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## FICTIONALITY MARKERS IN PROFESSIONAL SCIENTIFIC ARTICLES: A NEW APPROACH TO HEDGING

### Abstract

The present study is concerned with a select set of hedges – linguistic markers of stance. However, instead of accepting the functions of these constructs exclusively as indicators of uncertainty or negative politeness (Hyland, 1998; Varttala, 1999), I argue that in many cases hedges may be locations for fictionality. Later research already points to additional subfunctions of hedges (Aull & Lancaster 2014; Hyland, 2005; Hyland & Jiang, 2016; Lancaster, 2016a, 2016b). Data collected from 15 professional scientific articles (a corpus of 144,520 words) was examined for presence of the additional subfunction of fictionality. The phenomenon of fictionality in non-fiction is identified by Skov Nielsen, Phelan, and Walsh (2015a) as “what-if projections, if-only regrets, thought experiments, and hypotheses of all kinds.” In the process of examining instances of fictionality signaled by hedges, I identified the parameters of Real Condition and Fictional Condition each determined by context, verbal process types, and the number of hedging devices used. Real Condition embodies the already established functions of hedges, while Fictional Condition points to a new dialogic subfunction associated with fictionality. This exploratory study invites further research into functional aspects of hedging and raises awareness of fictionality in professional scientific writing.

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### Key words

fictionality, degree of fictionality, hedging, scientific discourse, digital physics, non-materialistic reality.

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## 1. INTRODUCTION

Scientific research articles have attracted a lot of attention from linguists (e.g. Barwich, 2013; Ciapuscio, 2003; de Oliveira & Pagano, 2006; Hyland, 2010; Lazaroiu, 2013; Livnat, 2012; Plappert, 2019). This attention is in part due to the increased visibility of and society's reliance on products of scientific research. The recent push for STEM education and the rise of popular science has also played a role in researchers turning to professional articles in order to understand the broad notion of science and its ideological concepts. This research article fits with the established linguistic scholarship on the nature of professional scientific texts, yet it offers additional insight on the negotiation of scientific claims by examining ties between science and fictionality – two areas historically perceived to belong to opposing camps (as described in Keene, 2014; Myers, 1997). This investigation is devoted to an observation of a select set of hedges – linguistic markers of stance (Hyland, 2005). Following developments in research on hedging that position these constructs as multifunctional and inherently dialogic (Hyland, 2005; Hyland & Jiang, 2016), this study proposes an additional functional dimension for hedges in professional scientific writing: fictionality marking.

For the purposes of this study, I regard professional scientific writing as research articles published in professional peer-reviewed journals and intended for practicing scientists. Fictionality, according to a traditional definition by Fludernik (1996: 39) refers to “the subjective experience of imaginary human beings in an imaginary human space.” This approach to the phenomenon reserves it for literary fiction exclusively; however, fictionality exists beyond this area. As Skov Nielsen, Phelan, and Walsh (2015a, 2015b) show, fictionality is “ubiquitous” (2015a: 62) or “extremely pervasive” (2015b: 110). Thus it is present in all forms of human expression and knowledge acquisition. Skov Nielsen et al. (2015a: 62) assert that “apart from the work by literary critics on generic fiction, fictionality is almost completely unstudied and often unacknowledged.” Despite this lack of general awareness, studies in the philosophy of science have been advocating for a non-literary kind of fictionality since the beginning of the 20th century (see, for example, Vaihinger, 1924). More recently, Arthur Fine (1993) has revived these ideas, which inspired a number of further explorations (see, for example, Barwich, 2013; Suárez, 2009; Toon, 2012). Fictionality, from this scientific point of view, is usually understood as “the role played by particular methods of model building such as abstractions, idealisations, and the employment of highly hypothetical entities” – “non-denoting elements” such as “frictionless planes,” for example (Barwich, 2013: 357-358). This view of fictionality focuses on an important aspect of the scientific process – hypothesizing. However, philosophers of science (see, for example, Cartwright, 1983; Toon, 2012) do not deny that fictionality in science is “analogous to literary [...] fiction” (Rouse, 2009: 37). In contexts of scientific writing, the aspects of imagination and experientiality present in Fludernik's (1996) definition are replaced with the discussion of the possibilities and probabilities.

More recently, research in theoretical physics points to a possibility of a wholly non-materialistic view of reality. There are several approaches that rely on this idea: digital physics (beginning with Fredkin, 1978; Zuse, 1967; and continuing with Aschheim, 2011 *inter alia* maybe seen as the umbrella term), the simulation hypothesis (Bostrom, 2003; Wheeler, 1990), and the self-simulation hypothesis (Irwin, Amaral, & Chester, 2020). Digital physics “is a non-materialistic view, which says there is no physicality but only abstract information as the fundamental building blocks of emergent informational structures of reality, such as atoms” (Irwin et al., 2020: 2). The simulation hypothesis suggests that “sufficient evolution of future technology leads to lifeforms capable of producing a large quantity of high fidelity simulations, called ancestor simulations. These simulations express an evolutionary process leading to humans and on up through higher levels of biological and technological evolution” (Irwin et al., 2020: 1). Idealistic holistic panpsychism “says that everything is thought or consciousness” (Irwin et al., 2020: 2). Finally, the self-simulation hypothesis proposed by Irwin et al. (2020: 1) posits that “everything is information, which [is] define[d] as thought. The universe self-actualizes itself into existence via self-simulation using a mathematical code and a simulation *game rule* called the principle of efficient language.”

Taking these views into account, the idea of fictionality becomes a permeating force in the explanations of what we consider to be physical reality. These philosophical developments tie together the scientific and the fictional in ways that imply an interdependency rather than polarity.

When it comes to professional scientific discourse, non-materialistic concepts such as possibilities and probabilities are conventionally realized through hedges (Hyland, 1998: 3). It is, therefore, possible to propose that these epistemic devices function as fictionality markers in certain cases. Skov Nielsen et al. (2015a: 62) suggest that fictionality can be expressed through “what-if projections, if-only regrets, thought experiments, and hypotheses of all kinds.” The IF constructions are essentially hedges; however, their functions in the context where Skov Nielsen et al. (2015a) observed them are clearly extended beyond the usual expression of uncertainty or politeness. They are obvious examples of fictionality, and like most hedging phenomena they are dialogic.

Dialogicity is an important aspect of fictionality in written texts, and it is made possible by the gradational nature of fictionality. A “degree of fictionality” is a feature present in non-fiction in general and in scientific writing in particular (Skov Nielsen et al., 2015a). It corresponds to the number of fictionalization techniques employed by the author, including the subject matter itself. For instance, a novel would possess a higher degree of fictionality than a research article, but this does not imply that academic writing is completely devoid of fictionality. Nor, it appears, is scientific exploration itself, as such established concepts as hypothesizing and modeling become supplemented by overarching ideas of non-materialistic universe. Skov Nielsen et al. (2015a, 2015b) state, “[i]n uses of fictionality outside of generic fictions, a sender [author] does not transform nonfictional subject matter into

something fictional but rather adopts a distinct communicative stance.” Stance taking has been established as a primary function of hedging (Aull & Lancaster, 2014; Hyland, 2005; Hyland & Jiang, 2016; Lancaster, 2016a, 2016b). In scientific writing, the concept of the thought experiment often represents a communicative stance connected with fictionality. In fact, those who explore fictionality in professional science (see, for example, Barwich, 2013; Toon, 2012) focus on thought experiments and modeling as the most easily observable examples that supply evidence of the importance of imagination, or fictionality, to science. Research on fictionality in popular science shows multiple fictionalization mechanisms ranging from thought experiments to fictional representation of the reader (e.g. Pilkington 2018a, 2018b; 2019). As Barberousse and Ludwig (2009) and Toon (2012) demonstrate, fictionality is an inevitable part of doing science. Fictionality in scientific writing can manifest in a number of ways and is not limited to presentation of hypotheses. Rouse (2009: 52) and Barberousse and Ludwig (2009: 57), focusing on fictionality in professional science, argue that it is essential to establishing relations between phenomena and enables scientists to present new knowledge more easily.

## 2. HEDGING: A BRIEF OVERVIEW

Traditionally, hedging has been defined as a linguistic means to an expression of attitude toward a knowledge claim. Hyland (1998: 1) says that hedging is used “to indicate either a) a lack of complete commitment to the truth value of an accompanying proposition, or b) a desire not to express that commitment categorically.” The views on hedging in scientific discourse (both popular and professional) can also be expressed in less precise terms allowing for additional functions. Thus Varttala (1999: 190) noted that “it can be argued that a rigid functional view of polypragmatic phenomena such as hedging may result in a somewhat distorted description of the use of certain rhetorical strategies.” Varttala’s (1999: 191) research confirms that texts produced for less specialized audiences may use hedges not as expressions of factual uncertainty or negative politeness but as mitigating strategies in cases “when information such as exact references or precise numerical expressions is unobtainable or unnecessary”, in other words, as indicators of a “low degree of exactitude.”

More recent investigations of hedging move away from the dual function of either expressing uncertainty or negative politeness and argue in favor of a multifunctional approach to hedging which involves a prominent dialogic function (Aull & Lancaster, 2014; Hyland, 2005; Hyland & Jiang, 2016). Furthermore, Lewin (2005) showed that lines between hedges and boosters can be blurred when professional scientists used linguistic markers that would be commonly recognized as hedges not to indicate a lack of confidence in a claim but to “tone up” their claims. Lewin (2005: 168) also acknowledged the dialogic function of hedging but in a

different light. Her observations suggest that “the authors’ and readers’ responses did not match the structures identified as hedges by linguists (traditional hedges).” Plappert (2019: 173) observed a general lack of hedges in scientific articles concerning genetics, yet he noted that the finding did not indicate lack of “modal meaning.” It indicated “modal meaning not through sentence meaning but through speaker meaning.” Such observations suggest that potential functions of hedges in a given text are negotiated between the author and the reader. Multiple studies of research articles produced in non-western research institutions (e.g. Ghana, Iran, China) demonstrate that hedging is a culture-specific phenomenon more common in research articles produced by native speakers of English than by L2 authors (Ngula, 2017; Samaie, Khosravian, & Boghayeri, 2014; Yang, 2013). Hyland and Milton (1997) identified a similar trend among native English speakers and L2 students, which they attributed to writing proficiency levels.

The interactive nature of hedges is undisputed. In fact, Hyland (2005: 177) positions hedging alongside directives, reader pronouns, personal asides and other engagement markers. Hyland (2005) and later researchers (e.g. Aull & Lancaster, 2014; Hyland & Jiang, 2016; Lancaster, 2016a, 2016b) see hedging as a manifestation of stance, which, in turn, puts hedging under a larger umbrella of interaction (Hyland, 2005: 177). As Hyland (2005: 178-179) explains, hedges “indicate [not only] the writer’s decision to withhold complete commitment to a proposition” [but] “also allow writers to open a discursive space where readers can dispute their interpretations.” Hyland and Jiang (2016: 259) elaborate when they state that hedges “mark statements as provisional to involve readers as participants in their ratification while conveying respect for colleagues’ views.” It is clear that the dialogic function does not negate the previously established “classical” functions of uncertainty and politeness but adds a new dimension.

Beyond the dialogic function, additional subfunctions of hedges have also been identified. Aull and Lancaster (2014: 160) note “approximative hedges” which Lancaster (2016a: 23) re-labels “scope hedges.” These are constructs that convey neither uncertainty nor politeness as their primary objective and are expressed by “wordings like *in general, somewhat, in most cases, largely, and often.*” Such hedges “intimate the extent or degree to which a proposition is true” (Aull & Lancaster, 2014: 160) and “work to narrow the scope of the proposition (Lancaster, 2016a: 23). Further, Lancaster (2016a: 23) identifies two additional subcategories of hedges: “objective” and “subjective” based on the source of uncertainty – internal or external to the writer. Similarly to this study examining writing in one academic field, Lancaster (2016b) identified six functional subcategories of hedging in philosophy papers.

In light of the studies that show potential for addition subcategories of hedging, I propose fictionality marking as a new functional category of hedges in professional scientific writing.

## 2.1. The case for fictionality through hedging

The very idea of a dialogue with a reader is predicated on the notion of fictionality (see Pilkington, 2018b; Thompson, 2001, 2012). Thus it is possible to interpret the dialogic function of hedging as connected with fictionality from the start. In this study, however, I examine more specific realizations of fictionality and do not make an assumption that all instances of hedging are necessarily carriers of fictionality. Rather, I propose that there already exists a connection between hedging and fictionality and that it would be a logical next step to extend the functions of hedges to include fictionality. In almost all discussions of hedging, there are present such categories as *plausibility/possibility*, *objectivity*, and *fact* and their counterparts – *uncertainty* and *subjectivity* (Hyland, 1998: 3; 2005: 179, 180). All research on hedging, to some extent, addresses the issue of balance between or among the functional categories. For example, Hyland (2005: 186) points out “the importance of distinguishing fact from opinion” as a feature of “writer perspective.” He also connects the realities of an academic discipline with the rhetoric used to describe its outcomes. In the sciences, “[n]ew knowledge is accepted on the basis of empirical demonstration, and science writing reinforces this by highlighting a gap in knowledge, presenting a hypothesis related to this gap, and then conducting experiments and presenting findings to support the hypothesis” (Hyland, 2005: 187-188). If fictionality is established as a prominent feature of the scientific process (i.e. hypothesizing), then it must be present in scientific writing as well. Hedges, it appears, are a possible location for fictionality in scientific writing. They present ideal conditions for containing fictionality since these are multifunctional constructs designed for assessment of knowledge claims and according to a variety of functional definitions are already endowed with an implicit dichotomies of fact/fiction, probability/possibility.

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The new function that the current study observed still deals with the perception of a knowledge claim; however, it also demonstrates an addition category which I labeled “fictionality.” The new subfunction is especially apparent in a less commonly analyzed epistemic marker. At the same time, looking at modal verbs also afforded evidence of fictionality marking.

## 2.2. Hedges as fictionality markers

The idea of fictionality in professional science is usually approached with caution. The perceived epistemic divide between scientific knowledge and artistic creativity makes it difficult to apply a shared analytical model to both spheres of human inquiry. The present examination of fictionality in professional research articles, however, is a small step in the direction of a common analytical platform. By looking at hedging – a typical occurrence (and in many cases a requirement) in professional

scientific writing – I demonstrate that the same markers that usually signal epistemic uncertainty or negative politeness can also signal fictionality.

As research shows (e.g. Hyland, 2005; Hyland & Jiang 2016; Lancaster, 2016a, 2016b; Lewin, 2005; Varttala, 1999), hedging is a multifunctional phenomenon. In fact, previous studies tentatively suggest that there are additional functions of hedges found in scientific writing. In some instances, as Lewin (2005: 168) observed, these functions are “the very opposite of” what hedging is associated with, such as heightening of claims instead of downplaying them. I argue that signaling fictionality is another one of the additional functions. Just as with claim heightening, it is important to be aware of this possible role of hedges in order to follow the original intentions of the author.

Distinguishing an epistemic probability from modeling (one of the ways fictionality is used in science) is crucial. One way to achieve clarity when both are signaled by similar lexical items is for both authors and readers to be aware of the possibility of fictionality and of specific resources associated with it. Thus paying attention to the number of modality markers and the content following them can help one to place a claim in the realm of either epistemic conditioning (Real condition) or Fictionality (Fictional condition). Knowing the difference between these categories will, in certain cases, help eliminate the confusion between an author’s intention and a reader’s interpretation that Lewin (2005) noted.

From the point of science communication both inside and outside the scientific community, acknowledging the presence of fictionality and being able to identify its concrete manifestations, allows for a broader and more accessible view. As this study shows through a small sampling of data, fictionality is ubiquitous among scientific disciplines. No significant difference was observed in the number of markers as associated with a specific branch of science. As such, the presence of fictionality is, in a small way, a unifying condition for scientific inquiry.

Fictionality is also a phenomenon that ties science to humanities – a tie that is rapidly becoming vital for development and support of scientific endeavors. As Winterhalter (2014) observes, recent studies in neurology begin to uncover a connection between aesthetic perception and scientific knowledge processing, “in certain aesthetic states, processing and perception happen in the same cortical centers of the brain.” The additional subfunction of fictionality added to the already existing roles hedges play will further illuminate author’s intentions and contribute to dialogicity.

Establishing a connection between scientific thinking and emotionality is a crucial point for communicating science to the public and for making research goals and processes accessible to potential external funding sources (Pilkington, 2018a, 2018b, 2019; Sackler, 2014). Fictionality serves as a connection in this area as well, establishing ties between professional scientific writing and narratology. As Harre (1994), du Sautoy (2015), and Olson (2015) show, the structure of a typical scientific paper mimics traditional narrative progression common in fiction writing. The presence of fictionality markers solidifies the claims about the similar nature of

scientific and fiction writing, and thus the universal nature of writing itself, and allows for potential quantification of a degree of fictionality (based on Skov Nielsen et al., 2015a, 2015b).

Much like hedging, fictionality as a communicative strategy deals with epistemic constructs. Therefore, the aim of this study is to suggest a new functional subcategory labeled “fictionality” for the phenomenon of hedging in professional scientific writing. Recognizing fictionality as a function of hedging may result in a more nuanced approach to academic writing taught at tertiary level. Lancaster (2016b) observed additional functional categories of hedging in philosophy writing based on an analysis of texts produced by two study participants and demonstrated that awareness to these additions had pedagogical significance. Similarly, I propose that an investigation based on a small corpus of research articles can be of significance when dealing with genre writing.

In the remainder of the article, I will attempt to determine whether or not speech acts of conjecturing in professional scientific writing can be classified as a separate functional subcategory of hedging labeled “fictionality”.

### 3. METHODOLOGY

#### 3.1. Corpus and data selection

The results analyzed were collected from a corpus of 15 research articles covering the following subjects: Biology, Health, Chemistry, Physics, and Mathematics. This presented 144,520 words for analysis, not counting References, Acknowledgments, Notes, or Appendixes since these sections were not considered for presence of fictionality markers. The articles were randomly selected using Academic Search Premier article database from SCOPUS-indexed peer-reviewed journals published between 2017 and 2019 (See Appendix). As the aim of the study was to identify a possible new trend in functional aspects of hedging, random sampling allowed a look at a variety of naturally occurring texts. Each article was examined for the presence of hedging devices. Each instance of hedging was labeled as such. The next step in data collection involved superimposing the category of fictionality onto the hedging devices. In order to cross-reference hedges and fictionality markers, I turned to Skov Nielsen et al.’s (2015a, 2015b) works on fictionality and to Varttala’s (1990) investigation of hedges. Skov Nielsen et al.’s research was chosen for its emphasis on fictionality in non-fiction, and Varttala’s for its suggestion that hedges should not be viewed within rigid functional paradigms. Thus the following markers were selected for analysis as fulfilling requirements for being both hedges and fictionality markers: APPEAR, ASSUME (searched for as ASSUM to include variants such as ASSUMPTION), HYPOTHESIZE (searched for as HYPOTHE to include variants of HYPOTHESIS, HYPOTHETICAL, etc.), IF, SEEM, MIGHT, TEND. Each

marker was then analyzed in context and labeled as either signaling an instance of traditional hedging or a hedge with an additional subfunction of fictionality.

### 3.2. Analytical method

After each instance of each marker in the corpus was labeled, I extracted sentences that contained the markers in order to examine each instance in context. That rendered 81 sentences. Then, the sentences containing the markers were arranged into groups according to the markers they contained. Not all of the markers listed in 3.1. were observed. The result of the analysis are as follows: 60 IF sentences, 9 MIGHT sentences, 5 SEEM sentences, 4 APPEAR sentences, 2 TEND sentences, and 1 HYPOTHESIZE sentence. Sentences that contained double markers were categorized under the first marker. A total of 90 hedges was observed and recorded. At that point, I could begin to determine which hedging structures were carriers of fictionality. Since I assumed that fictionality can manifest through hedging, and since hedging already introduces conditional reality, it was important to analyze the markers not for the presence/absence of conditional aspects but on the nature of those aspects. Therefore, traditional hedges with no additional function of fictionality would fall under the category of *Real Condition*, which I defined as *a conditional category where a marker is followed by specific parameters that are intended to be implemented and not imagined*. See example 1 below:

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[1] If we make the kinetic terms symmetrized, find the traces and then use the ordinary trace, the action will get replaced by Sen's action. (Hafeti & Vasko, 2019: 2)

Here, the parameters that follow the marker IF are clearly spelled out ("make the kinetic terms symmetrized, find the traces...use the ordinary trace"). They indicate a potential call to action and can be implemented. In such a case, the hedge IF does not carry an additional function of fictionality.

In contrast, *Fictional Condition* I defined as *a conditional category where a marker is followed by parameters that need to be imagined not implemented*. See example 2:

[2] If such figures ["classical Platonic solids"- O.L.] exist, how many are there? (Volkert, 2017: 28)

The marker in this example does not invite the reader to implement but to imagine. In other words, the reality itself is conditional, not specific manipulations or manifestations of it. "Classical Platonic solids" are an example of a non-denoting element as identified by Barwich (2013: 357-358). The condition represented by IF is, therefore, fictional.

Both Fictional and Real Condition could be seen as signaling the speech act of conjecturing – a category of hedging. Thus, those markers that point to fictional condition still remain within the broader domain of hedging, yet they introduce a new functional nuance that current hedging functions do not describe.

#### 4. RESULTS AND DISCUSSION

For each conditional category, I observed certain indicators that place a statement either within the category of Fictional or Real condition. For Fictional condition, the presence of two or more different or the same markers proved to be such an indicator. Examples 3.a and 3.b below show the discussed indicators in context:

[3.a] Since  $M$  is related to the mass  $m_C$  of a possible Kalb-Ramond field through  $m_C = g_{BC} g_C \chi M$ , coupling scales  $M$  in the few TeV to thousands of TeV range could indicate a Kalb-Ramond mass in the hundreds of GeV to hundreds of TeV range **if we assume** weak strength couplings of the Kalb-Ramond field. (Dashko & Dick, 2019: 84)

[3.b] One **might assume** that in infected humans, positive selection favors the rapid outgrowth of variants that possess mammalian type traits and that variants with human-adapting mutations **might** commonly be found as subpopulations within infected persons even **if** they were not present in most viruses. (Imai et al., 2018: 1236)

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Combinations IF...ASSUME, IF...MIGHT/MAY, and IF...APPEAR were most common, with ASSUME coupling exclusively with IF (no distinction was made between occurrences of IF and “even IF”). Certainly, other combinations are possible, but they were not present in the corpus. Other markers would combine with each other or with IF. Example 4 illustrates a marker combined with itself in the same sentence:

[4] In other words, adaptive mutations **might** alter virus phenotypes but **might** require the presence of potentiating mutations to maintain viral fitness. (Imai et al., 2018: 1236)

For the category of Real condition, mathematical formulas served as indicators of real parameters that need to be applied to satisfy a specific condition, as exemplified below:

[5] We analyzed in particular the case of a single dark matter component and found that the MeV-GeV mass range for dipole coupled dark matter remains viable under recent constraints from direct searches in electron recoils **if**  $a^2_e < a^2_{m...}$  (Dashko & Dick, 2019: 84)

In addition to formulas, Real condition was most often observed when a marker was followed by a verb expressing a material process (e.g. reduce, restrict, adapt, facilitate, etc.). The verbs following the markers of Fictional condition were more likely to be verbs expressing existential (e.g. is, was, exist, etc.) or mental processes (e.g. imagine, want).

The presence of qualitative indicators of either Real or Fictional condition set analytical parameters for processing the data observed.

## 4.1. The role of individual markers

### 4.1.1. IF

The most commonly observed marker in this analysis was IF. It appears of interest, however, not only because of its frequency but mostly because of its versatility. IF was observed designating both Real and Fictional conditions. It serves as evidence that an additional subfunction of fictionality is present in the commonly-established hedging constructions.

Consider examples of each, with 6 illustrating a hedge without the fictionality subfunction, and 7 representing Fictional condition, i.e. a hedge with a fictionality subfunction:

[6] ...the bosonic terms in the Lagrangian...are KR gauge symmetric **if**  $g_{BC} = 1/\sqrt{2}$ .  
(Dashko & Dick, 2019: 82)

[7] Hinton notes that “Null” is a colour “such that it makes no appreciable difference to any colour, with which it is mixed. **If** there is no such real colour let us **imagine** such a colour...” (Hinton, 1921, 136-137). [Cited in Volkert, 2017: 34, footnote 5]

The frequency distribution between the two categories was close: with 33 occurrences of Real condition and 23 of Fictional condition. The type of verbal process as well as the number of markers help distinguish between Fictional and Real condition within the speech act of conjecturing, with context exerting a strong influence. IF was the most versatile marker observed in the Fictional condition category as it was seen to combine with almost any other marker.

When it comes to analyzing context within which IF was found, it is important to note that this was the only marker to introduce mathematical formulas (see examples 5 and 6 above).

### 4.1.2. MIGHT

In the case of this marker, there is a stronger frequency distinction between Real and Fictional condition, with 9 occurrences indicating Real condition and only 4

signaling fictionality. In general, MIGHT appears to be a weaker indicator of Fictional condition based not only on frequency counts but also on the lack of observable instances of Fictional condition where MIGHT was the only marker. It does, however, function as a stand-alone signal of Real condition. Consider examples 8 and 9:

[8] **Real Condition:** We had access to only throat swab and tracheal aspirate samples; virus populations in other anatomic sites, such as alveoli, **might** differ. (Imai et al., 2018: 1235)

In this example, it is possible to discern the specific parameters under which “virus populations” will be different, that is, if “sites, such as alveoli” are examined. One does not need to imagine, but to test this proposition to determine its accuracy.

[9] **Fictional Condition:** One **might** assume that in infected humans, positive selection favors the rapid outgrowth of variants that possess mammalian type traits and that variants with human-adapting mutations **might** commonly be found as subpopulations within infected persons even **if** they were not present in most viruses. (Imai et al., 2018: 1236)

In example 9, no specific parameters that could be tested are present, and the multiple markers point to the need to imagine a particular scenario rather than invite an examination of a particular alternative condition. As above, the combination of “even IF” was of no significance.

Overall, MIGHT follows the general distinguishing parameters between Real and Fictional conditions: the importance of context, presence of existential verbal processes, and duplication/combination help determine whether it indicates fictionality or not. In these distinctions, however, it is less complex than IF, which can both stand alone and combine in either Fictional or Real condition.

#### 4.1.3. APPEAR, SEEM, TEND

These markers represented a relatively small portion of hedges signaling either Real or Fictional condition. They are, nevertheless, of interest as they function slightly differently from IF or MIGHT in Real condition situations. Unlike IF and MIGHT they do not introduce specific alternative parameters that could be tested to produce different results from what is stated in the main claim. Instead, they point to the pure uncertainty of a claim without offering any additional resolutions, as examples 10, 11, and 12 demonstrate:

[10] Intuition (Anschauung) still played a major role in geometry – and intuition **seemed** to be restricted to three dimensions. (Volkert, 2017: 28)

[11] Samples with 560 ppm Na<sub>2</sub>O (Figure 4B,D) show more faceted  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> grains and **appear** to have a wider grain size distribution than samples with 60 ppm Na<sub>2</sub>O. (Frueh et al., 2017: 2743)

[12] The inclusion size **tended** to become smaller with the increase of Mg concentration in the inclusions. (Jia et al., 2017: 801)

These markers function as traditional hedges signaling the author's lack of certainty. APPEAR and TEND were especially common in cases of Real condition, while SEEM was observed with a subfunction of fictionality. SEEM was often found following "would" – something that was never observed in instances of Real condition:

[13] In principle such a space **would seem** to have been easily accessible after 1750, for it was around then that solid geometry began to be studied in analytical form. (Volkert, 2017: 27)

Other common combinations were with IF – the most versatile marker.

#### **4.1.4. ASSUME and HYPOTHESIZE**

These two markers were observed exclusively as examples of the subfunctional category of fictionality. They were also seen most often in combination with other markers. HYPOTHESIZE was found once on its own (see example 14) and once in a combination with IF (see example 15). Such low concentration of this particular marker was surprising considering emphasis on hypotheses in scientific exploration. It does suggest that while the idea of a hypothesis is prevalent, it does not necessarily manifest through hedging devices.

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[14] Since SiO<sub>2</sub>-containing second phases, such as mullite or cordierite, were not observed in the samples, we **hypothesize** that SiO<sub>2</sub> and MgO form a solid solution in  $\alpha$ -alumina, as proposed by Handwerker et al. (Frueh et al., 2017: 2745)

[15] However, we **hypothesize** that **if** both MgO and SiO<sub>2</sub> are present at low concentrations, then it is more favorable for MgO and SiO<sub>2</sub> to form a solid solution in the  $\alpha$ -alumina structure than to form a second phase or remain in the grain boundaries as a siliceous liquid phase. (Frueh et al., 2017: 2747)

Contextually, the presence of chemical formulas in the above examples might be seen as an indicator of Real condition since I mention above that formulas have been observed as contextual clues of Real condition. In the case of HYPOTHESIZE, however, this is not so as the semantics of the marker carries a strong degree of fictionality, suggesting that imagining, rather than implementing, is implied.

ASSUME presents a more interesting case. In addition to indicating Fictional condition in professional research articles, it has also been associated with "negative hypotheses" in popular scientific writing (Pilkington, 2018a: 98-99). A negative

hypothesis is a tentative statement that proves to be wrong as a text progresses (Pilkington, 2018a: 98) and therefore can be interpreted as an instance of Fictional condition. Just as in the research articles analyzed for the present study, ASSUME in popular scientific texts is used in combinations with IF, pointing to a possibility of a universal distribution where multiple hedging devices actually point to fictionality when considered together but do not exhibit this subfunction in single occurrences. Example 16 illustrates a use of ASSUME with the subfunction of fictionality. Note the combination with MIGHT and IF (the analysis determined no significance of the “even IF” combination):

[16] One **might assume** that in infected humans, positive selection favors the rapid outgrowth of variants that possess mammalian type traits and that variants with human-adapting mutations might commonly be found as subpopulations within infected persons even **if** they were not present in most viruses. (Imai et al., 2018: 1236).

## 5. CONCLUSION

This analysis examined 15 research articles (144,520 words) with a total of 90 hedges in the context of 81 sentences. In the course of the observation, a new functional subcategory of fictionality was determined as present in some of the hedging devices.

In some cases, nearly 50% of the hedges exhibited an additional subfunction of fictionality. Based on these observations and the notion of a degree of fictionality (Skov Nielsen et al., 2015a), this study suggests a new subfunctional category for hedging devices. This category is fictionality. It is different from the already identified functions of hedging in the requirement that certain parameters be imagined rather than physically implemented. In some cases of fictionality, physical implementation is impossible, in others, it is merely not intended.

The main aim of this exploratory research was to determine whether a new subfunctional category of hedging could be observed in professional scientific writing. The evidence from the small corpus of examined articles points strongly to the presence of a new subfunction. However, a larger study is needed to confirm these initial observations.

In bringing attention to fictionality as a new subfunctional category of hedging, this study also promotes the general idea of the ubiquitous presence of fictionality in scientific discourse. It is important to recognize fictionality as a real and influential presence in modern science and its discourses (both professional and popular).

Recent developments in philosophy of science and quantum physics propose a move away from the commonly-assumed physicality of reality, suggesting instead, a focus on such intangible universals as information and consciousness (Irwin et al., 2020). For example, Irwin et al. (2020) emphasize the presence of non-physical

information when it comes to hard sciences, "...we can think in our minds of [physical] objects such as triangles without it [sic.] existing as physical information." Such an approach furthers the importance of modeling and hypothesis building to the scientific process. It is only natural that traces of these steps are present in scientific discourse. Further studies in this area will be crucial to developing a sense of the degree of this presence. This analysis was limited to written discourse; at the same time, it will be of interest to determine if the same phenomenon of fictionality manifesting through traditional hedging devices can also be observed in oral scientific discourse or in popular scientific discourse.

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## Appendix

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