In addition to sentence length, we also computed a readability index: Automated readability index (ARI; Figure 9). This index is designed to gauge the understandability of a text. Roughly, US grade level 1 corresponds to ages 6 to 8. Reading level grade 8 corresponds to the typical reading level of a 14-year-old US child. Grade 12, the highest US secondary school grade before college, corresponds to the reading level of a 17-year-old. The ARI relies on a factor of characters per word and words per sentence.

Four tales are found significantly more difficult to read: (i) 1840-1: *The Man and the Crowd*; (ii) 1841-3*: The Island of the Fay*; (iii) 1849-1: *Landors Cottage*; and (iv) 1849-3: *Von Kempelen and his Discovery*; whereas others exhibit very low readability indexes: (i) 1839-1: *The Devil and the Belfry*; (ii) 1839-4: *The Man that was Used up*; (iii) 1841-2: *The Gold Bug*; (iv) 1846-2: *The Cask of Amontillado*; (v) 1849-2: *The Lighthouse*; and (vi) 1849-4: *X-ing a Paragrab*.

Figure 9. *Automated readability index*.

2.6. *Abnormalities*

Table 2 below summarizes the results of all eight lexical variables measured. The first straightforward finding is that there seem to be periods of *complete normality* regarding Poe's lexical selection, as there are no apparent abnormalities in the lexical measures obtained: they are all between ±2 SD. These periods of *lexical tranquility* range from:

1. Mid-1831 to mid-1835;
2. Late-1843 to mid-1844;
3. Late-1844 to early 1846.

We also find shorter and isolated time spans of *normal* lexical usage in Poe:

1. Early-1838;
2. Mid-1839;
3. Early-1842;
4. Mid-1844.

Regarding abnormalities, we find a similar behavioural pattern: isolated abnormalities and periods of abnormalities, concatenating significant fluctuations in Poe's lexis like potential signs of more agitated events in his life.

Among the minor abnormalities, we get:

1. Early-1831: excessive use of long words;

2. Mid-1844: underuse of exclusive hapax legomena; potential sign of poor lexical variation;
3. Late-1844: very low STTR; again a sign of poor lexical variation;
4. Early to mid-1837: fluctuation of hapax legomena usage; poor *versus* rich lexical variation.

Regarding more acute periods of abnormal linguistic behaviour, we have detected:

1. Late-1838 to early-1839: fluctuations affect lexical selection (poor *versus* rich lexical variation: mean word length, hapax legomena and STTR) and syntactic/discourse elaboration of sentences and text in general (mean sentence length and ARI);
2. Late-1839 to late-1841: significant and constant up-and-down fluctuations in syntax and discourse (mean sentence length and ARI); discontinuous fluctuations in lexical variation (STTR, content words and hapax legomena);
3. Mid-1842 to early-1843: changes concentrate more specifically in lexical variation (STTR, mean word length, long words and hapax legomena);
4. Mid-1846 to late-1849: very notorious changes in lexical selection (content words and mean word length); however, the most significant finding is the constant fluctuations found in syntax and discourse (mean sentence length and ARI), where very complex written tales (very long sentences and higher degree of readability difficulty) are immediately followed by less elaborated tales; probably a potential sign of agitated events in Poe's life.

TABLE 2. *Results*.

	1831-1	1831-2	1831-3	1832-1	1832-2	1832-3	1835-1	1835-2
Standard TTR	1,8927	-1,6858	1,0728	-0,9834	0,8397	-0,0287	0,0192	-1,9923
Content words	0,9246	0,6124	-0,4355	-0,4864	-0,3196	0,5426	0,2213	-0,6558
Mean word length	1,5043	-1,3731	0,5624	-0,0930	-0,4257	0,3906	-0,7278	0,0093
Mean sentence length	0,8087	-1,3073	-0,5823	1,5628	-0,1040	-0,3147	0,3528	0,9697
Long words	2,6314	0,2723	0,2520	0,9716	0,4914	0,3824	-1,1694	-0,9215
ARI	1,1286	-1,5483	-0,3835	1,3986	-0,2057	-0,1847	0,1314	0,8853
Hapax legomena	1,4035	0,0839	-0,7314	0,1674	-0,6570	-0,0516	1,0565	0,0692
Hapax leg. (exclusive)	0,0141	-0,6145	-0,4402	1,7983	-1,2334	1,5817	-0,5972	-0,4141

	1837-1	1837-2	1838-1	1838-2	1839-1	1839-2	1839-3	
Standard TTR	0,7471	0,7184	-0,2012	-3,5824	2,8799	1,3373	-1,1508	
Content words	-0,9884	0,7121	0,2494	0,8469	-0,6883	0,0568	-0,2985	
Mean word length	-0,1838	1,6679	-0,8569	-2,9476	2,5791	0,9647	-0,7921	
Mean sentence length	-0,6036	0,0880	-0,3576	1,9948	-2,9611	1,7675	-0,4528	
Long words	-0,6000	1,6428	0,0170	-1,4565	-0,2475	0,8849	-0,4130	
ARI	-0,5975	0,5152	-0,5490	1,0473	-2,0232	1,8607	-0,6189	
Hapax legomena	-2,9160	1,7475	-0,6112	-0,5898	1,0282	-0,4144	-1,4823	
Hapax leg. (exclusive)	-1,6267	2,0954	-1,2621	3,0419	-1,7649	-0,2770	-1,0706	

	1839-4	1840-1	1841-1	1841-2	1841-3	1841-4	1842-1	
Standard TTR	-0,1227	**2,1200**	-1,9960	-0,2773	0,9259	-0,9907	0,4990	
Content words	-0,0415	0,7289	-2,1310	-0,0103	1,8346	-1,0563	-0,0216	
Mean word length	-0,6685	1,3136	-1,8517	-0,3651	1,6999	0,2179	-0,8942	
Mean sentence length	-2,4344	**2,4815**	0,6072	-2,1939	**2,0332**	-1,8215	0,2052	
Long words	0,3205	-2,0446	-1,1765	-0,4332	-1,2244	0,4360	0,0632	
ARI	-2,3907	**2,6019**	0,0698	-2,0926	**2,2944**	-1,6015	-0,0464	
Hapax legomena	1,6164	0,9562	-1,7594	0,9981	1,0249	-2,3595	1,4799	
Hapax leg. (exclusive)	0,9071	1,3632	-2,7452	**2,0935**	0,2122	-1,6809	-0,2865	

	1842-2	1842-3	1842-4	1842-5	1843-1	1843-2	1844-1	1844-2
Standard TTR	-0,5654	0,5590	-0,3768	-2,0179	**3,1705**	-1,3697	1,0281	0,1469
Content words	0,2962	0,3223	-0,1725	-0,9348	1,3211	-0,1919	-0,2005	0,7656
Mean word length	-0,6578	1,4180	-0,7163	-2,1969	**3,3522**	-1,5447	1,3889	-1,6510
Mean sentence length	-0,2844	0,7719	-1,0467	-0,7782	1,1320	-0,6407	1,2417	-0,0795
Long words	-0,4816	-0,7401	-0,4978	-2,2215	0,6115	-0,1327	0,6184	-0,2963
ARI	-0,4305	1,0726	-1,1398	-1,2815	1,9049	-0,9862	1,4927	-0,5030
Hapax legomena	-2,7236	**5,4462**	-3,4891	0,3440	0,6553	-0,2888	-0,3976	0,5523
Hapax leg. (exclusive)	-1,7550	**3,1481**	-1,2016	-0,5348	1,2755	1,4098	-1,6271	1,1746

	1844-3	1844-4	1844-5	1844-6	1845-1	1845-2	1846-1	
Standard TTR	-0,9930	1,5345	-2,1270	0,7043	0,6897	-1,9029	1,8851	
Content words	-1,1980	1,0683	-1,5701	0,2053	0,2141	0,1951	0,0786	
Mean word length	0,5807	1,6977	-1,1637	-0,1945	0,9107	-0,0034	-0,1574	
Mean sentence length	-0,4828	0,0168	0,1205	-0,3115	-0,0077	-0,6585	1,3728	
Long words	0,2972	1,0535	0,6959	0,0299	1,4701	0,7239	1,4436	
ARI	-0,2881	0,4581	-0,1938	-0,3343	0,2305	-0,6004	1,2088	
Hapax legomena	-0,4734	0,3323	-0,8779	0,1676	0,5089	0,4848	-0,6461	
Hapax leg. (exclusive)	-2,2717	1,3887	-0,5019	0,3534	-0,8441	0,8915	0,5672	

	1846-2	1849-1	1849-2	1849-3	1849-4			
Standard TTR	-1,2337	0,7471	-0,3352	0,3161	-1,2452			
Content words	-0,4189	1,2650	-2,5070	1,3945	-3,8350			
Mean word length	-1,9366	1,8040	-2,8182	**2,7587**	-2,6378			
Mean sentence length	-0,2844	0,7719	-1,0467	-0,7782	1,1320	-0,6407	1,2417	-0,0795
Long words	-0,4816	-0,7401	-0,4978	-2,2215	0,6115	-0,1327	0,6184	-0,2963
ARI	-0,4305	1,0726	-1,1398	-1,2815	1,9049	-0,9862	1,4927	-0,5030
Hapax legomena	-2,7236	**5,4462**	-3,4891	0,3440	0,6553	-0,2888	-0,3976	0,5523
Hapax leg. (exclusive)	-1,7550	**3,1481**	-1,2016	-0,5348	1,2755	1,4098	-1,6271	1,1746

	1844-3	1844-4	1844-5	1844-6	1845-1	1845-2	1846-1	
Standard TTR	-0,9930	1,5345	-2,1270	0,7043	0,6897	-1,9029	1,8851	
Content words	-1,1980	1,0683	-1,5701	0,2053	0,2141	0,1951	0,0786	
Mean word length	0,5807	1,6977	-1,1637	-0,1945	0,9107	-0,0034	-0,1574	
Mean sentence length	-0,4828	0,0168	0,1205	-0,3115	-0,0077	-0,6585	1,3728	
Long words	0,2972	1,0535	0,6959	0,0299	1,4701	0,7239	1,4436	
ARI	-0,2881	0,4581	-0,1938	-0,3343	0,2305	-0,6004	1,2088	
Hapax legomena	-0,4734	0,3323	-0,8779	0,1676	0,5089	0,4848	-0,6461	
Hapax leg. (exclusive)	-2,2717	1,3887	-0,5019	0,3534	-0,8441	0,8915	0,5672	

	1846-2	1849-1	1849-2	1849-3	1849-4			
Standard TTR	-1,2337	0,7471	-0,3352	0,3161	-1,2452			
Content words	-0,4189	1,2650	-2,5070	1,3945	-3,8350			
Mean word length	-1,9366	1,8040	-2,8182	2,7587	-2,6378			
Mean sentence length	-2,2795	3,3327	-2,0735	2,3296	-2,3951			
Long words	-0,3252	0,0585	-0,8819	1,0607	-1,1641			
ARI	-2,5804	3,5047	-2,6228	2,8404	-2,8685			
Hapax legomena	0,7199	-0,9022	1,9138	-1,1648	0,0312			
Hapax leg. (exclusive)	-0,8822	0,6917	-1,1343	1,2319	1,6590			

In order to get a neater picture of the potential abnormality patterns in Poe's lexis, we shall isolate the data according to the abnormalities found across time (Table 3) and, furthermore, consider only the cardinality[2] of significant values (Figure 10).

TABLE 3. *Periods of abnormalities*.

PERIOD 1	1838-2	1839-1
Standard TTR	-3,5824	2,8799
Mean word length	-2,0476	2,5791
Mean sentence length		-2,9611
ARI		-2,0233
Hapax leg. (exclusive)	3,0210	

PERIOD 2	1839-4	1840-1	1841-1	1841-2	1841-3	1841-4
Standard TTR		2,1200				
Content words			-2,3510			
Mean sentence length	-2,4244	2,4815		-2,1930	2,0852	
Long words		-2,0446				
ARI	-2,5907	2,6019		-2,0926	2,0991	
Hapax legomena						-2,3505
Hapax leg. (exclusive)			-2,7453	3,0036		

PERIOD 3	1842-2	1842-3	1842-4	1842-5	1843-1
Standard TTR				-2,0179	3,1705
Mean word length				-2,0069	3,3522
Long words				-2,2215	
Hapax legomena	-2,7236	3,0462	-3,3891		
Hapax leg. (exclusive)		3,1481			

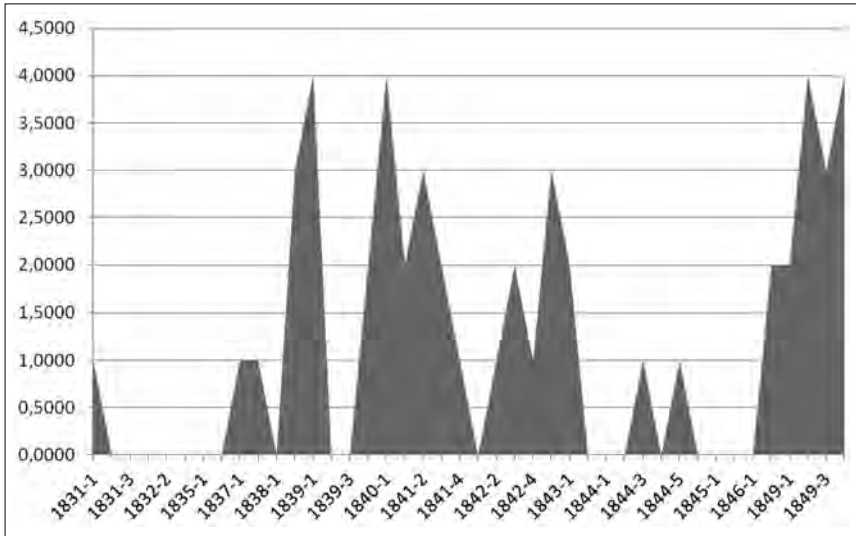| PERIOD 4	1846-2	1849-1	1849-2	1849-3	1849-4
Content words			-2,5070		-3,8350
Mean word length			-2,8182	2,7587	-2,6378
Mean sentence length	-2,2795	3,3327	-2,0735	2,3296	-2,3951
ARI	-2,5804	3,5047	-2,6228	2,8404	-2,8685

Figure 10. *Cardinality of significant lexical abnormalities*.

If we now reduce the abnormalities further –periods with two or more significant abnormalities– we get four dominant periods with a varied degree of abnormalities fluctuating above +2 SD and below -2 SD, indicating their falling outside the 96% *normality* range (Figure 11), which coincides with the four *abnormal* periods sketched above.
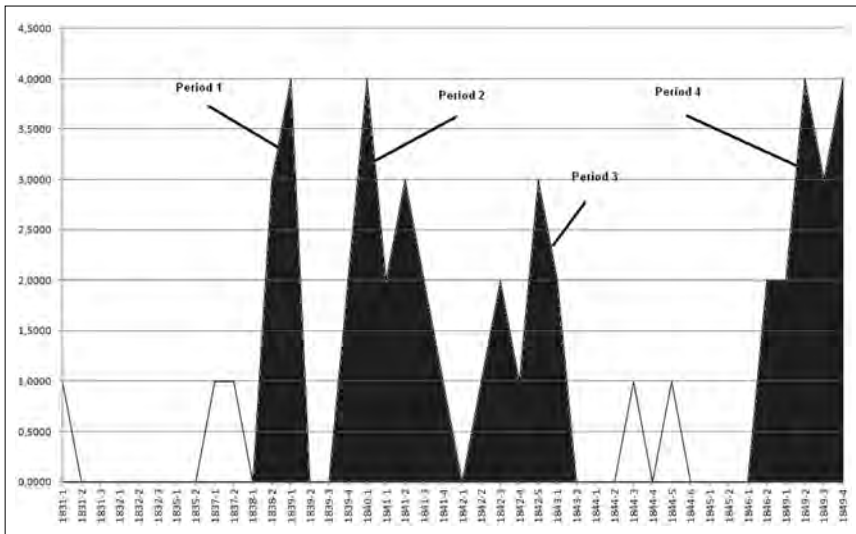

Figure 11. *Periods of significant lexical abnormalities*.

Period 1 ranges from late-1838 to early-1839 (Figure 12). *Why the Little Frenchman* (1838-2) stands out for having little lexical richness and many short words; contrasting with an overuse of rare words only occurring in this tale. In *The Devil and the Belfry* Poe does exactly the opposite: it is lexically very rich, he overuses long words, but it is very easy to read (very short sentences and very low ARI).
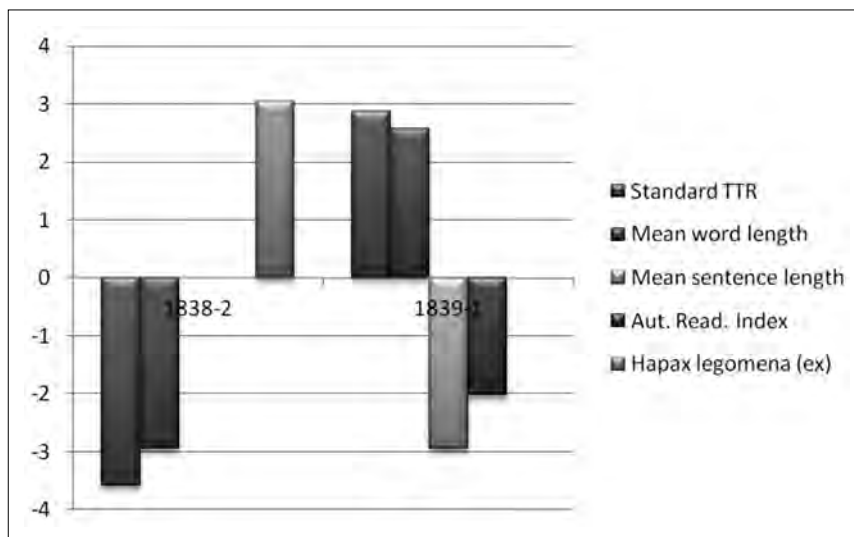

Figure 12. *Abnormalities in Period 1*.

Period 2 ranges from late-1839 to 1841 (Figure 13). Abnormal fluctuations are nearly constant regarding sentence length and readability (*The Man that was used up, The Man and the Crowd, Never Bet your Head* and *The Island of the Fay*). Other isolated abnormalities can be encountered in STTR (*The Man and the Crowd*), content word use (*A Descent into the Maelström*), use of long words (*The Man and the Crowd*), hapax legomena (*The Murders in the Rue Morgue*), and exclusive hapax legomena (*A Descent into the Maelström* and *Never Bet your Head*).
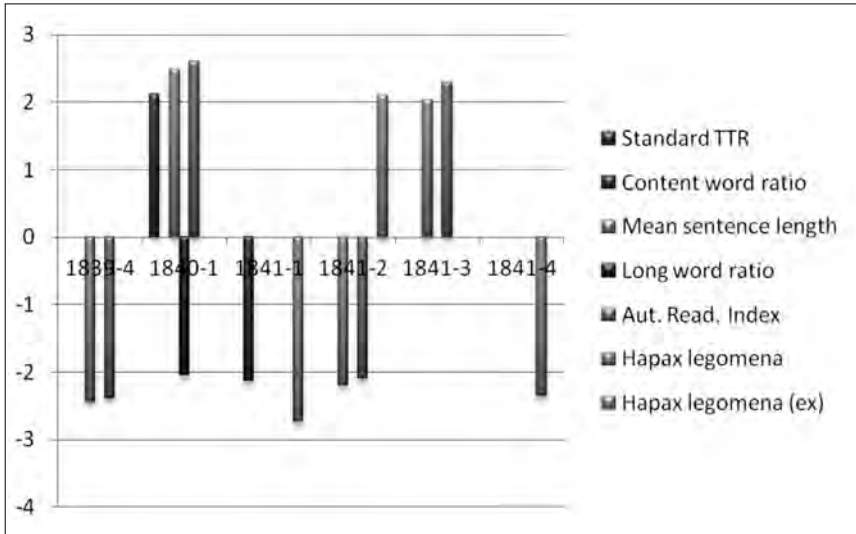
Figure 13. *Abnormalities in Period 2*.

Period 3 (mid-1842 to early-1843; Figure 14) shows two distinct trends: (i) abnormal fluctuations regarding hapax legomena (*The Gold Bug, The Mask of the Read Head* and *The Pit and the Pendulum*); and (ii) atypical fluctuations in STTR, mean word length and long word ratio (*The Tell Tale Heart* and *The Tale of the Ragged Mountains*).
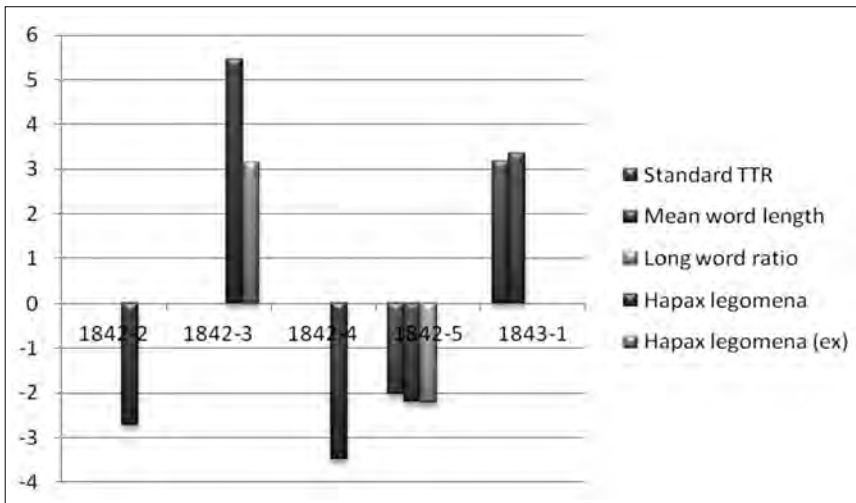

Figure 14. *Abnormalities in Period 3*.

Finally, period 4 (mid-1846 to 1849; Figure 15) exhibits the most outstanding abnormal fluctuations in (i) sentence length and readability (*The Cask of Amontillado, Landors Cottage, The Lighthouse, Von Kempelen and his Discovery* and *X-ing a Paragrab*); and in (ii) content words and mean word length (*The Lighthouse* and *X-ing a Paragrab*).
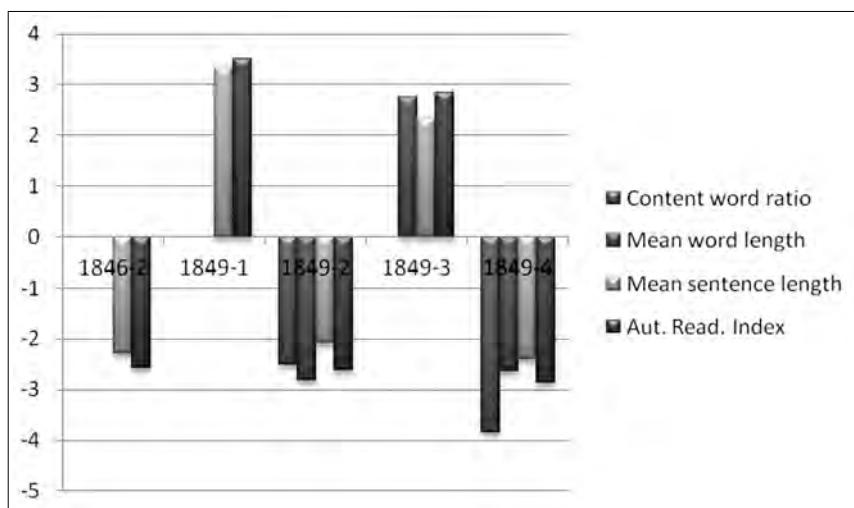

Figure 15. *Abnormalities in Period 4*.

3. CONCLUSIONS

The lexical data analysis based on Poe's tales reveal four distinct periods with abnormal linguistic fluctuations.

1. Period 1: abnormalities concentrate on lexis and syntax/discourse.
2. Period 2: great variability of abnormalities; major concentration on syntax/discourse.
3. Period 3: abnormalities are in complementary distribution depending on two sub-periods: mid-1842 ("rare" words) and late-1841 to early-1843 (huge variability in lexical choice).
4. Period 4: abnormalities seem to be most acute and "constant" (less content specific and great variety in syntax/discourse).

If we contrast the abnormalities detected in Poe's tales against some episodes in his life, we may conclude that they seem to run parallel to specific events in his life:

1. 1838 to early-1939: Poe and his family moved to Philadelphia –the year before his stay in New York. His financial situation was disastrous and he worried

about his family. Poe had just married a 13-year-old girl in 1836. *Depression* and *euphoria* follow each other in those circumstances.

2. Late-1839 to 1841: in 1839 Poe published a book with some commercial success. It was a breath of fresh air in his literary career. *Euphoria* apparently prevails, with some *depressive* periods though.

3. Mid-1842 to early-1843: Poe had finally been offered a job in Graham's Magazine. Nevertheless, his unreliability and frequent absence in work made him lose his post –most unwillingly! Consequently, *depression* prevails.

4. Mid-1846 to 1849: Poe's wife dies in 1847, his depressive moods increased and a year of acute financial debts followed: a *depressive* state of mind prevails.

The apparent correlation between Poe's life and the lexical abnormalities found in his tales lead us to consider the plausibility of our research hypothesis and consequently accept the H_1: *Poe's changing and cyclothymic disorders, fluctuating from euphoria to depression, reflect themselves in lexical change/choice along his tales.*

Of course, this previous paragraph needs to be taken cautiously. What we do conclude from the data is that there seems to be an evident parallelism between Poe's most venturesome life episodes and his linguistic production. In addition, if Poe suffered from some sort of mental disorder, more specifically bipolar disporder –as most scholars, that have worked on his literary production, his life and his psychiatric pathology, do–; then we might also assume that his cyclothymic moods fluctuated from normality to irritation, depression or creative hyperactivity must have had some refletion in his life, and ultimately also in his actions, behaviour and creative work. In this research, we have proceeded from backwards to forwards, starting examining Poe's creative work (tales), his actions/behaviour (lexical usage) and try to find any linkage to his life episodes (cyclothymia).

Needless to say that this study has a number of potential limitations. It has been based on written language; Poe's tales are written documents and are therefore more carefully elaborated and probably also revised by somebody else. Therefore, there is no firm guarantee that the texts analysed are just by Poe! In addtion, there are many other factors at work that could also be adduced to explain his mood fluctuations such as the topic of the tale, its characters, its spatio-temporal and social background, the pursuit of dramatic effects, etc.

In future research, we shall try to consider some of the factors and variables, just mentioned, and examine also other supposedly sane and/or mentally disturbed authors.

NOTES

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1. A simple Google search ("Edgar Allan Poe bipolar disorder") outputs more than 200,000 results.

2. Total number of abnormalities found.

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