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Invaders and Containers: Cognitive Representations of Biological and Particular Matter (bioPM)

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Abstract

Air quality management concerns the assessment, analysis and mitigation strategies associated with ensuring that air is breathable and non-toxic. Successful management is a cognitively intensive task, knowledge-focused and converges multiple sources of information to develop a shared understanding of a problem. To operate effectively in this space, managers and operational teams share common points of reference in discussing problems and solutions, strategies, tactical briefings, etc., and communication and technical language use are key to the discipline. However, few studies have homed in on the language communities of air quality management discourse, and fewer still have exploited this to gain insight into the cognitive processes underpinning salient operational knowledge production. This paper draws upon a discussion from a multi-stakeholder workshop on bioaerosols and the built environment and draws upon Cognitive Linguistics to systematically examine the cognitive structuring of those different stakeholder representations. This approach is then explored as a contribution to good practice in air quality knowledge management and communication that is consistent with studies on cognitive and learning science and has potential for policy formulation.

Keywords: air quality management; stakeholder perception; biological and particulate matter; knowledge production; communication; cognitive linguistics

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1. Introduction: Towards a 'Language' of BioPM

Environmental quality managers and affiliated operational and policy-making professions face mounting challenges due to the direct and indirect risks of global warming effects [1–3]. Indeed, the Intergovernmental Panel on Climate Change (IPCC) and many others continue to call for reductions in air-borne pollution and the mitigation of and reduction in other particulate emissions which enhance global warming [4].

Although the quality of air may have once been taken for granted, this no longer is the case in many parts of the world. Urban areas in particular are prone to large variations in air quality, with corresponding health problems from polluted ambient external and indoor air [5,6]. Urban air is laden with particulates from numerous sources. For example, a primary component of road traffic emissions is PM2.5, which is strongly associated with associated with lower cancer survival rates [7], and lower rates of neuro-cognitive development [8] in children, as well as a number of health impacts, including marked general increases in respiratory disease [9] and allergic infections across populations [10],

and cognitive decline in older people [11]. The study of air-borne biological and particulate matter (bioPM) is therefore attracting increasing attention from chemists, biologists, environmental managers, architects, construction engineers, politicians, urban planners and other stakeholders, converging with different perspectives on this broadly interdisciplinary area of interest [12]. The studies to date have made impressive inroads into furthering our understanding of the behaviour of air-borne bioPM. In particular, we now have a more detailed and nuanced understanding of both the dynamics of particulate flow and concentrations within indoor spaces [13,14] and their dispersal at the street level and between buildings in urban environments. This improved understanding, in turn, contributes to enhanced modelling by urban designers [15,16]. Moreover, the health impacts of air-borne pollutants, especially on neuro-cognitive and respiratory development and functioning, are well documented [8,11,17], and air quality is rapidly emerging as a concern across a number of the United Nations' Sustainable Development Goals (e.g., SDG 3 'Good health and wellbeing'; SDG 11 'Sustainable cities and consumption'; SDG 13 'Climate action'; and SDG 15 'Life on land') [18].

Research contributes to improving our understanding of air quality impacts, particulate dispersion and concentration patterns in indoor and external urban environments, along with the health impacts, particularly on children, of air-borne bioPM. However, we must now also prioritise the effective application of evidence-based understanding in order to optimise opportunities to mitigate the effects, while managing and adapting to escalating levels of air pollution [19]. Advancing the scientific understanding of particulate dynamics in interior spaces, the lifecycle of spores and associated allergenic consequences, and the fluid mechanics of air-borne bioPM in urban environments is a cognitively intense endeavour. It involves abstract concepts and attempts to apply these insights to the domains of policy development, public health communication strategies, regulatory standard specifications, and good disciplinary practice. Arguably, science about the causes and amplifiers of both external and internal air pollution and air-borne bioPM and the consequences and health impacts of these is by now well established [20,21], yet various tensions and conflicts persist, exacerbated by policy drivers such as those for energy efficient building and landscape design and construction. As a result, the evidence is suggesting that well-insulated and energy-efficient buildings themselves can pose health risks due to accumulations in internal air of various gases, such as radon gas [22], and promote the growth of fungi, with the potential to become air-borne [23,24]. In addition, in healthcare settings, experiments have shown that ventilation impacts on the concentration and size fraction of air-borne fungi [25].

Despite advances in science, what is required now is to progress the development of evidence-based policy and the methods for operationalising these insights. Mirroring knowledge exchange efforts in global sustainability science [26], a transdisciplinary consortium of activities is urgently required for aligning public health priorities with the reduction and mitigation of air-borne bioPM. For the purpose of this paper, a transdisciplinary approach is one that adopts a whole system approach to the communication of diverse stakeholder perspectives about a specific issue [27]. In the field of environmental quality management, this line of inquiry is still relatively uncommon, with a few exceptions (e.g., [28–30]). Despite this lack of attention, applying structured methods to systematically study how natural language is used can help demonstrate the complex weave of relationships between linguistic, social, cultural and cognitive phenomena. To this end, the current paper takes a step back from the science of bioPM to examine the conceptual systems used by stakeholders to theorise, operationalise evaluate, and communicate this science. That is, how do relevant stakeholders understand and make sense of the experience of air quality and air quality management?

Acknowledging the cognitive loading involved in knowledge exchange and good operating practices, this paper focuses on cognition and language in the context of stakeholder discussions about bioPM within the built environment. The aim is to generate insights into how stakeholders cognitively construe bioPM science and how this informs their responses prior to identifying potential policy and science communication implications. To achieve this, the discipline of Cognitive Linguistics is explored due to its theoretical maturity and empirical base. This affords a critical lens through which the conceptual representations and cognitive models engaged by stakeholders are examined.

Concern about air quality converges an array of subject fields, from fluid mechanics, thermal stratification, building physics and air pressure to dispersion dynamics and socio-technical systems, all within the wider systemic frames of cultural and economic interests. For scientific insights to be meaningfully applied by those with environmental quality management responsibilities, understanding the ways that practitioners and community stakeholders themselves think about, understand and translate scientific insights into practice is a field of study with a range of benefits [31]. The lens of linguistics and critical discourse analysis has been previously applied in a range of domains, including studies on how the challenges of climate change are articulated and what discourses are motivated within the United Kingdom's parliament [32], meanings framed within different sustainability communication strategies [33], sustainability transitions proposed by civil society and grassroot social movements [34], public health communication about the risks attributed to nitrates in drinking water [35], social justice and inequalities in air quality and respiratory health [36], and the situational logics of language in use in environmental politics [37] to name a few.

This study advances our insight into the coproduction of common knowledge and practice frameworks through the close examination of transcribed discussions sampled from an online workshop about air-borne biological and particulate matter (bioPM) in the built environment. This paper's contribution is to the theoretical base of knowledge and practice development already within the purview of this journal. In this paper, we take a step back to examine the processes involved in the coproduction of domain-relevant knowledge itself. How is salient knowledge generated and communicated? How are the concepts of microscopic particles articulated by communities of practice describing and accounting for the complex dynamics of the language in use among those communities? In short, how is domain-relevant knowing generated, and how are complex constructs understood and interacted with as this pertains to the management of microscopic scales of air-borne biological and particulate matter from the perspective of air quality management.

What can a language-based study offer the air quality management discipline? A growing number of studies across a range of disciplinary boundaries are recognising the value of using language to leverage insights into how people and social groups think and organise at varied scaled and across roles (academics, practitioners, and community stakeholders). This paper is a micro-scale analysis that tracks the accounts given by workshop participants in the cognitive construal of how they understand the interactions between perceptually invisible biological particulate matter, the built environment and public health impacts. These are, in effect, operationalised cognitive models mapping relations and simulating change as described by the stakeholders. The case study discussed here potentially lends itself to work in other disciplines too. As argued elsewhere, climate change and the wicked problem of sustainability (i.e., the Anthropocene) are each challenges to a way of thinking that no longer fits the data we are able to collect and make sense of concerning the state of our shared and common biosphere [38]. In this paper, we examine the cognitive construal of the complex

relationships between bioPM and the built environment. We detail the production of knowledge through the analysis of how these complex relationships are articulated by the participating stakeholders in the domain of air quality management through the analysis of a transcribed audio recording of stakeholder conversations.

This analysis describes how cognitive structures shape the articulation and operationalisation of understandings relevant to the complex world we find ourselves living in. Neurobiology constrains and determines the perceptual range of our experience, and these patterns are reflected in the way language is used. This is why a transcribed verbatim discussion of the stakeholders about bioPM and the built environment offers a unique point of entry into describing knowledge-generation processes, with potential applications for policy and knowledge management studies.

The paper is structured as follows: In Section 2, the discipline of Cognitive Linguistics as an empirically based transdisciplinary framework is introduced, and the key concepts are discussed. This contextualises the third section, in which the stakeholder workshop and the associated data set is introduced. This study comprises keyness and collocate analysis from Corpus Linguistics, and from Cognitive Linguistics, Structural Configuration and Conceptual Blending. These methods are explained at the point of use. Section 4 reviews the construal of salient bioPM concepts within the context of communication and operations, drawing on image schemata in terms of Structural Configuration and Conceptual Blending. This paper concludes by briefly exploring the implications for knowledge management and broader policy development.

2. Cognitive Linguistics: A Brief Overview

The application of Cognitive Linguistics to stakeholder discussions on air quality may require some justification for readers unfamiliar with or even sceptical about the approach. The rationale for doing so here is based on the recognition that language is not neutral; it reflects and shapes how people conceptualise and communicate issues. Numerous studies have demonstrated that people tend to reason through metaphors, often with reference to embodied perspectives (image schemas). Indeed, how an issue is framed may determine what solutions seem logical or acceptable relative to that framing. Consequently, how metaphors, frames and categories are used in policy documents may influence public perception, political action and stakeholder engagement. One of the contributions of Cognitive Linguistic analysis, therefore, is that it helps reveal latent assumptions held by policy makers and the public. In so doing, this may help reframe debates in ways that might contribute to developing new policy options, framed using accessible, relatable language that helps foster public comprehension and trust.

2.1. Fundamentals

Cognitive Linguistics is the study of patterns relating language, the mind (consciousness) and social and physical experiences as cognitive phenomena, on a par with memory, proprioception and so on. Evans [39] identifies three broad sub-branches to the field, i.e., cognitive approaches to *grammar*, with a focus on language structure and organisation; cognitive *semantics*, with a focus on meaning and knowledge representation; and cognitive lexical semantics (*pragmatics/stylistics*), with a focus on individual word meanings. The methods employed in this paper draw on the grammar and semantic approaches, and a very brief account of Cognitive Linguistics gives these ideas context. A branch of cognitive science with roots in biology and engineering, Cognitive Linguistics intersects with AI and computing, humanities, media studies and policy development and evaluation, and there is current interest in large language modules (LLMs) for training machine learning

applications. Its transdisciplinary character is one of its strengths, since most of what it means to be human in the modern world involves language use.

Cognitive Linguistics remains scientifically grounded by two commitments, these being the '*Cognitive Commitment*' to align analysis and theory with the current thinking in cognitive science and neuro-biology, and the '*Generalisation Commitment*' to understand linguistic activity as the outcome of "general cognitive abilities" [39] (p. 130). The generalisation commitment is underpinned by a set of assumptions, and Evans [39] (p. 131) identifies five, as summarised in Table 1.

Table 1. Five assumptions underpinning Cognitive Linguistics [39].

Assumption	Explanation
Embodied cognition	Perception is determined by the structure of our biology, that is, "the nervous system does not operate with a representation of an independent world" [40] (p. 208). Our knowing of the world is constrained by our neuro-biology and embodiment (i.e., embodied experience) and mental representations of what we take to be reality are rooted in mental states arising from our embodied experience (i.e., grounded cognition).
Encyclopaedic Semantics	Semantic structures (the representations of meaning in linguistic systems) "interface with representations in the conceptual system" [39] (p. 132), or, as per Cognitive Grammar, 'conceptual structures' [41,42]. Secondly, the thesis posits that conceptual structures are networks of structured knowledge. Meaning relies on access to a semantic encyclopaedia that is determined by the context of the specific usage-event. For example, the lexeme 'fast' can refer to qualities of speed and velocity (e.g., fast car, fast food) or it can refer to the cessation of eating for a period of time
Symbolic Thesis	Symbolic units are form-meaning pairings of grammatical constructions from morphemes, whole words to expressions. For example, the symbolic unit 'dog' has two poles, its meaning (a member of the canine species) and its sound, or phonology (i.e., '/d/ /ɔ/ /g/').
Meaning is Conceptualisation	Non-linguistic neurological processing contributes to most meaning that is linguistically mediated, through a process termed higher order 'conceptualisation' [39,43].
Usage-Based Thesis	"[K]nowledge of language *is* knowledge of how language is used", that situated instances of language use form for the language user the abstraction of symbolic units which comprises their mental grammar [39] (pp. 135, 134). In the context of the present study, the usage-based thesis offers insight into processes of operational decision-making by environmental quality managers and other stakeholders.

The in-depth study of language use offers opportunities to garner deep insights into how thinking is realised [44], realised in the "flow of thought, consciousness, discourse organization, information flow, attention, coherence, interactional patterns, epistemic stances, etc." [42] (p. 22). Indeed, when transcribed speech is studied systematically, it is evident that the "range of cognitive aspects [. . .] reflected in language use is extensive" [45] (p. 211). Attending to how ordinary conversations unfold leads to us obtaining insights about a range of cognitive processes. This paper applies two of these ideas, which are discussed next.

2.2. Applications

The analysis of language in use from a Cognitive Linguistic perspective enables us to make observations about how embodied cognitive structures shape how experiences are processed and meaning and knowledge are generated. In the present study, two approaches informed by the Cognitive Linguistic theory are used, i.e., *Structural Configuration* [46] and *Conceptual Blending* [47].

Structural Configuration—This is a communicative strategy wherein a speaker imposes a particular image schematic onto a scene, intentionally or not. Image schema are

cognitive primitives, likely developed before speech, concerning how perceptual elements are related and categorised. Often schema are carried by prepositions, such as *in* connotes a container, a bounded space with edges, while *on*, refers to the interaction of at least two surfaces, suggesting a force schema [48], which connotes the character of relationships among elements. This perspective represents how the world of experience is structured as primitive forms and categories [46].

In Cognitive Linguistics, as noted above, a core assumption is that of embodiment, and the experience of being embodied gives a perspective of the world. Over time, these experiences of the world from one's own unique perspective are condensed as a representation of one's body in interaction with the world. The phenomenology of experience is embodied in image schemas [49], a process termed Structural Configuration or schematisation, through which "a particular image schematic representation [...] constitutes our basic understanding of the internal structure of an entity, event, situation or relation", pertaining "only to such structural properties of the scene as topology, sequence and causation" [46] (p. 111). Indeed, image schemas are at the heart of conceptual mapping from one domain to another and underpin the blending and mental space theory, which is to be considered next.

Conceptual Blending Theory—Drawing from earlier work on mental spaces as semantic units connected with networks of association, Conceptual Blending studies the creation of novel concepts and linguistic accounts of these in the context of use. Language analysis attends to the salience of inferences and information, for example, in the context of social activities, "about the goal of particular actions in [the listener's] comprehension of sentences" [50] (p. 58). Meanings are generated online (in real time) and involve the linking structures of inference networks and the integration of mental spaces.

Previous applications of the Conceptual Blending theory to social–ecological system management discourses have demonstrated that the insights of this approach can determine how conceptual systems are assembled and maintained [51,52]. These insights inform the development of practices and team cultures, the shared way of tackling problems, workplace expectations and private or personal lives. Towards the end of this paper, the broader relationship between bioPM and the built environment is mapped using Conceptual Blending to demonstrate the structure of single concepts and how blends operate at the meta-level across conceptual domains [47,53].

2.3. Concluding Remarks

The rich potential of situated language use as a means to examine our embodied cognition cannot be overstated. Cognitive Grammar posits that language can be analysed to determine multiple online processes that are analogous to neuroscientific phenomena. For example, the construal of concepts involves categorisation (what is being construed, how are construals differentiated or grouped together, etc.?). However, what is categorised also depends on what is 'profiled' or attended to, which involves gestalten and figure-ground organisation (a subject or object and what is being done?), and this invokes conceptual archetypes (e.g., nouns, events, actions, and parts of speech) and positionality (deixis and perspectives) and image schemas. However, there are also significant automated ritualised preformed chunks of language (e.g., "how are you?" and "I'm fine, thanks"), which form social behaviours (e.g., cliques, speech habits, and sociolinguistics). The analysis of language usage is a potentially rich topic to explore, but this section can only provide a brief introduction.

This paper draws on Cognitive Linguistic tools to empirically explore the variable and multi-layered, nested relations among meanings, word forms (i.e., lexemes) and grammatical properties that comprise speech as transcribed in the body of data under study.

In the next section, the study materials, the corpus and the two analytic methods employed are introduced and discussed.

3. Materials and Methods

The data set for the present study is an anonymised orthographical transcript of audio-recorded discussions among 28 participants in an online workshop on bioPM and the built environment. This was held during 'Lock-Down' in 2020 as part of a wider UKRI (United Kingdom Research Institute)-funded networking project (BioAirNet), the aim of which was take a transdisciplinary approach to understanding the complexity and connectivity among people, BioPM exposure and the resultant health impacts and the indoor-outdoor continuum [54].

For the purpose of this paper, transdsciplinarity is seen to have three central components: The ability of stakeholders (academics, practitioners, communities, etc.) to think systemically and to collectively generate a holistic interpretation, but not necessarily a consensual one, of a complex phenomenon. To communicate these diverse viewpoints and to develop an empathic appreciation of other views. And finally, to 'learn from the future' through brainstorming on those views and associated future casting [27].

Ethical approval for this work was obtained by the funded institution, and all the participants consented to the use of the anonymised recordings for future research. The workshop was designed to include a wide range of stakeholders who had direct or indirect involvement with air quality research, and specifically bioPMs as they relate to the built environment. The workshop participants were drawn from the architecture and landscape design field; the construction supply chain; environmental management and administration; community problem-solving groups; and qualitative, environmental- and engineering-based research disciplines. The audio recordings of the workshop were transcribed using AI speech-to-text software, and the draft transcripts were subsequently corrected manually in conjunction with the audio recordings. Names and other identifying content were removed to ensure the anonymity of the participants.

This study draws on two main analytic approaches. The first uses techniques from corpus linguistics, and the second applies two corpus linguistic methods. In the first corpus linguistic approach, the first step is to ascertain the unique profile of the data being studied, the focal corpus. To do so, the focal corpus was analysed using the 'Words' tool in the #LancsBox suite of corpus linguistic software [55]. This determines the statistical frequency of words in the corpus when compared to a reference corpus, here the spoken component of the British National Corpus (sBNC) 2014. This produces a list of key words that are statistically unique to the focal corpus, which are then used deductively in collocation analysis. Collocation analysis, also adopted from corpus linguistics, identifies the part of the lexical network of words found to characterise the focal corpus and does so through measures of associative strength. The findings give analytic insight into locally salient concepts and their meanings according to the context within which they are used by speakers.

The second of the two main approaches uses two methods drawn from Cognitive Linguistics, i.e., Structural Configuration and Conceptual Blending, both of which were briefly introduced in the preceding section. The first of these, the Structural Configuration of the corpus, identifies the discursive strategies that structure how the basic semantic event is construed and organised using particular image schematic representations. These representations are understood to be "abstract, holistic knowledge structures distilled from repeated patterns of experience during pre-linguistic cognitive development" [46] (p. 112). These are not images per se, but are conceptual abstractions formed from the perceptual experiences of scenes that appear to share structural

commonalities and arise "in basic domains of experience like action, force, space and motion" [46] (p. 113). Some common examples of image schema concern change and movement, and an event may be described with reference to a force that is said to 'drive' or 'motivate' a change in the perceptual field. In such a way, one might be said to be 'driven' by ambition, or experiencing work 'pressures'.

The second of the Cognitive Linguistic methods is Conceptual Blending [47], which refer to the development and dynamics of mental spaces. These spaces are conceived of as "conceptual structures which facilitate the discourse process" [56] (p. 118). The core concepts of concern for the bioPM stakeholders, such as the built environment and air quality assessment and management, will be explored as blends forming a semantic network presented schematically.

A brief note is warranted to differentiate the approaches taken here from those of the more traditional qualitative methods, such as thematic analysis, which are useful for small data sets, such as the one used here. The fundamental difference is that thematic analyses, while very useful in identifying and bringing to the fore subtle and often implicit discursive themes, does not claim to reflect cognitive processes and structures, and so has little to offer analyses that seek to explore the processes whereby knowledge is coproduced among groups of stakeholders. As this is the focus of the present study, an approach that affords a more in-depth account of such processes is therefore favoured over those that describe discourse and even power operations within a given domain of knowledge and practice.

The next section introduces and describes the study corpus, discussing it from the perspective of corpus linguistics initially, and then through Cognitive Linguistics.

4. Results

This section briefly introduces the focal corpus comprised of transcribed audio recordings of discussions with the stakeholders during the online workshop on biological and particulate matter (bioPM). The corpus itself comprises 10,011 tokens (the total number of words), 1554 types (the total number of different words) and 1411 lemmas (root word forms), resulting in a Type/Token Ratio (TTR), obtained by dividing the types by the tokens, of 15.5%, which suggests a reasonably high degree of lexical variation.

4.1. Corpus Linguistics

The first part of this section discusses the findings from the use of the corpus linguistic methods, keyness and collocation analysis.

4.1.1. Keyness

The first stage of this corpus linguistic analysis is to identify the words in the bioPM corpus that occur more frequently than when compared with the spoken component of the British National Corpus (BNC) 2014. The latter is a corpus comprising over 100 million words and contains several sub-sections, one of which is natural speech. This sub-corpus (sBNC) is a relevant point of comparison to evaluate the relative significance of the words used in speech by the workshop participants. The first thirty of the statistically significant words are summarised in Table 2. The value of this comparison is to gain insight into how the focal corpus is unique and suggest the 'keyness' or topic/thematic profile of the focal corpus [57]. The statistics show that given the frequency of the words in the focal corpus compared with their frequency in the reference corpus per total number of words in each corpus, in the focal corpus, the words are more frequent, and hence significant.

Table 2. 'Keyness' of focal corpus when compared with spoken BNC (sBNC) 2014.

Index	Type	Freq (bioPM)	Freq (sBNC)	Statistic
1	health	27	556	18.223
2	air	28	831	16.099
3	pollen	15	21	15.667
4	information	23	609	15.118
5	guidance	13	20	13.722
6	indoor	13	22	13.696
7	impact	14	113	13.515
8	construction	12	52	12.368
9	buildings	13	176	11.961
10	building	23	1053	11.91
11	user	11	24	11.717
12	quality	16	470	11.695
13	knowledge	12	222	10.701
14	industry	12	226	10.668
15	outdoor	10	55	10.437
16	impacts	9	7	9.923
17	ventilation	9	10	9.895
18	communicate	10	117	9.877
19	sources	9	41	9.611
20	keen	11	304	9.275
21	workshop	9	81	9.268
22	environment	10	213	9.12
23	stakeholders	8	5	8.948
24	housing	9	180	8.516
25	trees	11	425	8.509
26	document	8	96	8.231
27	network	8	148	7.871
28	link	9	294	7.788
29	evidence	8	172	7.715
30	research	12	725	7.651

From the data summarised in Table 2, it is evident that when compared with the spoken sub-corpus of the BNC 2014, the statistically more significant terms in the focal corpus correspond to topics that one would expect to find in stakeholder discussions about air-borne biological and particulate matter. These concern topics such as (public) health, the built environment, pollen—including levels and sources—and air flow characteristics, all of which are statistically less likely to be concerns of everyday language users as per the reference sub-corpus. Consequently, these are statistically significant lexemes for this corpus and collectively characterise the study corpus as having an 'aboutness'. Space constrains this discussion to consider fifteen key words only, viz. 'health*', 'air', 'pollen', 'information', 'guidance', 'indoor', 'impact*', 'construction', 'building*', 'user', 'quality', 'knowledge', 'industry', 'outdoor' and 'ventilation'. Note the use of the wildcard ('*') for searching the variations of a word (e.g., 'health*' will also return 'health', 'healthy' and 'healthier').

4.1.2. Collocation Analysis

The strength of association between the node (key word) and its collocates can be calculated statistically. For each of the key terms from Table 2, the log likelihood (LL) measure of association was calculated to identify the words with which the node is most familiar. The LL has a significance threshold of 6.63. The meanings of the words arise within the networks or linguistic contexts of use. This is not only the thesis of the Conceptual

Blending Theory (CBT), but reflects the thesis of encyclopaedic knowledge. Arguably, the meaning of words will be known by the company the speaker keeps [58].

Using the Collocation Parameter Notation (CPN) format for reporting collocation output succinctly, as proposed by Brezina [59], the output from collocation analyses usually reports the parameters used in calculations, and for collocations, the following are noteworthy: the statistic used (here, this will only be log likelihood) the cut-off value of the statistic (here, >6.63), the span of the window to the left and right of the node (here, L5 and R5 words each), the minimum frequency with which the collocate appears in the corpus (here, this is five times), and the minimum frequency with which the collocate term collocates with the nodal term to be significant (here, this is one). Finally, further analytically salient notes can be appended to the 'Filter' section.

Table 3 separates the collocates from the colligates, the latter reflecting common associations between the node term and grammatical 'function' words, such as 'the' and 'a', among many others. In text mining, these are often referred to as 'stop words', and algorithms are used to exclude them from analysis. However, in Cognitive Linguistics, these types of word function as 'Cognitive Grammar' [41,60], which will be explored further in the following discussion about Structural Configuration.

Table 3. Collocates for key words (* indicates a 'wildcard').

Row ID	Key Word	Collocates (Nouns, etc.)	Colligates (Grammatical Markers, etc.)
1	health	being, well, we, i	and, the, of, in, at, on, a
2	air	quality, indoor, pollution, outdoor, we, know, i	in, the, and, is, of,
3	pollen	tree, pollen	the, and, in, what, a
4	information	just, it's, i, we	the, of, and, to, that, a,
5	guidance	be, you	to, the,
6	indoor	air	the, and
7	impact *	health, i	the, on, to, of, in, that
8	construction	industry	the, is, and
9	building *	Building, how, i, we	a, and, of, the, to, in, for, not, that
10	user	end	the, to
11	quality	air	a, and, of, the
12	knowledge	NA	and, to, the
13	industry	construction	to, and
14	outdoor	air	the, and
15	ventilation	NA	a

In Table 3, row 1 (T3:R1), for the key word 'health', there are four collocates and seven colligates. Intuitively, patterns can be discerned linking the nodal term 'health' with 'well' with 'being' via the colligate 'and' in the phrase 'health *and* well being'.

This can be confirmed by n-gram analysis (the words that combine in more complex phrases, e.g., 'air pollution' is a bi-gram), which shows a preformed 'chunk' phrasing 'health and well being'. These preformed chunks of ritualised meaning are called topoi, and language is replete with these. This is a well-established pattern of co-occurring as part of the common lexicon. Similarly, the case of pairings of 'air' (T3:R2) with significant associates, such as 'quality', 'indoor', 'outdoor' and 'pollution', are to be expected given the context. However, in T3:R7, 'health' is again referenced, but now as a collocate with 'impact'. It is, in effect, an object to which unspecified force is applied. The colligate 'on' confirms this relationship between force and a point of contact with a cognitive structure that evokes an image schema to index a 'surface' characteristic of the abstraction 'health'. These dynamics are revisited in the analysis of the image schema invoked by different nouns and verbs.

A review of the collocates in Table 3 therefore conforms with a 'sanity' check; one would expect to see these pairings in a corpus of this nature. Of interest from a Cognitive Linguistic perspective are the colligates and how these depict the topology, causation and sequences that evoke relationships among nouns and verbs, cognitive representations and conceptual models. These are discussed next.

4.2. Cognitive Linguistic Analysis

This sub-section discusses the findings from the two Cognitive Linguistic methods—Structural Configuration and Conceptual Blending.

4.2.1. Structural Configuration

Some examples of Structural Configuration can be found in the focal corpus, and to see these more clearly, analysis began with a review of the nouns. Nouns are a useful entry point for understanding the Structural Configurations of key, albeit abstract, concepts and relationships within the stakeholder discussions about bioPM. The focal corpus contains 1212 unique noun forms, many of which are repeated frequently throughout. Table 4 presents the first 15 of these in descending order of frequency (* denotes a wildcard, which reflects variations in the root word form).

Table 4. Fifteen most frequent nouns in bioPM corpus (* indicates a 'wildcard').

Noun	Count	%
people	63	5.2
thing *	42	3.47
lot * (as an unspecified volume/quantification of categories)	39	3.22
sort of	37	3.05
build *	36	2.97
air	29	2.39
something	28	2.31
Problem *	24	1.98
way *	23	1.9
year *	21	1.73
pollen *	18	1.49
tree *	18	1.49
end (65% collocated with 'user' as the bigram 'end user')	17	1.4
point *	17	1.4
quality	17	1.4

The "prototypical semantic values" associated with major word classes are that nouns "designate objects, verbs designate processes (and states), adjectives designate properties (of objects), while prepositions designate relations (especially spatial relations) between objects" [60] (p. 168). Because nouns connote distinctions or categories into which the phenomenology of a lived experience is 'sliced' into object categories of 'thing', 'idea', 'place', and 'person' [61,62], identifying nouns as designated objects in speech determines the non-human elements in the speaker's 'speech world'. Table 4 lists a sample of these.

Returning to Table 3, the colligate column lists the prepositions that describe three dimensions of a relationship, viz., location, movement and time/temporality, with an additional uncategorised cluster, as summarised in Table 5.

From Table 5, we notice several prepositions in common with the colligates in Table 3. In Table 3, there are three prepositions that elicit spatial locations, viz., 'at', 'on' and 'in', and each of these collocate with the nouns 'air', 'building*', 'health*', 'impact*' and 'pollen*' (note the wildcard). While preposition use is frequently fixed as a composite and idiomatic

phrase (e.g., 'in the nick of time') and are, in themselves, less noteworthy, prepositions also cluster to form 'contrast sets' that describe spatial relations, e.g., 'above', 'over', 'under' and 'below' [63] (p. 345). Of the prepositions in the collocate list, 'in' and 'on' suggest spatiality and collocate with the key terms 'air', 'building*', 'health*', 'impact*' and 'pollen*' and were discussed with reference to Table 3. On the other hand, 'on' collocates with 'health*' and 'impact*', suggesting nouns with characteristic surfaces that afford support or resistance.

Table 5. Single-word prepositions and relations with space, movement and time.

Relationship	Single-Word Preposition
Location	above, at, by, below, between, in, on, out, over, under
Movement	across, around, down, into, past, through, to, towards, up
Time/Temporality	after, at (specific time), before, during, in (month/year), on (day), since, until
Other	about, as, by, for, from, of, with

Each preposition involves a concept of a bounded space; for example, as noted earlier, for some phenomena to have an 'impact on' something, the preposition invokes a surface contact, while a pollutant is said to be 'in the air', eliciting a schema of a container, a schema with sides, an interior and an exterior. Similarly, one goes 'into a building', while the preposition 'at' invokes a schema of a boundary or limit point, such as the period is 'at the end of the sentence'.

For the purpose of this study, the preposition 'in' is examined for the nouns it collocates with. The term itself is used 145 times in the corpus, and of those uses, it collocates most closely with 'the' (n = 32 or 22% of the occurrence of 'in'), denoting a definite article, a noun presumed to be familiar to the speaker's audience. According to this analysis, 'the' collocates most favourably with 'in' with an LL = 307.584, almost twice as high as that of the next most significant collocate 'and' at 168.203. This suggests that when 'in' is used, it will commonly be within the wider context of a definite article, and some degree of familiarity on the part of the audience appears to be assumed by the speaker.

The terms collocated with 'in the' two or three times each are 'air', 'development', 'house', 'impact', 'outdoor', 'real world' and the 'UK'. The term 'air' collocates with 'in' and 'the' seven times, and in such collocations, 'air' is structurally configured as a container image schematic given a common reference, i.e., in the air. Even though 'air' has no boundaries as an object, its existence is postulated as a medium that can and does contain particulates. While 'in the air' represents a container image schematic, given the omnipresence of air as a medium, one is immersed in air; in itself, this Structural Configuration is not remarkable. But this does bring to light an interesting pattern. The collocation of 'in' as a default containment image schema with 'the'—a marker of definite nouns, known or common points of reference—constitute a bi-gram 'in the'. Directly, the bi-gram references nouns as container-like constructs able to hold other unities and processes, or to differentiate a boundary between inside and outside, supporting the calculus of indications as drawing of distinctions as boundary markers [64,65].

However, even in the absence of coupling with 'the', the preposition 'in' is also prevalent in collocating with nouns referring to homes, houses, social housing and buildings. But this raises the question of what the references to containment actually involve. Also, upon closer examination, there is a sense of something crossing the boundary markers of the containment image schemas, as these samples illustrate:

> "Moulds, and the pollens, how do they, **in** a new house get **in**to our house";
>
> "And the moulds and everything are getting **in** as well but what actually happens when";

"It might be pollen did crop up **in** there, when we spoke about it, it's";

"Or not sealing the building, letting air **in** when we've don't know the outdoor sources";

"Tree over there, and the pollens coming **in** your house and causing this person to".

These concordance lines invoke images of boundaries being transgressed, of something (pollen and biological and particulate matter) that is difficult to control and that violates the integrity of bounded spaces in some way. There is even a hint of anxiety in phrases that speak of the unknown coming into one's house along with the air one chooses to let in. There is also a sense of confusion about how pollens move into one's home in the first place. These intruders are accounted for as stealthy, mysterious and even vaguely threatening.

In addition to the buildings as containers, a second image schema can be discerned that describes the locomotion of air-borne bioPM. Something traverses a path, or more precisely, a source–path–goal schema; this is the fundamental way in which elements move. The path is a "means of moving from one location to another [and] consists of a starting point or source, a destination or goal, and a series of contiguous locations in between, which relate the source and the goal" [66] (p. 135). In the accounts of the stakeholders' conversations, buildings are what are referred to as 'landmarks' (i.e., kept stationary), while motile bioPM is termed 'trajectors', something that can move about in space. Diagrammatically, this relationship can be shown as per Figure 1 and can be applied to model boundary crossings, whether abstract change in variable measures across scales, or wind blowing through an intermediary physical space, such as an entrance hall.

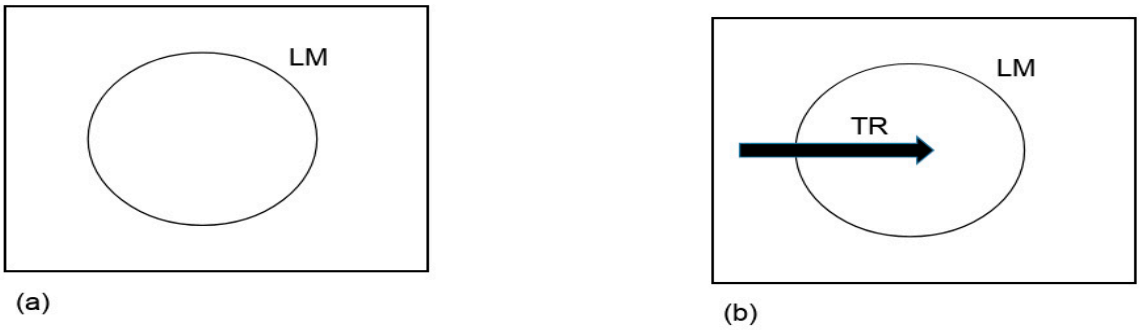


Figure 1. Landmark and trajector elements describing the source–path–goal image schema.

In Figure 1a, the landmark (LM) represents the built environment (i.e., houses, homes, and offices) depicted as a closed container. In Figure 1b, bioPM is depicted as a trajector (TR), and no force is nominated, so the arrow is not connected to any specific source. The TR starts 'outside' the LM at the beginning of the path, but stops, having crossed the boundary, inside the LM. This is consistent with the characteristics of containers, which comprise an interior that is separated from and kept apart from the exterior by means of a boundary. The basic property of the containment image schematic is that elements can be either included or excluded, and for the stakeholders participating in this discussion, air-borne bioPM is construed to be kept beyond the boundary marking the interior space. This interpretation of containment could be extended to consider boundaries that are external to buildings, i.e., the path alongside a busy road on the way to a school or vegetation that incorporates species that are harmful to a minority of the population.

The image schema of buildings as containers suggests a protected or defensible space, one that clearly differentiates what is inside and proper from that which is also inside, but is foreign and unwanted. These spatial relationships, the demarcation of boundaries as a

fundamental organising distinction between "two structural elements, the interior—the area within the boundary—and the boundary itself" [63] (p. 181), illustrates the many ways that as Hart argues, cognition makes use of "common, underlying forms of representation [that are] constitutive of linguistic knowledge or meaning" [67] (p. 182). The Structural Configuration of the interactions between bioPM and the built environment has been modelled with reference to bounded spaces and the movement of bioPM with which the stakeholders are concerned. In the discussion among the stakeholders, the motility of air-borne bioPM potentially violates the boundaries of contained spatial areas, coming into sealed buildings in mysterious or stealthy ways. These relations are explored further in the following section from the perspective of Conceptual Blending.

4.2.2. Conceptual Blending and Semantic Network Mapping

This is the second of the Cognitive Linguistic methods used and relates very closely to Fauconnier's earlier work on mental spaces, which Hart [46] (p. 113) describes as "conceptual pockets which continually open up and close down as discourse unfolds". In this section, the analysis foregrounds the mental spaces of the built environment (homes, housing, buildings, etc.) and the bioPM contents of the air, both indoors and out. In the stakeholder discourse studied here, these two cognitive representations are engaged in an on-going dynamic, tension due to keeping pollen and air-borne bioPM out of buildings.

The conceptual framing of buildings, especially homes, likely invokes myriad references to and associations with feelings of safety and security, a defensible space and even a sovereign domain (one's home is one's castle) and are therefore at the deictic centre from the speaker's perspective. In this mental space then, buildings are (leaky) containers, while pollen (and other bioPM) is construed as an invisible (stealthy) invader or intruder, characterised by its capacity to enter contained spaces, both indoors and out, and evade detection. Once inside the containment area or boundary, human occupants are often oblivious of its presence until the formation of mould or the release of pollen is triggered with potentially significant allergic and other health-related effects on the occupants. Even the lifecycle of pollen itself becomes ominous, described as lying dormant for extended periods of time until triggered by moisture, at which point the grain releases its pay load, initiating the allergic sequence as a health impact. In several of the excerpts, there is a sense that something undesirable has penetrated the contained spaces of the built environment and is occupying that space.

The following quotes illustrate this perception (added emphases to show the movement and transgression of boundaries):

(a) "Not only is that sort of pollution getting into my house but the aero biologicals and the moulds and everything are getting in as well";

(b) "In a new house get into our house";

(c) "Mould was rampant";

(d) "Trying to stop mould growing";

(e) "Letting air in";

(f) "Light grass pollen and birch tree pollen can attach themselves to people, and actually be transported into the house";

(g) "If it's taken into a house and it's kept dry. It can stay there for years";

(h) "You can bring outdoor pollutants like biologicals indoors, and along with the moulds as well".

In the Conceptual Blending Theory, these ideas can be represented dynamically as a process of concept development and blending and diagrammed, as in Figure 2.

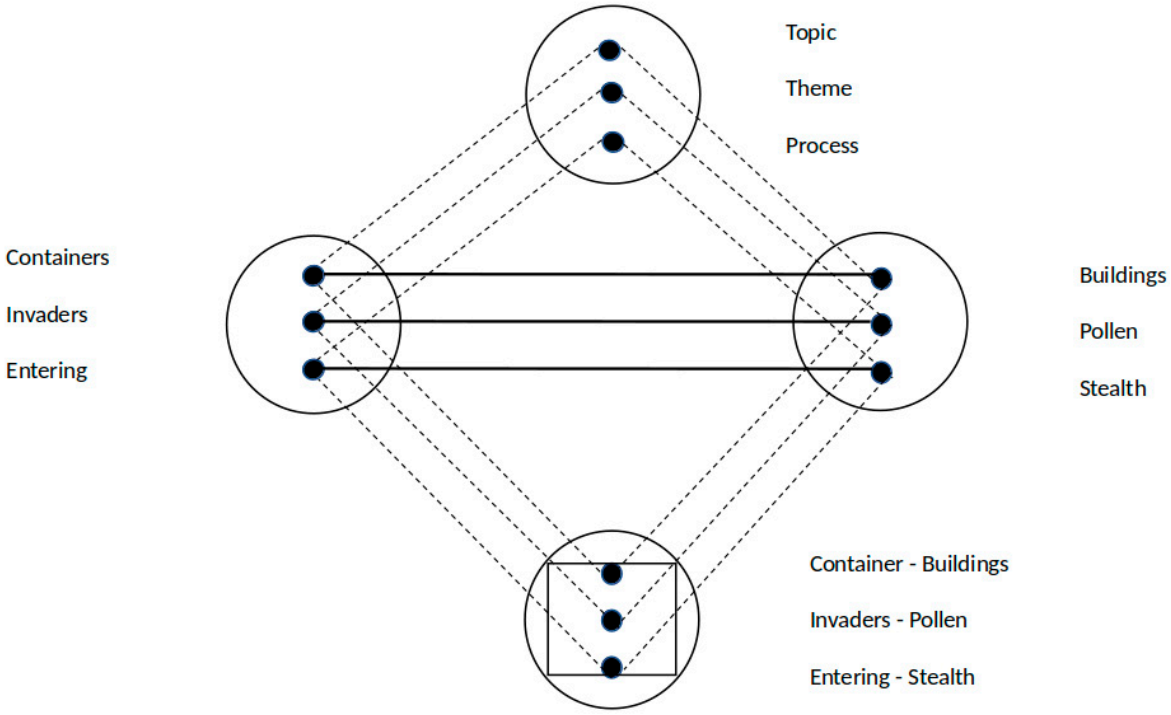


Figure 2. Conceptual Blending network for interaction of "buildings (as leaky containers)" and "pollen (as stealthy invaders/ intruders)".

The CBT considers sampled semantic units (e.g., metaphors and concepts) as a "conceptual projection involving four mental spaces", which can be represented diagrammatically in "notation based in mathematical set theory to represent mental spaces and conceptual blending patterns" [56] (p. 109). The four spaces comprise a generic space (comprising the 'templates' Topic, Theme and Process), two input spaces (here, comprising 'Containers' as the Topic; 'Invaders' as the Theme; and 'Entering' as the Process on the left of Figure 2, and 'Buildings' as the Topic; 'Pollen' as the Theme; and 'Stealth' as the Process on the right), and a blended space which shows the blending of the two Topics (i.e., 'Containers' and 'Buildings'), the two Themes (i.e., 'Invaders' and 'Pollen') and the two Processes (i.e., 'Entering' and 'Stealth'). New input spaces are generated when the concepts and ideas discussed require different grounding or background assumptions [47]. The generic space comprises an abstract structure that inputs share and which can be projected onto the counterpart elements of the input spaces, as well as the blended space. The final space, the blended space, is the product of Conceptual Blending and is an emergent structure formed from both the input spaces. This emergent structure is diagrammatically represented by a box inside the blended space. In CBT diagrams, the use of dashed lines connecting the elements denotes the conceptual projections that span the network as pairings, analogous to Hebb's law of neuronal coactivation and bindings, summarised axiomatically as 'neurons which fire together, wire together' [68,69]. The emergent structure is the result of three processes, i.e., 'composition', which when it comes to metaphors, the composition process is 'fusion' involving the projection of counterpart elements in the input spaces. These are projected onto the blended space, while the topological relations among the counterpart elements are conserved in the blend. The second process, 'completion', refers to how the background (or 'encyclopaedic') knowledge associated with the elements in the input space informs and contributes to the generation of meaning and understanding of the words used in discourse. Finally, 'elaboration', considered the most significant process in blending, is effectively the 'running' of the blend as a simulation and represents the cognitive work

performed on the blends in terms of reasoning, drawing inferences and the triggering of affective associations.

Figure 2 depicts a network model comprising the four relevant 'spaces' outlined above. At the top is the so-called 'base' or 'generic' space, which relates to the generic properties of the elements in both the input spaces. These are generically given as the 'Topic', the 'Theme' and the 'Process', which refer to the agent (or subject) that is acting upon the subject and what is being enacted, respectively. Next, there are two input spaces, the first on the right is populated with buildings, pollen and stealth, which elicit, in the left hand input space, the image schemata of containers, invaders and locomotion.

The locomotion image schematic describes the manner of movement attributed to pollen, which is 'entering' from outside to inside across a boundary threshold (see Figure 1). In the corpus itself, these are accounted for by verbs and adverbials, such as 'getting into', 'letting in' and 'taken in', with pollen 'attaching itself' so it is carried, and so on. These are linked by the solid lines, which represent counterpart mapping between the elements in the two input spaces. The dashed lines represent co-activation bindings. The final space at the bottom of Figure 2 blends the two input spaces as a map between the image schemata and the topic, the theme and the processes of both the input spaces. This single blend cognitively models the movement of air-borne bioPM into enclosed (indoor) spaces as an invasion, encroachment into interior domains that are construed as correspondingly defenceless.

Because biological and particulate matter are, for the stakeholders in this discussion, unwanted and are associated with health problems, buildings and indoor spaces as construed as at risk from invasion. Indeed, the invader element in the input space appears to be activated by the more general conceptual frames that link to semantic networks and enlist the encyclopaedic knowledge of invasion, of being stormed by an enemy and having to be on the defensive. This blend is elicited through the inferences that invading pollen is an external enemy overcoming defences and taking over or colonising indoor spaces (see Figure 1 and the TR and LM configurations). The emergent structure in the blended space shows three counterpart elements from the input spaces fused together, yielding an emergent structure in which buildings are conceptualised as containers under threat from stealthy invaders that once inside, have the potential to release biochemical pay loads with potentially serious health effects.

A shown in Figure 2, the blending process produced an emergent model of meaning accounting for the movement of pollen from trees and other flora into buildings that, despite being construed as container image schema, are nevertheless 'leaky'. This diagram charts the shifts in the construal of the two main Structural Configurations favoured by the stakeholders in this discourse: buildings (i.e., houses and homes) and air-borne bioPM. The blending process in Figure 2 describes a semantic network, which integrates underlying knowledge structures in the creation of meaning. As Evans [66] (p. 168) notes, Conceptual Blending "works by selecting specific elements from each of [the] bodies of knowledge [bioPM and built environment]", and the respective counterparts are integrated into the final blend through a process of compression. The process of Conceptual Blending is an attempt to make sense of the relationship between air-borne bioPM and the built environment. The understanding arises from the manipulation of two different bodies of knowledge, i.e., bioPM and buildings, that must be integrated as part of the cognitive processes of conceptual representation. In brief, Conceptual Blending enables speakers to "reduce great complexity to the scale of human experience" [56] (p. 175) and generate mental models about complex relationships and events. Here, the blend simplifies the model of an inside area to be guarded from stealthy invaders coming in from outside, potentially bearing payloads causing health impacts.

5. Discussion and Conclusions

The analysis of language in use, informed by Cognitive Linguistics, seeks to identify the prompts or markers for a range of conceptual processes. For example, how are the ways of talking about bioPM by stakeholders linked to the construal of salient concepts and relationships? That is, what conceptual representations are encoded in stakeholder discourse about bioPM and the built environment? This final section discusses the generation of concepts describing the relationships between the interior and exterior built environments and air-borne biological and particulate matter in terms of the blended space theory.

As expected for a workshop about air quality and the built environment, there was much talk about the inside and outside of buildings and the transfer of biological and particulate matter across the boundaries demarcating these exclusive spaces. This talk is rich in its emphasis on a container schema. The spatial prepositions 'in' and 'out' and variations of these predominate throughout the corpus studied and reference the 'indoor' and the 'outdoor' environment as distinct spatial locations. The nature of what separates these two environments was also a frequent topic of conversation, and these boundaries were ascribed a range of adjectives.

For example, the quality of these boundaries determining containment ('indoor environment') and exteriority ('outdoor environment') are generally considered 'leaky'. Some stakeholders maintained that buildings (specifically homes and houses) possessed certain characteristics or abilities, such as promoting good health and wellbeing, or being of a certain quality of character that one might advocate on its behalf (e.g., well built or constructed to a high standard). In other accounts, several stakeholders referred to buildings as having a poor character and quality, having been built at a low cost, being shaped by expectations of profit, and of being of low-quality as a result of a dearth of skills in the UK, with the sector described by one stakeholder as akin to the 'Wild West'. The metaphors favoured in such accounts are italicised, suggesting spatial metaphors for value (up is good/down is bad), that skills (and knowledge) are quantifiable and that the building sector in the UK is lawless, or at least poorly regulated.

Unsurprisingly, bioPM generally and pollen specifically were described as invaders (which suggests topoi of threat and risk), intruders and substances that 'got into' or were 'transported into' houses, even though the point of entry for such invasions were not well articulated, giving the impression that such particles exhibited a capacity for stealth. Indeed, the stakeholders spoke about how pollen can attach itself to people or animals, and is thereby passively taken indoors, where it can lay dormant for extended periods until it becomes wet, and thereafter becomes allergenic. These are expressions of how the participants construe and describe bioPM in the context of indoor and outdoor air quality. Not only do these expressions suggest particular conceptual representations and mental models, but the language used itself shapes these construals. Pollen, mould and other bioPM are not thought of like invaders; these are not similes or prosaic turns of phrase. Rather, these particles are invaders, and in such construals, must be responded to as such.

Arguably, from a sociological and cultural perspective, the identification of intruders and invasions, the need to keep something out, is well established, and such construals invoke encyclopaedic knowledge associated with being invaded from the outside (e.g., the Roman Empire under siege from the "Barbarians at the gate", denoting threats from outside the realm). Arguably, those deemed harmful to society (e.g., criminals) are excluded from, kept out, of mainstream society; borders control the illegal movement of people from one place to another; bodies are protected from infection by viruses; and so on. In the corpus studied here, for example, the stakeholders spoke of developing specific tools to identify invasive pollen and other bioPM and of generating guidance

and information for the public on how to spot and deal with such 'invasions' of bioPM into homes and the built environment.

One can argue that the schema of invaders that people need to be protected against is an archetype, a representation of a more abstract dynamic that demonstrates a remarkably and reliably good fit, and maps onto the more general 'intruder' schema. As such, it is an induced schema, one that "sanctions the analogy" of pollen and biological particles as invaders "at a very high level of abstraction" by "ignor[ing] the technical aspects of each domain" [70] (p. 20). That is, pollen particles behave the way that they do as part of a (birch) tree's reproductive cycles, and for which the characteristic of being light enough to be carried by air is a clear advantage for species reproduction. This is an affordance for pollen in one way, but it clashes with the belief characterised by people living in houses who need that same air to survive and who in the course of living will open windows and doors. The house (walls and doors) becomes, in effect, a border line across which pollen may travel, but for those who suffer allergies, such transgression is a source of considerable discomfort or worse, and this is represented schematically in Figure 1 with reference to landmarks and trajectors.

In terms of contributions to policy and good practice for air quality management, the insights presented here demonstrate some key concerns of the sampled stakeholders, along with their understanding of how such dynamics transpire. The data suggests that the 'invasion' of bioPM into previously contained spaces is one of the primary concerns of the stakeholders' common point of reference. This was demonstrated when the usage of 'in' as a prepositional statement was analysed relative to the key nouns. The use of image schemas is fundamental to how our cognition and language use mutually structure each other in the processes of sense-making. The development of policy and good practice therefore may benefit from attending to these conceptual processes and incorporating these more deliberately into briefing and training materials to generate a shared communicative niche among diverse audiences. The evidence suggests that audiences respond differently to different messages that frame a topic. For example, in climate action messaging, audiences tend to respond by feeling more empowered when messages include hope and specific actions that can be taken, whereas they tend to feel hopeless and despondent when messages are framed nihilistically, as doom and despair [71].

To conclude, this paper has presented a novel approach to understanding the processes invoked in the production of specialist knowledge relating to the management of air quality. No claims are made that this study is representative of the wider discipline, but it does reflect the manner with which the nature and dynamics of air-borne bioPM in interaction with the built environment are construed by informed stakeholders. It is anticipated that given a different group of stakeholders, and also given a different medium for interaction to the online platform used here due to the pandemic, analysis may produce quite different findings. For example, the online nature of the workshop may have shaped the flow of conversation among the participants, resulting in more stilted and measured interactions, including back-and-forth processes, which often act as springboards for the elaboration and generation of novel ideas and conceptualisations. Moreover, the level of conceptual differentiation and granularity in some of the more technical aspects of discussion among the participants is admittedly limited. In subsequent work, some of these issues may be explored by specifically asking the participants to think through and reflect on some of these in situ as part of the facilitator's prompts. However, the principled approach to the Cognitive Linguistic analysis of transcribed speech remains constrained by the content of such transcriptions and cannot introduce extraneous claims not supported by the data.

Nevertheless, what this paper has demonstrated is that knowledge refers less to a pre-existing and objectively (i.e., in the absence of any observer) 'true' set of conditions, but is rather the result of negotiation among a complex array of mental models and cognitive construals that exists within the ecosystem of situated communication and language use. This paper has introduced and briefly demonstrated an analytic framework with which to interpret and model how air-borne biological and particulate matter (bioPM) is cognitively construed, and this has implications for air quality management strategies within the built environment.

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Abbreviations

The following abbreviations are used in this manuscript:

bioPM	Biological and particulate matter
CBT	Conceptual Blending Theory
LL	Log Likelihood
sBNC	Spoken component of the British National Corpus

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