

ALICE IN THE WONDERLAND OF SCIENCE: INTERTEXTUAL FIGURES IN SCIENTIFIC ARTICLES

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Abstract

Since numerous scientific and mathematical concepts can unsurprisingly be found in *Alice's Adventures in Wonderland*, the book itself has been a great source of inspiration for many scientists. This paper gives an overview of how Alice finds her way into scientific articles. More precisely, it discusses intertextual figures that refer to *Alice's Adventures in Wonderland* in a corpus of 29 scientific articles from disciplines including psychology, medicine or astrophysics. Results show that intertextual figures tend to be more explicit in the field of physics and medicine than those found in the field of psychology. Crucially, observations show that intertextual figures found in the collected scientific articles serve different purposes depending on the discipline that makes use of them.

Keywords: Alice in Wonderland, Intertextuality, Language for Specific Purposes.

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Science and tales

Science has a long history of turning to literature to explain or name facts. For instance, in 1964, Gell-Mann and George Zweig realized that hundreds of particles could be integrated in a simpler system that contained only a few fundamental particles. The two scientists named those fundamental particles “quarks” in reference to a nonsense word used by James Joyce in the novel *Finnegans Wake* that says “three quarks for Muster Mark” (Joyce, 1939, p. 383). Later on, scientists even assigned flavors to quarks that correspond to their electric charges.

Another example comes from astrophysics. Astrophysicists named intermediate-mass black holes “goldilocks black holes” after the fairy tale *Goldilocks and the Three Bears* in order to show that those black holes are neither too small nor too big, just like Goldilocks trying to find objects of the right size in the bears’ house.

Alice in scientific disciplines

Unsurprisingly, scientists have found great inspiration in *Alice’s Adventures in Wonderland* as well. Examples come from all sorts of disciplines ranging from psychology to physics. For instance, in psychiatry and psychology, some mental illnesses are described by drawing parallels with Wonderland: English psychiatrist John Todd coined the term “Alice in Wonderland Syndrome” (AIWS) to describe patients experiencing body image illusions involving distortions of size, mass, etc. Other examples from psychology make references to Tweedledum and Tweedledee or the rabbit hole as in title “Down the Rabbit Hole: Emergency Department Medical Clearance of Patients with Psychiatric Behavioral Emergencies” (Tucci, Siever, Matorin, & Moukaddam, 2015, p. 721).

The notion of Wonderland is also quite popular among mathematicians who use it in order to describe a specific mathematical system that they call “the Wonderland Theorem” that is “the main input” to “singular continuous spectrum” (Lenz & Stollmann, 2006, p. 203).

Mathematicians also make great use of the metaphor of symmetry with *Through the Looking-Glass and What Alice Found There*, as one can see in the following title of an article about probabilities: “Maximum Entropy and the Glasses You are Looking Through” (Grünwald, 2000, p. 238).

However, the concept of Wonderland is far from restricted to just one or two disciplines. The field of economics was also inspired by it in its description of a model of economic standards. Economists see “Wonderland” as a “compact, integrated economic, demographic and environmental model” that is “investigated using methods developed for studying critical phenomena” (Kohring, 2006, p. 214).

Other disciplines like biology and medicine make even more extensive use of Alice’s story: in gastroenterology, gastric flows are compared to the Mad Hatter’s tea party. In another example, medical advice is taken from the Mad Hatter (and not from the Caterpillar). The rabbit hole metaphor is also popular in biology and in the study of sleep, while Tweedledum and Tweedledee are used to express the duality of certain biological facts.

Last but not least, to physicists, Wonderland is a theorem and the rabbit hole becomes a black hole where Alice is taken as an example of what would happen to a person or an object falling into such a star. Yet, the most striking reference to Alice is the term “Quantum Cheshire Cat”, which will be described in more detail later on.

All those references point to the fact that *Alice’s Adventures in Wonderland* has clearly nurtured many scientific disciplines.

Types of references

Different kinds of references can be found among the articles that are part of the corpus we worked on (we will talk about the corpus later on). The references can roughly be arranged either at the sentence level or at the word level.

At the sentence level, there are quotations; words literally “copied” from *Alice’s Adventures in Wonderland*. Then there are what we may call plain references; in other words, mentions of Alice without direct quotation, like some sort of allusion. There are also comparisons such as analogies, which are comparisons between two things that are intended to show that the two are similar. Similes are another kind of comparison; they are phrases that describe something by comparing it to something else using the word “like” or “as” and finally contrasts, which show the opposition between two things.

At the word level, there are terms and what we may call portmanteau noun phrases. We define the latter as noun phrases made by combining the sound and meaning of other noun phrases. The following table shows examples for each kind of reference:

Table 1*Examples of different types of references in the corpus*

Quotations	“ ‘Well! I’ve often seen a cat without a grin’, thought Alice, ‘but a grin without a cat! It’s the most curious thing I ever saw in my life!’ No wonder Alice is surprised. In real life, assuming that cats do indeed grin, the grin is a <i>property</i> of the cat –it makes no sense to think of a grin without a cat. And this goes for almost all physical properties.” (Aharonov, Popescu, Rohrlich, & Skrzypczyk, 2013, p. 2)
Plain references	“When Alice fell down the rabbit hole, she encountered a variety of strange characters: an infuriatingly enigmatic caterpillar, a Queen with an unhealthy proclivity for decapitation, and a hatter whose idea of catering left much to be desired.” (Bianchi, 2016: 1315)
Comparisons	“The ‘Cat’ is a photon in two possible locations, [L> and [R>. The ‘grin’ corresponds to its circular polarization state.” (Aharonov et al., 2013, p. 2)
- Analogies	
- Similes	
- Contrasts	
Terms	“The main tool we use goes back to Simon’s Wonderland Theorem.” (Lenz & Stollmann, 2006, p. 204)
Portmanteau noun phrases	“Air Medical Research Advice from the Mad Hatter” (Peterson, 1995, p. 53)

Corpus

References were analyzed in a corpus of 29 texts. The texts were searched for in the *Science Direct* and *PubMed* databases and in the *New Scientist* magazine with the use of keywords such as “Alice”, “Wonderland”, characters’ names, Carroll’s name and the titles of chapters. Articles about literature or the book itself were excluded. The corpus consists of 5 articles about math and economy, 8 articles about medicine and biology, 4 articles about psychology and psychiatry, and finally 12 articles about physics and astrophysics. The corpus is 90,000 words long with each text being approximately 3,100 words long.

Definition of intertextuality

Intertextuality can be defined as “a correlation between two or more texts, more precisely with one text being effectively present in the other one most of the time”¹ in a more or less explicit way (Genette, 1992, p. 8).

In *The Strategy of Forms*, Laurent Jenny (1976) draws a distinction between “works which are explicitly intertextual – such as imitations, parodies, citations, montages and plagiarisms – and those works in which the intertextual relation is not foregrounded” (Jenny cited by Allen, 2011, p. 109).

Koch also gives a definition of explicit and implicit intertextuality. According to him, on the one hand, explicit intertextuality is the reference to previous or further texts overtly made in a given text, such as the texts referred to in the review of the literature section and the list of references of an academic article (Koch, 2009, p. 146). On the other hand, implicit intertextuality is the reference to texts without indicating its source, such as jokes in which previous discourses are ironically referred to or criticized, relying only on the interlocutor’s familiarity with them (Koch, 2009, p. 145).

Distribution of references on an “explicitness continuum”

Placing the different types of references on an explicitness continuum according to the definitions stated above, direct quotations with mention of Carroll’s book would be situated on the explicit side of the continuum, followed by quotations without bibliographical references to the book. The middle of the continuum would be occupied by references that are not treated as quotations by their authors probably because they are well known (for example, the title *curiouser and curiouser* that appears without quotation marks nor mention to the author), plain references to Alice’s adventures (without quotations, but evoking Wonderland or its characters) and comparisons. Finally terms and *portmanteau* references would be at the end of the implicit pole of the continuum because it is assumed that the reader knows the link to Alice’s world and therefore understands the meaning of the word or term in the new context. An illustration of the continuum is given below.

¹ Unless otherwise noted, all translations to English are my own.

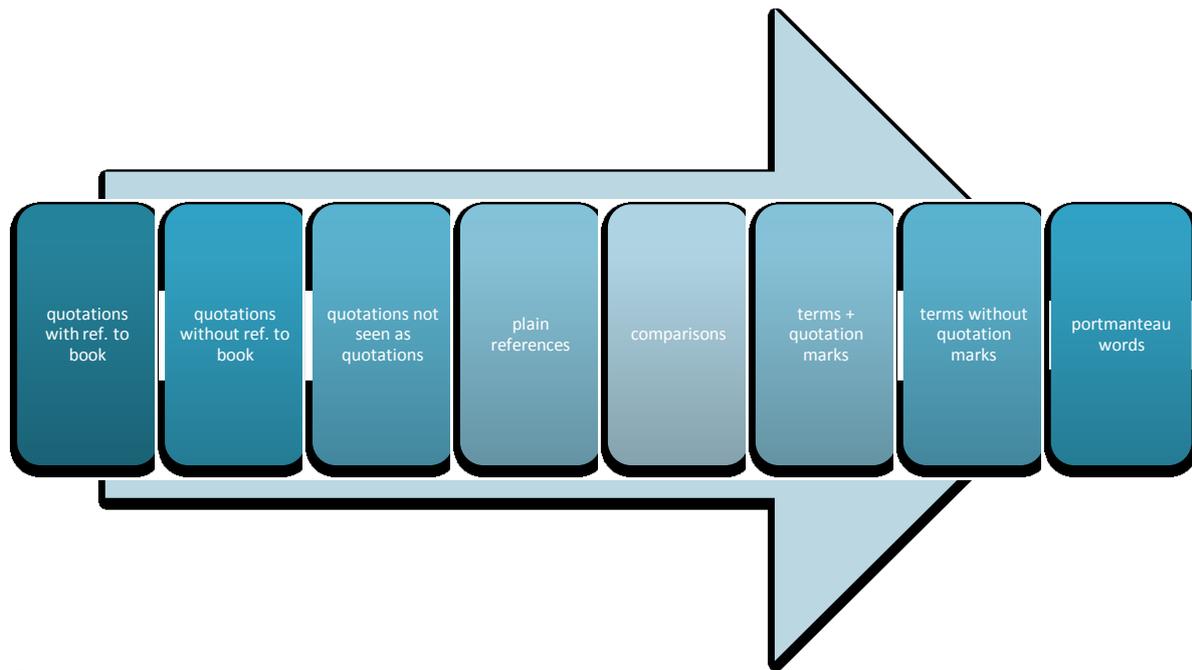


Figure 1: explicitness continuum

Looking closer at the weighted mean of each type of reference, it is clear that terms without quotation marks are the most used category in the corpus, with an average of 0.27 occurrences per 100 words. This type of reference is closely followed by plain references and then by quotations without direct mention of Carroll's book, as shown in the following graph.

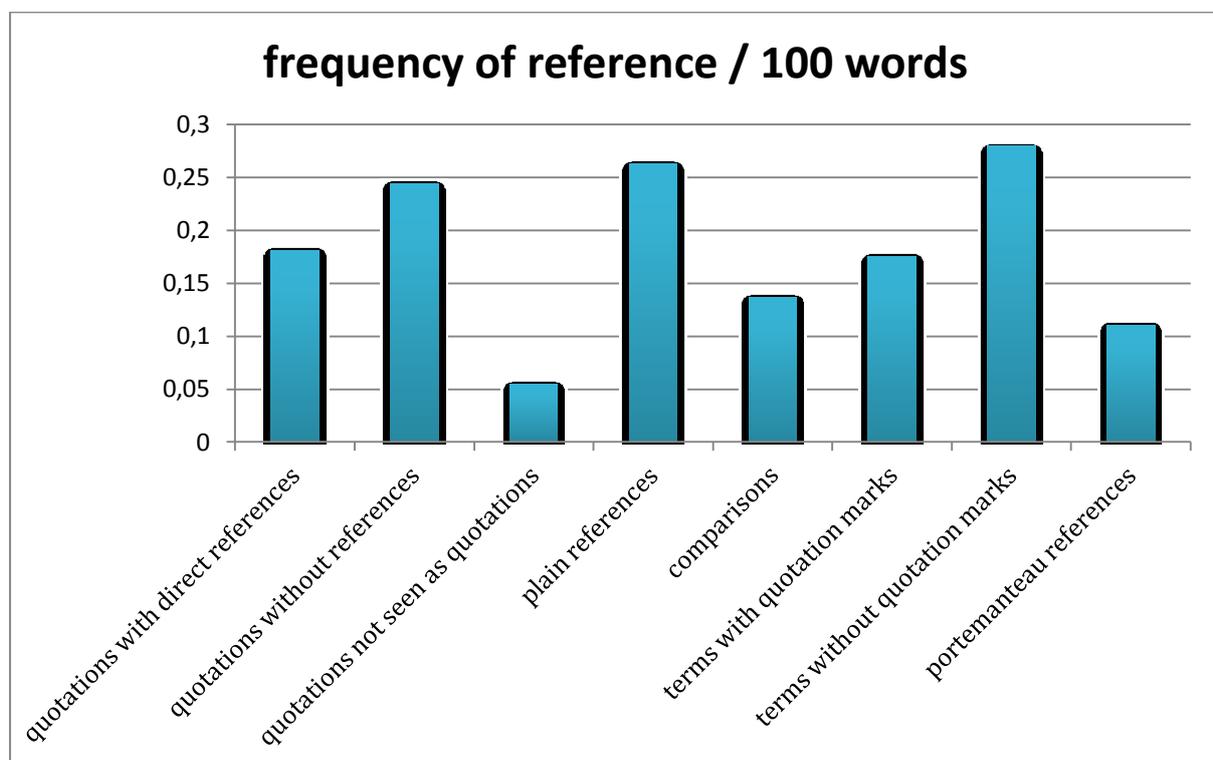


Figure 2: Frequency of each type of reference per 100 words

Above all, it is interesting to analyze how disciplines make use of references, from very explicit references to very implicit ones as shown in the following figure. It is apparent that psychology dominates the explicit end of the continuum, with more quotations and plain references than the other disciplines. Medicine seems very keen on using comparisons to Alice's characters while physics makes great use of terms based on Alice. Therefore, medicine and physics tend to occupy the implicit end of the continuum.

Psychology	Psychology	Psychology	Psychology	Medicine	Physics	Physics	Medicine
Quotations with references	Quotation without references	Quotations not seen as quotations	Plain references	Comparisons	Terms + Quotation marks	Terms without quotation marks	Portmanteau words



Figure 3: Distribution of references on an explicitness continuum for three disciplines

The functions of references

The different types of references to Alice play different roles in the corpus. Most quotations (with or without mention to Carroll's book) are used at the beginning of articles (in the title or in the introduction) and can be seen as hooks, catchlines or lead-ins to attract readers. Therefore, they have an appeal function.

Plain references can serve to introduce quotations or they may have been used because of lack of time/will to find the precise quotation from Carroll's book.

Comparisons are used to give the reader a better idea of concepts explained in the text by comparing them with Alice's characters or events in the book. They mainly have a vulgarizing function.

Finally, a term based on Wonderland may have three main functions: a nominative function because it gives a name to a new concept. It can also serve as a cognitive short cut to understand this concept (because the concept shares characteristics with one of Wonderland's characters). And in this way, it can also be heuristic and help scientists study the concept from a different angle. The use of quotation marks and explanations when using a term may be a sign that the term is still new to the scientific community and that it may qualify as a neologism. The fact that those quotation marks are not present in more recent articles can be interpreted as a sign that the term is more frequently used by scientists, who no longer see it as a "new term".

The special case of neologisms

We may also wonder how a term coined after Alice's Adventures in Wonderland continues to be used in a scientific community.

"The Agronomic Jabberwocky" (Kempton, 1928, p. 629) is the title of an article published in 1928 in *Science* in which Kempton, a scientist, makes fun of three agronomists who dared to coin new terms in the way Carroll wrote the Jabberwocky poem. The terms coined by the agronomists are: rugaplanes, thickth midlux, umblux, etc. In the article, Kempton explains how furious he is about those new terms.

Kempton's view on terminology can be compared with the Wüsterian approach to terminology (1930), which prescribed a universal, simplified and strictly technical use of language in the creation of terms.

However, the emergence of socioterminology in 1980-1990 and socio-cognitive terminology in 2000 changed this strict view of terminology and promoted the plurality of language and the importance of studying terms within their social context. As a result, terms were coined more freely and metaphors, and references to mythology and to literature started to make their way through terminology.

Clues as to whether a term is a neologism are the potential presence of explanations or gloss and quotation marks around it (Bowker & Pearson, 2002). In the corpus used in this study, the term "Quantum Cheshire Cat"² is present in four texts. Physicists in Grenoble coined this term in 2014. It describes the capacity of neutrons to temporarily separate from their magnetic field (Denkmayr et al., 2014). Most occurrences of the term were present without quotation marks but with explanations and a few occurrences of the term were found both with and without quotation marks in one text.

In the NOW Corpus³, 11 occurrences of the term "Quantum Cheshire Cat" were found: 3 of them with quotation marks and 6 of them with explanations. It is highly likely that the term "Quantum Cheshire Cat" is a neologism that is gradually becoming permanent.

It should be mentioned that scientific communities do not use neologisms instantly. Depending on different parameters, they have a certain chance of survival. According to Schneider (2017), a neologism's chances of survival are directly linked to its

² The search was done overlooking case sensitivity

³ The Now Corpus is a 4.7 billion-word corpus made up of news on the web in English.

frequency, its distribution among articles in a corpus, the absence of an equivalent term in the same language, and finally the absence of an equivalent term in another language.

It is hard to have a precise idea of the frequency of that term but a case-sensitive search on Google results in 7,800 hits of “Quantum Cheshire Cat”. The distribution of the term in 4 articles in the corpus is quite even (between 2 and 5 occurrences every thousand words). There is no equivalent term or synonym in English or in other languages. Given this evidence, one might say that there is a fair chance that the term “Quantum Cheshire Cat” will survive.

Conclusion

Alice’s Adventures in Wonderland is undeniably a great source of inspiration for scientists working in many different fields such as math, physics, medicine and psychology. More precisely, the corpus of 29 texts reveals numerous references to Carroll’s book that can roughly be organized on a continuum from very explicit references on one side to implicit references on the other side. Psychology seems fonder of explicit references, while medicine and physics make more use of implicit references. Finally, terms tend to be the most common kind of reference used within the corpus. Having a closer look at one of those terms, we argue that given its frequency on Google, its distribution in the corpus and the absence of an equivalent term, the neologism “Quantum Cheshire Cat” seems to have a fair chance of becoming a permanent term in physics.

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