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The concept of contagion in finance

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Abstract. In everyday communication, figurative language is used to express emotions, value judgments and beliefs as well as to blend and create new concepts. In finance, metaphors often present messages of alarm in a soothing tone to overlook the cause of a problem and focus, instead, on a solution. The concept of *contagion* has recently entered discourse on international systems of regulation, finance and economics. We examine the use of *contagion* at semantic and grammatical levels and show how various patterns are used to elaborate particular features and diminish others. We present a corpus-based analysis of US congressional documents and compare them to medical reports from the World Health Organization and the Center for Disease Control. The results show that some lexical-pragmatic properties are carried over from the biomedical context while others are not, which has implications for the specialist language of finance and politics. In another analysis, we introduce a computational method based on word clustering in WordNet, to analyse how the context of *contagion* signals various metaphors in the congressional corpus. The results show patterns in the metaphorical domains that *contagion* uses. We conclude that *contagion*'s use in finance is more complex than term-borrowing as it establishes a range of lexical, pragmatic and figurative properties.

Keywords. Lexical genesis, metaphor, corpus analysis, computational analysis.

1. Introduction

In the 1930s the term *market crash* was used to refer to the beginning of economic recession. Now, we use terms such as *financial recession*, *credit squeeze* and *downturn*. Unlike a crash, which implies that recovery is unlikely, recessions and credit squeezes allow for eventual recovery. In recent financial discourse, the term *contagion* has been used to describe the onset and transmission of problems among financial institutions. Similar to *recovery*, *contagion* uses a metaphor of disease and illness to relate economic systems to living beings. How does such a disease, biological or financial, spread? In the early 1900s, a 14th century term *contagion* was used to describe diseases that could be communicated from one person to another. The term “communicable” is relatively neutral but *contagion* carries the negative implications that come with diseases (Pernick, 2002). This paper seeks to provide an account of how the concept of contagion has been figuratively applied to finance, based on analyses at different levels of linguistic description. Tracking the use of new terms in specific domains is important to fully understand the meaning of new terms as well as how such a process takes place in general. Doing so will show that technical language often contains semantic and conceptual ambiguities, emerging over time and often overlooked.

The term *contagion* originated in morality and religion, from where it was adopted by medicine and biology and subsequently by the social sciences and most recently in finance and economics. In this paper, we explore the use of this term in academic writing and in official documents of the US Congress, the World Health Organization (WHO) and the U.S. Center for Disease Control (CDC). The congressional and biomedical texts were analysed to provide a comparative analysis of *contagion*. The congressional documents were further analysed for use of what Andrew Goatly calls *root analogies*, which are primitive metaphorical mappings that “structure

the lexicon of English” (Goatly, 2011). We found that the term *contagion* continually finds use in new disciplines and that both researchers and legislators adapt the term quickly to suit new domains. By examining the metaphors underlying the use of *contagion*, we found they commonly relate institutions and systems to concepts like war, defense, ideas and emotion. Such relations between terms and concepts are common and systematic in everyday language (Lakoff & Johnson, 1980). We begin this paper by looking at the historical and current use of *contagion* in representative synchronic and diachronic samples of language.

Our goal is to characterize the communicative efficacy of the term by providing a comparative, corpus-based analysis of its semantic, grammatical and conceptual behaviour across domains. As we will see, because the term comes with some defining features from its originating biomedical context, its use in finance points to subtle changes at the semantic, grammatical and conceptual levels. To address the semantics of *contagion*, we present a concordance analysis to extract semantic features based on the term’s context. This is similar to corpus-based studies that seek to understand changes in meaning and word behaviour by examining contextualised evidence (Ureña & Faber, 2011, Charteris-Black & Musolff, 2003, MacMahon, 1994). Secondly, we explore the term’s use in its most common grammatical relations. At this level, we find that productivity in some relations is quite different between financial and biomedical texts. Lastly, we introduce a semi-automated procedure for extracting likely metaphorical domains using WordNet and Andrew Goatly’s theory of *root analogies* (Goatly, 2011; Miller, 1995). At the conceptual level, we find that *contagion* instantiates a range of figurative concept that are common throughout economic literature, as well as concepts that elaborate on the semantic and grammatical analyses. In light of our findings, we propose that though *contagion* has distinct semantic and grammatical behaviour in financial language, it does not yet have a stable definition, relying, instead, on diversely interpretable metaphors mapping different concepts in different situations.

2. Related work

Understanding the circumstances, mechanisms and implications of *contagion*’s adoption in finance is important not only for understanding modern finance, but also for uncovering how this type of language change comes about. In this work, we adopt a data-driven approach to language analysis, common to corpus-linguistic research. Using text as data is not foreign to matters of figurative language (Deignan, 2005a; Goatly, 2011; Charteris-Black & Musolff, 2003) nor to cognitive linguistics (Gries & Stefanowitsch, 2006) or computational linguistics (Gerow & Keane, 2011a; 2011b). What the term *contagion* provides, rather, is a kind of case study, observable in recent documents and relevant to the future of international economics.

In finance, *contagion* is a figurative term relating institutional problems to a disease. Metaphor has long been argued to be a pervasive cognitive phenomenon, central for understanding and comparing concepts. However, metaphor comprehension appears to be partly mediated by how metaphors are presented in text (and other modalities). For example, analogical metaphors, such as “an atom is like the solar system”, are thought to require a process of feature alignment and projection (Gentner, 1988; Bowdle & Gentner, 2005). Other metaphors appear to be processed by a category matching procedure (Glucksberg & Keysar, 1990; Glucksberg & Haught, 2006). Linguistic metaphors, and figurative language more broadly, are found in many forms in addition to analogies and category assertions. This has led to finer-grained delineations of figurative language, such as morphological metaphors, metonymy and synecdoche (Deignan, 2005b; Barnden, 2010; Stockwell, 2002). Further, grammatical form, lexical cues, modality and narrative context are known to mediate processes of comprehension (Torreano et al., 2012; Prasada et al., 2012, Thibodeau & Boroditsky, 2011). While metaphor processing surely constrains how terms are figuratively applied, the present study seeks to provide a corpus-based account of how this process might be evidenced in text.

The analyses presented here are based on corpus-linguistic techniques in which we adopt a

data-centric view drawing on language use. This view is generally adopted by corpus-based studies in language change (MacMahon, 1994), cognitive linguistics (Gries, 2006) and metaphor studies (Deignan, 2005a). The ramifications of metaphor use in economics have been analysed in two-sided opinions (Charteris-Black & Musolff, 2003) and ontological commitments (White, 2003). The current study employs similar techniques at the semantic and grammatical levels, where we analyse features of *contagion* and make observations about the grammatical pattern in which it is observed. Further, to exemplify the strengths of a computational approach, we use a semi-automated method of identifying figurative concepts in raw text. This method represents a synthesis of corpus-based, cognitive linguistics (Goatly, 2011) and computational lexicography (Miller, 1995). Computational metaphor analysis has been addressed in various (and often disparate) ways, but to our knowledge, this is the first study to apply a computational analysis of figurative language to terminological research (see Shutova, 2010 for a review).

3. Analysis of institutional writing

3.1. A corpus-based approach

To examine *contagion*'s use, we employ traditional corpus analysis techniques (concordancing, co-text examination, part-of-speech (POS)-tagging and collocation analyses) to explore its semantic and grammatical properties. We take a feature-based approach to the semantic level of description that will reduce the need for intuitions about typicality and embodiedness. Additionally, the feature-based approach will simplify a comparative analysis between corpora in different domains. The semantic features, which are fuzzy and somewhat intuitive, are not meant to exhaustively capture the term's semantic behaviour, but instead, allow quantitative comparisons among domains. The results from the feature analysis motivate a finer-grained inspection of the grammatical behaviour of the term. Both of these evaluations comprise the starting point of a computational analysis of *contagion*'s conceptual behaviour with regard to the metaphors it instantiates.

3.1.1. Dataset

The data we use for this examination was chosen to be relatively serious, deliberate forms of communication. However, because we do not necessarily want to examine academic language, as research publications tend to be explanatory in nature, we built a collection of documents from the United States Congress. This corpus consists of hearings, testimonies, reports and press releases. Because hearings and testimonies are usually made under oath, the language they contain comes with a degree of deliberation not common in less formal venues. The corpus consisted of 39 publicly available documents from 2001 to 2012 downloaded from www.senate.gov and www.congress.gov. It contained a total of 267,256 tokens, and was made up of 18 testimonies, 10 reports, 8 hearings and 3 press releases. There were 96 instances of the word *contagion* in the corpus, occurring in 87 sentences, always in the singular noun form, and always referring to the financial concept. The words *contagious*, *contagiousness* and *contagions* never occurred.

To compare *contagion*'s use in the financial and legislative domain, where the term is figurative, we developed a corpus of disease-related texts. We collected documents from the World Health Organization (WHO) and the US Center for Disease Control (CDC). The corpus consisted of 13 news reports from the WHO, 5 articles from the WHO's *Disease Outbreak News*, 44 papers from the CDC's *Emerging Infectious Disease* journal and 38 reports from the CDC's *Morbidity and Mortality Weekly Report*. This consisted of 100 documents from 2000 to 2012, downloaded from agencies' websites. In this collection the word *contagion* occurred only 10 times, in 10 sentences and *contagious* occurred 141 times in 120 sentences. Both corpora are available online³.

3.1.2. Method 1: Keyword in context

We first conducted a concordance analysis with Sketch Engine (Kilgarriff et al., 2004) to examine the context of *contagion* in the congressional and biomedical collections. Concordances are a way to systematically analyse a term’s context, and are commonly used by lexicographers to develop definitions. Moreover, this is perhaps the simplest place to begin a terminological analysis of a word used in a *new* context. This analysis provides a base-level comparison between *contagion* in finance and *contagion* in biomedical text. Using the 87 sentential instances in the congressional corpus and the 130 in the biomedical corpus, semantic features were extracted manually. Extracting features to distil the semantic behaviour of *contagion* addresses two methodological goals. It adheres to the language-as-data paradigm adopted by our corpus-based approach, allowing a quantitative analysis. It also minimises the requirements for intuitions about the term’s use with exemplary, prototypical or embodied concepts (Lakoff & Turner, 2009). The feature analysis will lead into the grammatical and conceptual analyses presented in the following sections.

3.1.3. Results

In the congressional corpus, the noun form is the only form of the word – whereas in the biomedical corpus the adjective form, *contagious*, dominates (83%). Overall, the context of *contagion* carries a negative affect, and instantiates various kinds of type, movement and scope features (Table 1). Sometimes *contagion* is personified with action verbs, affording it a kind of independence to move, effect change and cause events. This also allows *contagion* to be characterized in terms of what it *does*, as in the sentence, “The contagion may spread further in the short term.” This autonomy is found significantly less in the biomedical texts where *contagious* is typically used to modify or qualify another object, as in *highly contagious*.

Feature	US Congressional Reports (N _{contagion} = 87)	Medical Reports (N _{contagious} = 120; N _{contagion} = 10)
Can be helped / prevented	18 (<i>reduce-3, prevent-3, avoid-2, protect-2, stem-2, avoid-2, combat, end, restrict, stop</i>)	9 (<i>avoid-3, controlling-2, eradication, prevent, preventable, reduce</i>)
Has scope	22 (<i>from-7, source-3, to-3, into-2, spread-2, inside-2, among, scope, transatlantic</i>)	5 (<i>period-5</i>)
Has types	15 (<i>financial-6, global-2, debt, default, international, market, transatlantic, risk, systemic</i>)	4 (<i>potentially-2, disease, <disease>*</i>)
Can move / has velocity	9 (<i>come-2, spread-2, driven, force, rapidly, restrict, transmit</i>)	10 (<i>from-5, spread-2, transmit-2, to</i>)
Can worsen	4 (<i>deepen, intensification, magnified, spark</i>)	1 (<i>further</i>)
Is a type of [...]	5 (<i>risk-3, effect-2</i>)	47 (<i>disease-19, <disease>-18*, abortion-2, person-2, risk-2, individual, nature, origin, secretion</i>)
Cline		54 (<i>highly-33, less-5, most-4, as-3, more-2, readily-2, extremely, moderately, particularly, serious, slightly</i>)
Agent	5 (<i>itself-2, create, force, present</i>)	
Can cause [...]	6 (<i>effect-3, spark-2, fueled</i>)	
Can present itself	2 (<i>appear, emerge</i>)	

Table 1: Features, their frequency of occurrence in each corpus and their instantiations found in the concordances of congressional and medical texts. Note that <disease> denotes a specific disease.

In the congressional corpus, there are five features not apparent in the biomedical corpus: *agent*, *can cause*, *can present itself*, *is caused by* and *has depth*. These features share a theme: that contagion is something that can act, be acted upon and most importantly, can be discussed without reference to its relationships. In a sense, the concept of contagion is more independent in finance and legislation than in medicine and biology. Moreover, the congressional documents exhibit a wider range of semantic features. For example, note the number of scope, type and

movement features. Not only is it more common in politics to use these properties, but also they are instantiated in more diverse ways. Perhaps this reflects the newness of the term in this domain or points to it being less tightly defined.

Considering the biomedical corpus, we see that the adjective form, *contagious*, appears often with the *cline* feature. This is observed when the term is used with intensifiers and diminishers such as *highly* or *slightly*. This is perhaps due to writers describing specific diseases or maladies, that can, in them, be contagious. These *cline* instantiations are absent in the congressional corpus, where there is little to no talk of what, or in what way, something can be contagious. The *type* feature is also more prominent in the biomedical texts. In medicine, it appears that there can be many things that are potentially contagious, whereas only two instantiations (five instances) were found in the congressional documents. This may also point to a lack of specificity in finance about exactly *what* a contagion is contagious *to*. Overall, it appears that finance lacks two analogous features found in medicine and biology: the connection between the contagion and that which contracts the contagion, and the relation between the contagion and its own type (disease, virus, infection, etc.).

3.1.4. Method 2: Grammatical collocates

The results of the feature analysis provide an overview of the semantic behaviour of *contagion*, as used in the congressional and biomedical collections. We can extend this understanding by examining the grammatical constructions in which it occurs. The features identified above do not address how the word is put to use grammatically. Is *contagion* compared to other problems in finance? Is it used to modify existing problems, or perhaps is itself modified? Is it typically the subject of sentences, or the object? This analysis is less concerned with the semantics of *contagion*, seeking to provide a finer-grained description of its function. Diachronic changes at the grammatical level have been shown to relate to other levels, such as token and word-form frequencies (Gerow & Ahmad, 2012) and they constitute a key component of language change (MacMahon, 1994). Comparing the biomedical and financial corpora shows that *contagion* has undergone more than semantic changes. To investigate *contagion* at the grammatical level, the corpus was tagged with part-of-speech (POS) information (noun, verb, adjective, etc.) and grammatical relationships were extracted (subject_of, object_of, modifies, etc.) using templates on the POS sequences. TreeTagger was used for POS tagging (Schmid, 1995) and Sketch Engine (Kilgarriff et al., 2004) was used to extract the grammatical relations.

3.1.5. Results & discussion

Table 2 summarizes the common relations where *contagion* was found in each corpus. We see that *contagion* can be *stemmed*, *reduced*, *avoided* and *sparked* in an object_of relationship. As an object, it can be *transmitted*, *stopped*, *restricted*, *ended*, *driven* and *prevented*. Note the different grammatical modifications where there are various types of contagion, such as *market*, *financial*, *global* and *systemic*. Reviewing and/or relations, *contagion* is commonly compared to *deterioration*, *stress* and *crisis*. Lastly, the word's use in various prepositional and subordinate conjunctive phrases shows it can affect things like *unions*, *areas*, *countries* and *debtors*.

Contagion's grammatical collocates in the congressional corpus show that it is commonly used as a modifier and is commonly modified itself. Given the uniformly nominal use of the term, its use as a modifier implies that while there are types of contagion, there is little reason to describe something as *contagious*. There are occurrences like "debt contagion" and "market contagion" but never "contagious debt" or "contagious market". In the congressional corpus, note the term's productivity as an object where there are 26 such instances, as opposed to the biomedical corpus where there are only three. The most frequent object-object relation is "transmitting contagion" which is perhaps a defining feature of *contagion* as opposed to a generic malady. In the and/or constructions, there are some proposed synonyms and antonyms such as *stress*, *deterioration*, *confidence* and *crisis*. From a definitional standpoint, these collocates point to pre-existing terms

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used to define and explain the concept of contagion itself. Comparing subject_of arguments between domains, biology devotes considerably more discussion to *what* is contagious (a disease, *person*, *virus*, etc.) as opposed to finance where there is no talk of contagious entities. It is conceivably important for biology to specify exactly how a contagion exhibits movement and transmission, independent of its carriers – but not so in finance. This same aspect of specification is perhaps used to distance financial and political institutions (the carriers of contagion) from the phenomenon of transmission, making contagion a problem independent of the systems' constituents. Instead of talking about financial institutions and their problems, authors talk about contagion – a move that detaches the problematic phenomenon (contagion) from the problem itself (institutional behaviour).

	Relation	Keyword (left)	Collocate / argument	Keyword (right)	Frequency (per/100k)
Congressional Documents (N _{contagion} =87; 32.5/100k)	object_of		26 (<i>be-6, avoid-3, stem-2, prevent-2, reduce-2, spark, transmit, magnify, stop, restrict, spread, end, drive, reflect, address, make</i>)	contagion	26 (9.7)
	modifies	contagion	19 (<i>risk-7, effect-5, event-2, deterioration, leader, securitization, concern, leader</i>)		19 (7.1)
	modifier		24 (<i>financial-6, debt-2, global-2, market-2, fueled, combat, gradual, securitization, widespread, possible, potential, systemic, default, international, such, new</i>)	contagion	24 (9.0)
	and/or	contagion	9 (<i>deterioration, stress, confidence, leader, investor, area, economy, crisis, market</i>)		9 (3.4)
	subject_of	contagion	11 (<i>be-5, have-4, spread, take</i>)		11 (4.1)
Medical Documents; (N _{contagion} =10; 1.7/100k)	object_of		3 (<i>avoid, prevent, reduce</i>)	contagion	3 (0.05)
	modifier		4 (<i><disease>, suicide, further, possible</i>)	contagion	4 (0.07)
	and/or	contagion	2 (<i>vector, reporting</i>)		2 (0.03)
Medical Documents; (N _{contagion} =120; 2.1/100k)	modifies	contagious	76 (<i>disease-39, <disease>-16, person-3, infection-3, abortion-2, nature-2, virus-2, secretion, traveller, origin, syndrome, pathogen, individual, illness, period, case</i>)		76 (1.3)
	modifier		48 (<i>highly-33, not-6, as-2, moderately, readily, extremely, particularly, potentially, usually, often</i>)	contagious	48 (0.8)
	and/or	contagious	53 (<i>acute-6, bovine-5, infectious-5, active-5, viral-4, caprine-3, fatal-3, respiratory-3, advanced-2, new-2, other-2, miasmatic, pustular, diarrheal, deadly, lethal, transmitted, virulent, preventable, entire, notifiable, serious, bacterial, able</i>)		53 (0.9)
	subject_of	contagious	21 (<i><disease>-8, person-3, virus-2, case-2, empowerment, infestation, lesion, student, patient, disease</i>)		21 (0.4)

Table 2: Grammatical relations in which *contagion* was found. The frequency of individual collocates is given for each, as well as of the construction overall. Relations are not mutually exclusive and only the most common relations are shown here. Note that *<disease>* denotes a specific disease.

3.2. A computational analysis of figurative context

The previous analysis found a number of features of contagion, based on the term's lexical and grammatical context in US congressional documents compared to a biomedical context. We now turn to an analysis of *contagion*'s conceptual behaviour. Here, we employ a semi-automated computational procedure to find likely figurative domains of *contagion*. These domains are known as *topic* and *vehicle* domains, that correspond to what the metaphor is being applied to (the topic) and by what concept it is applied (the vehicle). For example, in the statement “debt is a contagion”, *debt* is the topic and *contagion* is the vehicle. The term *contagion* can also be used as a topic, as in “the contagion invaded the Eurozone” where *contagion* is characterized

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as an invader, using a war metaphor. The convention in metaphor research is to express such a metaphor as DEBT IS A CONTAGION, which is an instance of PROBLEMS ARE DISEASES. The following study explores the use of a computational method of extracting likely topic and vehicle concepts from contextualised instances of the term *contagion* in the congressional corpus described in Section 3.1.

3.2.1. Method

We developed a procedure that builds on two sources of linguistic information: WordNet (Miller, 1995) and the *Map of Root Analogies* (Goatly, 2011). Root analogies are the result of corpus linguistic analysis on how metaphors are used, borrowed, defined and identified in text. The product of this work is a set of commonly paired topic and vehicle concepts called *root analogies*. These analogies comprise and organise many of the linguistic metaphors commonly found in text. Using this database as a set of seed terminology, a sentence can be examined for pairs of words relating a metaphorical topic to a vehicle. This is achieved using WordNet to measure the distance between observed terms in a sentence and candidate concepts in the set of root analogies. Combined with some heuristics, such as predication and selectional preference, the system ranks the most likely root analogies (topic-vehicle pairs) for a given statement. Using a ranking over all possible interpretations allows a statement to instantiate more than one metaphor (where more than one scores high). Figure 1 shows an example of analysing the sentence “Sovereign debt is a contagion.”

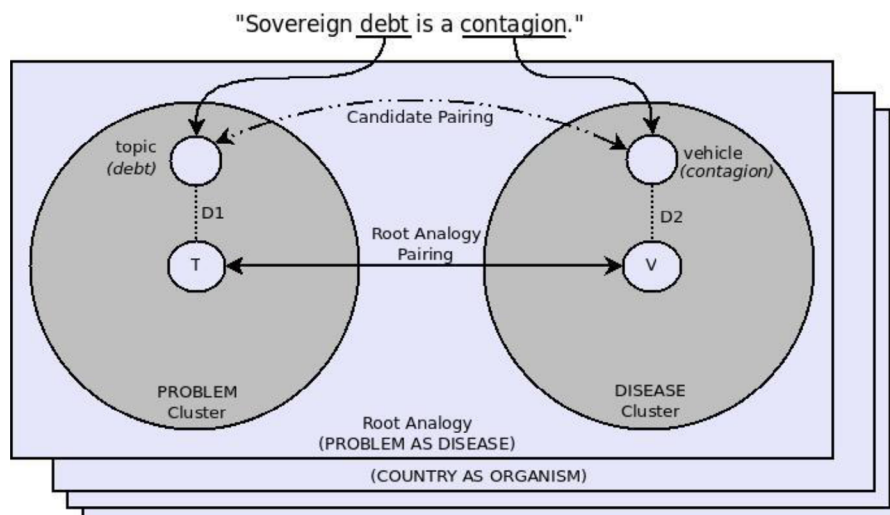


Figure 1: The metaphor extraction method uses a clustering approach to find pairs of words in a statement that are related to concepts in Goatly's root analogies, which are defined by a pair of topic-vehicle concepts (T and V). Likely interpretations, then, are those where the WordNet distances D1 and D2 are minimized.

For every candidate metaphor, a score from 0 to 1 is calculated, 1 being the best. This score is initially computed as the average of relatedness scores, D1 and D2 using WordNet⁴. After these scores are computed, a series of heuristic bonuses are applied to the score. These heuristics include a bonus if the observed word is synonymous in WordNet with its candidate term (for example *contagion* and DISEASE in Figure 1). Another bonus is applied if the observed vehicle predicates the topic in the statement (as is the case with *contagion* and *debt* in the example). Observing co-text markers signalling the use of linguistic metaphor like “metaphorically speaking” and “utterly” will also contribute a bonus to the final score. Lastly, a bonus is applied to account for so-called *selectional violations*, where a verb in an object-/subject-verb relation violates the typical class of verbs selected by that object (Wilks, 1978; Resnik, 1995). These heuristics do not help identify the “correct” metaphor, but serve to promote likely topic-vehicle pairs, based on features not inherent in the root analogies. Note that this method allows a statement to instantiate more than one metaphor, as in the sovereign debt example as an instance

of both PROBLEM AS DISEASE and COUNTRY AS ORGANISM. The results consist of the top 20 highest scoring candidate metaphors for each sentence, and only if the scores were above 0.5. Using this method, we analysed the sentences in the US Congress documents containing the word *contagion*.

3.2.2. Results & discussion

The metaphor of contagion in finance is one of a disease that develops or is contracted and subsequently spreads. These aspects come directly from a biological conception of financial institutions, their problems that are contagious, and their relationships that enable their problems to spread. Table 3 shows some example metaphors identified in the congressional documents in which there are groups of common metaphors. Note the group of war-related metaphors as well as ones relating to ideas and emotions.

Sentence	Candidate metaphor	Topic term	Vehicle term	Score
[...] entering a critical phase as policy initiatives undertaken so far have not prevented systemic contagion.	DISEASE = INVASION	contagion	entering	0.88
[...] contagion may spread further in the very short term.	DISEASE = INVASION	contagion	spread	0.74
[...] a material impact in addressing market contagion.	DISEASE = WAR	contagion	impact	0.71
The contagion is driven primarily by what other securities are owned [...]	DISEASE = WAR	contagion	need	0.60
[...] has come a new strain of global contagion [...]	DISEASE = IDEA	contagion	strain	0.83
[...] as part of its operations can extend the contagion risk [...]	DISEASE = IDEA	contagion	part	0.79
Banks have solvency regulation to protect depositors and to defend the banking system from contagion risk.	DISEASE = IDEA	contagion	regulation	0.71
Anticipating future sources of contagion is difficult [...]	DISEASE = IDEA	contagion	source	0.70
[...] a real contagion risk to the financial system [...]	DISEASE = IDEA	contagion	system	0.70
General investor panic is the final reason for contagion.	DISEASE = EMOTION	contagion	panic	0.78
The contagion is driven primarily by what other securities are owned [...]	DISEASE = EMOTION	contagion	security	0.69
Financial contagion to the US from further deterioration [...]	DISEASE = EMOTION	contagion	deterioration	0.59

Table 3: A sample of 12 analysed sentences from the congressional corpus, with their top-scoring candidate metaphors. The sentences are grouped according to the candidate metaphor's vehicle domain.

Table 4 shows the number of different metaphors in each sector of Goatly's *Map of Root Analogies*. The most prominent type relates *Human, Senses, & Society* to *Human / Animal, Body & Senses*, of which there were a total of 208. This type includes metaphors of institutions as people and animals as well as humans as animals. It is not surprising to find metaphors personifying organisations and using various sense and body categories, given the biological origins of the term *contagion*. Another common type of metaphor relates *Living Things & Substances* to *Human / Animal, Body & Senses*, which includes the personification of institutions, objects and phenomena. *Values, Qualities & Quantities* as *Activity & Movement* and *Values, Qualities, & Quantities* as *Space & Place* are also common pairings. These account for metaphors where physical and spatial changes are equated to movement and substances, such as liquids and gas. This kind of metaphor is generally common in economics (Charteris-Black & Ennis, 2001) reflecting the domain's focus on change – both abstract and quantitative. Moreover, metaphors of change are very common in everyday language, many of which structure the way we think about numerical values (Lakoff & Johnson, 1980). These metaphors are also personifying in finance, often used to construe situations and events as agents. Take, for example, a phrase from the congressional texts: “a disturbing level of contagion has already been evident around the hemisphere.” This statement uses *contagion* as though it were a quantity, applying a metaphor of CHANGE IN QUANTITY IS CHANGE IN ELEVATION. A defining feature of the concept of contagion is that it spreads – making change-related metaphors particularly apt, given finance's

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focus on change. Other frequent types include metaphors with vehicles involving movement, velocity, scope and geography. These vehicle concepts are abundant throughout figurative language and may be an artifact of more general conventions. What is perhaps most surprising is the apparent lack of metaphors with a topic concept of *Thinking & communication*. This implies that metaphors of contagion tend not to be used as ideas, understanding, mind, knowledge, speech or text. It appears that *contagion*'s root domain of biology constrains its use in such a way that precludes these domains, which is a well-known phenomenon (Lakoff & Turner, 2009).

Vehicle:	Topic: Activity & Movement	Human, Senses, & Society	(Living) Things & Substances	Values, Qualities, & Quantities	Emotions, Experience, & Relationships	Thinking & Communication
Things & Substances	15 (10, 5)	39 (27, 12)	7 (5, 2)	0 (0, 0)	3 (2, 1)	9 (0, 9)
Human / Animal, Body, & Senses	13 (6, 7)	208 (93, 115)	155 (58, 97)	69 (8, 61)	12 (6, 6)	5 (2, 3)
Activity & Movement	41 (22, 21)	11 (2, 9)	7 (5, 2)	99 (41, 58)	0 (0, 0)	9 (0, 9)
Space & Place	16 (8, 8)	23 (21, 2)	46 (31, 15)	98 (67, 31)	45 (39, 6)	0 (0, 0)

Table 4: Types of metaphors found in the congressional corpus. The total number is given, and in parentheses is the number of times *contagion* was found as a topic term and the number of times as a vehicle term respectively. Though sectors on the map are mutually exclusive, sentences may instantiate more than one metaphor.

Examining use of *contagion* as a topic-term of the metaphor – the part of the metaphor being understood or described – effectively looks at metaphors *about* contagion, as opposed to contagion *as a metaphor*. In these metaphors, there is a high degree of uniformity in the topic concepts – mostly comprising DISEASE – an example of biology's association between contagion and disease. The contagion concept is also found in other topics such as *Values, Qualities, & Quantities* and *Emotions, Experience, & Relationships*. These imply that contagion is not always used as a disease, but can be measured and personified – features not found in the biological domain. Notice that when the topic is *Emotions, Experience, & Relationships*, contagion is predominantly equated to space and place. This shows that financial contagion, when personified, is something local and present, as opposed to moving or spreading (as it is when used in *Values, Qualities, & Quantities*). Apparently, when measuring and examining contagion in finance, writers tend to focus on its movements, but when it is personified, it is in some way immobile.

Instances where we found contagion as a vehicle of a metaphor illustrate the way that it can be used to make sense of other concepts. Vehicle concepts range from common domains such as SPACE, TIME and MOVEMENT to more specific ones like WAR, BUSINESS and OBSTACLE (see examples in Table 3). In terms of root analogies, *Human / Animal, Body, & Senses* is a common vehicle domain for contagion. Here, metaphors liken institutions (banks, markets, countries, etc.) to organisms, presumably with the assumption that they can contract a disease. These metaphors have been found previously in similar contexts (Greco, 2009). Earlier, we found that financial and political language seldom explains how, or even *that* contagion is something to be contracted. However, in this metaphor, the association is made clearer: likening institutions and countries to living beings (animals and human) makes sense of concepts or entities conceived of as contagions.

4. General discussion

The term *contagion* has been adopted rather prominently in finance, where it describes problems that spread between institutions. The term's features relating disease (a problem) and its transmission (movement or spread) are defining elements of *contagion*. However, financial language focuses more on contagion itself, rather than using it as a property the way biology and medicine do. This finding raises the question: what exactly is contagious in finance? Our intuition is that the contagious entities are financial institutions, like banks, markets and governments, but this is not evident in language. There is significantly more discussion given to

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the scope, type and movements of financial contagion. Unfortunately, without a more technical analysis of the concept, a viable definition remains elusive. Such analyses of financial contagion do exist (Bae et al., 2003 for example), but the congressional document analysed here (used to inform international policy) does not adequately define *contagion*.

When it comes to a definition of financial *contagion*, the term is still ambiguous. Our opinion is that, like many figurative concepts, it will become increasingly well-defined until the metaphor is lexicalised. However, until significant discussion in finance is given to what separates a contagion from another type of problem, its definition will remain unclear. One defining feature of the concept is movement, but this is not enough to propose that a contagion in finance is simply a moving problem. The concept is more complex, instantiating scopal, agent, type and causal features. The grammatical constructions where *contagion* occurs are considerably more diverse than in biology and medicine. In the end, it appears that the figurative notion of *contagion* is where the term derives its communicative and explanatory efficacy.

5. Concluding remarks

To sum up, *contagion*, has evolved over the last 700 years as a term in science, especially in biology and medicine, but also in social science. It is now used to characterize the severity of economic downturns, identify the mechanisms of financial trouble and to consider solutions. It is crucial to note how the use of this disease metaphor redefines how financial phenomena are conceptualized and understood in light of global economics. It is not clear what motivated the use of this term, however apt. Was it to signify the gravity of a situation or was it to divert attention from inherent problems in the financial system? The use of metaphorical terms such as *contagion* should be monitored and analysed to determine their effects on peoples' understanding of why and how ideas and judgments propagate through financial systems.

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7. Notes

¹ Lakoff and Johnson's (1980) cognitive linguistic work refers to these metaphors as *conceptual metaphors*, whereas Goatly's (2011) corpus-based analysis calls them *root analogies*.

² http://www.scss.tcd.ie/~gerowa/contagion_corpora/; 1 October, 2013.

³ We use Lin similarity in WordNet – an information theoretic metric that incorporates entries' semantic distance and their respective information overlap (Lin, 1998).

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