

An Empirical Revision of the Definition of Science Fiction: it's all in the Techne

Menadue, Christopher B., Giselsso, Kristi., Guez, David.

James Cook University, Cairns, QLD 4870. Australia

Corresponding author email address: ben.menadue@jcu.edu.au

Abstract

Researchers increasingly employ science fiction and fantasy in public engagement, advocacy and education, and imply popular understanding. Existing definitions of science fiction, especially postmodern definitions, risk obliterating the very concept of genre, and the use of science fiction as an effective research tool is undermined if the genre no longer contains meaning. We surveyed the public for their definitions of science fiction and fantasy and discovered the popular definition of science fiction is based on a few, very clearly defined, story features, unlike the complexity and fluidity of academic approaches. The survey analysis suggests science-fiction contains a categorical core within a mutable family of associated features. The empirical survey data is highly consistent, and demonstrates a very clear distinction between popular definitions of science fiction and fantasy. We support this finding with theoretical analysis that implies historic definitions may be artefacts of examining secondary characteristics, as if these were the primary genre features. Wittgenstein's family resemblances, sometimes employed as definitive, should be interpreted as surface features. We identify and explore primary features exposed by the survey and, on the basis of the common themes within the raw material itself, suggest the Classical concept of techne better describes the empirical essence of science fiction.

Key words: digital humanities; science communication; science fiction; fantasy; genre; postmodernism; English literature, audience survey

Introduction: the need for a popular definition

A recent literature review found that science fiction – in text, cartoon, game, film and television forms – is being increasingly used as source material to aid research outcomes across multiple disciplines (Menadue & Cheer, 2017). Science fiction is used for public engagement (Carpenter, 2016; Hansen, 2004; Larsen, 2011; McIntire, 1982; Milner, 2009; Toscano, 2011; Van Dijck, 1999; Wilsing & Akpınar-Wilsing, 2004). Research also relates the evolving content of science fiction to cultural change, concerns and interests (Bina, Mateus, Pereira, & Caffa, 2016; Guerra, 2009; Hollinger, 1999; Hull, 2005; Kohlmann, 2014; Kotasek, 2015; Menadue, 2017b, 2018b; Nerlich, Clarke, & Dingwall, 1999; Parrinder, 2009; Schwartz, 1971). Advocacy, pedagogy, and science communication, that employ science fiction to effect real-world outcomes must rely on common understandings of science fiction to be meaningful. It is difficult to overstate the importance of effective science communication – consider fields of research as hotly contested and potentially damaging as anti-vaccination activism (Nyhan, Reifler, Richey, & Freed, 2014), and climate change denial (Maibach et al., 2012).

The literature review was published in a multidisciplinary open journal. To respect the wide-ranging audience, an all-inclusive definition of science fiction was used to include the contexts of all 43 works reviewed, starting with the cloning motif found in the Sumerian *Epic of Gilgamesh*. This generalised definition was not queried by the editor or peer-reviewers, and it was found the majority of papers identified in the literature review, across multiple disciplines, did not provide any definitions of the science fiction that was a significant element of their research. The implication is that the researchers reviewed believe ‘science fiction’ is universally comprehended, and does not demand definition. This contrasts with analytical, formal academic approaches, which approach genre definition from a historical research tradition, and omit the phenomenological experience of the audience. The survey *Science Fiction and Fantasy: Your Opinions* (Menadue, 2017a) was created to address this phenomenological gap, for the purpose of discovering popular opinions on the nature, structure and definitions of science fiction and fantasy. The findings from that survey are analysed here.

The relevance of science fiction-focused research requires the researcher and their audience to share the same comprehension of the genre. To assume that the researcher’s definition is commonly shared might be problematic. If, for example, a research group extrapolated public interests and concerns about science from a subjective selection of science fiction works, which did not accurately reflect the public view, and used the results to direct public science funding priorities. This may seem an unlikely example, but Olivia Bina, Sandra

Mateus, Lavinia Pereira and Annalisa Caffa did exactly this, in a paper written to influence EU policy on science funding priorities (Bina et al., 2016). The works that the researchers included as indications of public attitudes are a hit-list of the finest critical examples of the science fiction canon, including: Verne's *Paris in the Twentieth Century*, Forster's *The Machine Stops*, Zemyatin's *We*, Godard's *Alphaville*, LeGuin's *The Lathe of Heaven* and the Tarkovsky film of Lem's *Solaris*. Much as science fiction academics might weep over the fact, contemporary consumers are largely, even perhaps blissfully, unaware of these works. Responses to a recent survey (Menadue, 2016) indicate that Terry Pratchett, Isaac Asimov, Ursula LeGuin, J.R.R. Tolkien, Robert Heinlein, Neil Gaiman, Philip K. Dick and J.K. Rowling are the most popular authors of science fiction and fantasy today, and in that order. Only LeGuin features in Bina's catalogue.

1.1 Terminology used in this paper

We discuss existing academic theories of the science fiction genre, and how they contrast with, or support, the popular definitions derived from survey responses. For clarity, it is necessary to distinguish between categories of science fiction definitions to avoid potentially confusing or misleading the reader. The term 'Fiction of Estrangement' (FoE) is applied here to the collective historic academic approaches – an acknowledgement that the battered crown of sf definition is generally to be found on the 'cognitively estranged' head of Darko Suvin, following his landmark work on genre analysis that he wrote in the late nineteen seventies (Suvin, 1979) – and it is perhaps an easily remembered acronym. The terms 'science fiction' and 'fantasy' will refer to non-academic classifications of these works, including those of authors, publishers, retailers and editors. The term 'sf' will be applied generically to all science or fantasy fiction regardless of whether this is from academic or non-academic perspectives.

2 METHODS

Our methodological approach applies two perspectives to the problem of definition – analysis of the responses to an audience survey and an evaluation of science fiction genre theory. We then compare and contrast with the findings.

2.1 The World Outside Text: The Survey

Subjective opinions of authors, and established academic theories, appear not to have been previously subjected to independent evaluation based on the expectations and opinions of the general public – who are the beneficiaries of applied research that employs science fiction concepts and content. We suggest this lack of a common baseline fuels increasingly complex academic work towards the uncertainty of being able to create any meaningful definition. It was with a view to investigating this complexity that the *Science Fiction & Fantasy: Your Opinions* survey (Menadue, 2017a) was created, the aim being to assess the genre definitions of science fiction and fantasy from an original, empirical perspective, rather than relying on theory alone.

2.2 Sample Characteristics

Email and Facebook promotion of the survey generated a significant sample of 232 unique, globally distributed, responses. Most respondents were English speaking North Americans, Western Europeans, Australians and New Zealanders. The North American responses showed a spike in responses during promotion of the survey on the Facebook page of the SFFWA, indicating writers and fans participated. The demographics of the respondents showed a broad spread of ages, no gender bias, and a dominance of tertiary educated respondents. These demographics were also observed in the previous *Science Fiction & Fantasy: Your Experiences* survey (Menadue, 2016; Menadue & Jacups, 2018).

2.3 Survey Results and Discussion

Only two survey respondents employed FoE terms and concepts. Two further respondents referred to Samuel Delany's classification of science fiction on the basis of 'subjunctivity' (Delany, 2009: 31-36), and three referred to *Clarke's Third Law* (Clarke, 1968) that "any sufficiently advanced technology is indistinguishable from magic" to justify apparently fantastical elements appearing in some science fiction stories. Qualitative survey of the

remaining 97% of responses found definitions based on presence or absence of specific content, which suggested statistical evaluation on the basis of word frequency and category would be a suitable analytical method to generate meaningful results (Table 1.). The story application of the content described was also frequently couched in terms of plausibility or lack of plausibility, the presence of explanations or lack of explicable content. This remarkable lack of equivocation and qualification of responses was the first clear indicator that the definitions of the respondents were markedly and categorically polarised.

Time stamp of response	What is it about a book that makes you think of it as fantasy?	What is it about a book that makes you think of it as science fiction?
11/11/2016 15:58:11	Incorporating creatures such as dragons or orcs; the story contains magical elements.	Within the realms of possibility using scientific elements or scenarios.
11/12/2016 6:59:45	Fantasy is when elements of the novel are not realistic or possible. I.e. include mythical creatures, super powers...	Evolution of science based inventions or themes.
11/19/2016 14:48:20	A story with fictional elements that could never happen.	A story with fictional elements that could happen, usually based around advanced technology.
11/20/2016 0:23:38	Magic of some sort; something that reminds you it is not real	Generally speaking I do not read science fiction although I do watch SF movies; so my answer might be cliché: other planets, science and technology that is far more advanced than ours which makes the story implausible.
11/20/2016 14:29:24	Fantasy tends to rely on magic for its world building rather than science, engineering, or economics.	Science fiction to me tends to focus on the future and present a vision, somehow rooted in science or engineering or real history, of how the future might work out.

Table 1. Examples of responses to genre definition questions. For full list see Appendix A.

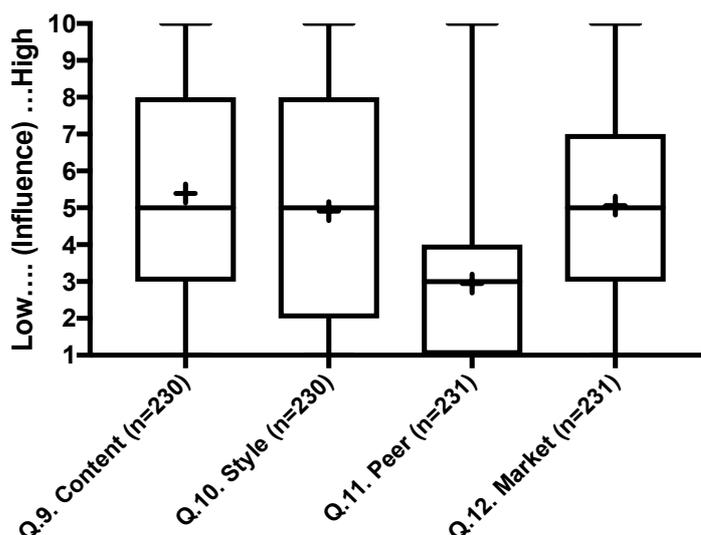


Fig. 1. Perceived content, style, peer and

We asked general questions about the influence of content types, style and structure, peer influence and marketing on genre definitions (Fig. 1), but the responses to these questions

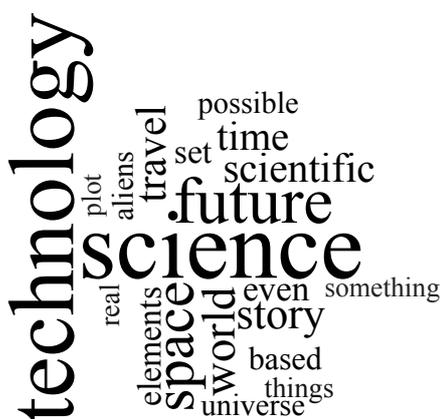


Fig. 2. What makes a story



Fig. 3. What makes a story

were ambivalent except for the assertion that peer influence has little effect. Our more exact questions regarding personal assessments of the quality of fiction provided unequivocal opinions (Fig. 7), but no science fiction or fantasy terms. These responses imply that generic factors do not clearly affect definitions of science fiction or fantasy. This is interesting, as when asked more direct questions on what makes a story fantasy or science fiction the answers were clearly and directly focused on exclusive differences in content and structure, which may support the suggestion that the comprehension of genre is intuitive – that respondents do not consciously believe these factors are important to genre definition, but identification of a specific genre is nonetheless founded in specific content and structure categorisation.

Free-text responses to the questions ‘what makes a story science fiction’ and ‘what makes a story fantasy’ used distinctive vocabulary (Fig. 2, Fig. 3, Tables 1-3). ‘Science’ and ‘technology’ are categorical indicators for science fiction (Fig. 2, Table 2), and the word ‘magic’ dominates descriptions of fantasy literature (Fig. 3, Table 3.). Statistical classification of the terms used to distinguish science fiction and fantasy demonstrate overwhelming consistency, with the presence of magic associated with fantasy, and the combination of science and technology being a universal indicator for the science fiction category (Fig. 4, see Appendix for data table). Word clouds of the 20 most frequent terms in the free text responses (Fig. 2, Fig. 3) illustrate the strength of discrimination between fantasy and science fiction content. In generating these word clouds, antithetical phrases such as ‘no magic’ or ‘no science content’ were converted into single words e.g. ‘unmagical’ and ‘unscientific’ to enable them to be visible in appropriate context. To avoid skewed results caused by self-referencing, the terms ‘science fiction’ and ‘fantasy’ were not counted when employed as genre names, rather than descriptions of content. For categorisation analysis, all responses were qualitatively assessed to identify the presence and context of the 30 most frequent words used in each definition found in frequency analysis and the results tabulated by stemming (e.g. ‘magical’, ‘magic’, ‘magic-based’ would all be categorised as ‘magic’). In Figure 4, classification tree branches are at presence or absence (including negative statements) of terms found in any of 464 responses, 232 ‘what makes it fantasy’, 232 ‘what makes it science fiction’, 17 non responses were received to both questions. This classification tree potentially had 44 nodes based on the 30 most frequent words in response to each question – 16 words were shared between science fiction and fantasy definitions, generally in a positive or negative affirmation e.g. ‘science fiction does not contain magic’ or ‘fantasy is based on magic.’

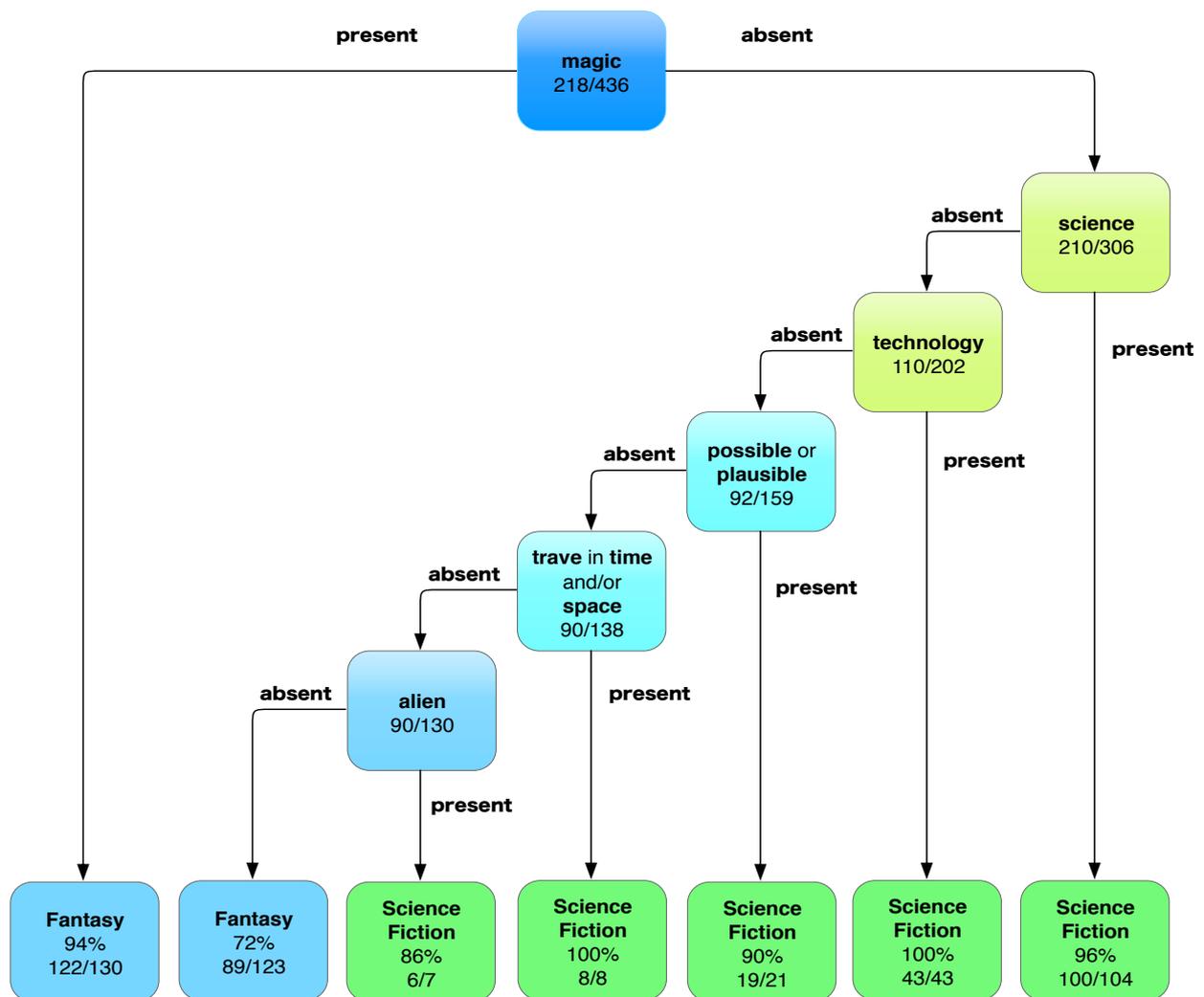


Fig. 4 Classification tree demonstrating confidence levels of categorisation of science fiction or fantasy based on descriptors.

Qualitative examination of the free text responses to this question provide a more nuanced perspective. Some respondents employed Clarke's Third Law to integrate ostensibly fantastic elements into a science-fictional narrative: they argued that plausible explanations converted impossible fantasy into possible science fiction. The genetic engineering of humans into organic computers seems plausible in a society that has banned thinking machines. The powers of the messianic central character arise from special properties of the spice, combined with the sociological factors of the Fremen's fanatical devotion and the manipulations of the Bene Gesserit. Those who found these elements to be impossible or implausible rated *Dune* towards the fantasy end of the scale.

However, when explaining where they had placed *Dune* on the Likert scale, respondents did not introduce new 'science-fantasy' terminology. Instead, they classified the content of *Dune* as a set of individual science fiction or fantasy elements, meeting the same criteria they used to define these genres more globally. This seems to confirm that science fiction and fantasy have specific and distinct characteristics which do not overlap. *Dune* provides evidence that respondents apply the classification in Fig. 4. to individual elements of story narrative. The proportion of specific science fiction to specific fantasy elements, and not a blurry continuum of the sort despised by Frederik Pohl, determines Likert scale placement of *Dune*. Works such as *Dune* may intertwine the threads of family resemblances of science fiction and fantasy, but the core distinguishing features of science fiction are unchanged: science, technology and possibility – there is no evidence for a unique third genre of 'science fantasy.'

world	40	1.36%	world, worlds
story	38	1.29%	stories, story
travel	33	1.12%	travel, traveler, travelling
scientific	32	1.09%	scientific, scientifically
possible	30	1.02%	possibilities, possibility, possible, possibly

Table 2. Ten most commonly occurring words used to define science fiction (by word counts of raw data). ‘Science’ and ‘fiction’ appear prominently in responses as the name of the genre, as well as to refer to science as a feature of the genre. To account for this, responses were analysed and uses of words as genre names were removed for categorisation tree analysis.

Word	Count	Weighted %	Similar Words
magical	169	4.60%	'magic', magic, magic', magical
fantasy	163	4.43%	'fantasy', fantasies, fantasy
science	80	2.18%	science
worlds	77	2.09%	world, world', worlds
elements	40	1.09%	element, elements
story	34	0.92%	stories, story
dragons	34	0.92%	dragon, dragons
technology	34	0.92%	'technology, technological, technologically, technologies, technology
fiction	34	0.92%	fiction, fictional
like	33	0.90%	like, likely

Table 3. Ten most commonly occurring words used to define fantasy (by word counts of raw data). Note that ‘fantasy’ appears in responses as a genre name as well as a description of content. In Table 3., ‘technology’ and ‘science’ appeared in the responses as negative values, used by the respondents to describe what fantasy is not. This was applied as negatives in the categorisation tree analysis.

Word frequency analysis of responses (Tables 2 & 3), and classification tree analysis (Fig. 4) demonstrate very specific discrimination between science fiction and fantasy through content filters of magic, science, technology and plausibility. The overwhelming lack of complex, theory-based, responses suggests a quantitative and categorical analysis is appropriate, and implies respondents were providing personal, intuitive definitions rather than ones based on knowledge of academic theory, and this was the case regardless of whether the

respondents gave their occupation as a 'genre-professional' (e.g. writer, editor) or not, again adding substance to argument that these responses are not sourced from definitions taken from academic theory.

2.3.4 Evidence of Fuzzy Sets

A fuzzy set is composed of items that are not defined by purely binary conditions, but exhibit degrees of membership (Zadeh, 1965). These, alongside family resemblances, appear to augment our core categorisation of science fiction and fantasy. We have used a combination of methods to illustrate and support the rigour of our analysis: word clouds, classification analysis and Likert scales; to illustrate personal perspectives (Figs. 2,3,4), and external influences (Fig. 1). The choice of words in free-text responses is statistically significant in indicating an evidently binary categorisation. In apparent contrast, Likert scale indications of the influences of content, style, peer and market are not polarised. In some cases, the responses indicate almost complete ambivalence, with both means and medians close to the centre point of the response scale (Fig. 1., showing results from Q. 9, 10 and 12 of the survey (Menadue, 2017a)). The fuzziness of these responses is indicated by the relative lack of extreme responses to the scaled questions. The control question that could falsify a strict demarcation of science fiction and fantasy by identifying non-binary categorisations was whether *Dune* is fantasy or science fiction. Out of 224 responses to this question there were 43 responses of (1): definitely science fiction, and four that it was (10): definitely fantasy. Research has been carried out at length into the factors affecting Likert scale responses, which can include avoidance of end-of-scale responses, gravitating towards the ends, and bias caused by the direction of positive, negative and neutral points on the scale (Coertjens, Donche, De Maeyer, Vanthournout, & Van Petegem, 2012; Croasmun & Ostrom, 2011; Hartley, 2014; Lantz, 2013; Thissen-Roe & Thissen, 2013). As we were looking for evidence of *any* non-binary response, scale biases are largely irrelevant to our interpretation of the results. The results indicate a fuzzy set of associations including vocabulary, style, marketing and peer pressure, outside the sharply defined core characteristics of science fiction and fantasy. Family resemblances are clearly relevant to the ability of respondents to classify a range of different works without difficulty. Other varieties of content and external phenomenological experiences are also present, and associated with science fiction and/or fantasy. These appear to form fuzzy sets around the core criteria. This explains the fact that respondents were able to provide a variable scaled response to some questions, without compromising a clearly categorical classification.

2.4 Limitations

Research on the characteristics of online surveys have found that online surveys have a comparatively low drop-out rate and more complete data responses compared to postal surveys, but are inherently influenced by self-selection (Dolnicar, Laesser, & Matus, 2009). Martine Van Selm and Nicholas Jankowski have discussed how targeting specific online communities can be an effective method of harvesting survey responses, and specifically for what Swoboda et. al. describe as “expert interrogations,” also highlighting the cost-effectiveness of this approach and the openness of responses that is encouraged by anonymity (Selm & Jankowski, 2006: 437). Selm and Jankowski acknowledge the limitations arising from technology use, and being unable to control the pattern of respondents due to lack of control over survey dissemination (p. 438). The survey was only available in English, as were the survey instructions and promotion, which reduces the responses by non-native speakers of English and influences survey dissemination.

Complex media engagement practices, involving two-way interactions, are found in online audiences, and this is considered to make online survey design and application challenging, and not as similar to pre-technological research paradigms (Livingstone, 2013; Yun & Trumbo, 2000). Overcoming limitations of the characteristics of online surveying (Callegaro, Lozar, & Vehovar, 2015), can only be reduced by multi-modal and methodical sampling beyond the resources available to this study. It should be noted, however, that the survey sought the opinions of people who are familiar with the genre, and therefore the meaningfulness of the responses is not impacted by a lack of dissemination among a wider population. The “expert interrogations” highlighted by Swoboda et. al. should apply particularly strongly to this survey as approximately half the responses came from people visiting the Facebook page of the Science Fiction and Fantasy Writers of America, but we found no significant difference between definitions given by ‘professionals’ and those of other respondents.

2.5 Survey Results: Summary

We discovered that science fiction and fantasy genre definitions are predominantly influenced by vocabulary and plausibility. This contrasts with historic academic definitions of FoE. This distinction was so sharply defined that the word ‘magic’ was a categorizing factor in 94% responses to the question ‘what makes [a work] fantasy?’, and the presence of the word ‘science’ (independent of labels for the genre) was a 96% indicator for science fiction. The

word ‘technology’, provided a 100% categorisation as science fiction. The public recognise the categories without deep analysis, and independently to aesthetic considerations. They interpret the narrative as an assembly of terms and relationships combined with external influences, and the genre is known by how these resonate. This circumvents definitions based on qualitative standards or purely theoretical structures, including those found in FoE research. The empirical evidence suggests the survey respondents are defining genres from a core of essential features, which are orbited by family resemblances and fuzzy sets. The influence from marketing and peers are parts of the fuzzy sets of associations, and marketing categorisation may even be influenced by shared distinctions understood by the marketers, rather than being the arbitrary designations that might be assumed.

We found that the quality of content is immaterial to classification, although it is vital to what makes a ‘good’ or ‘bad’ story, and evidence of distinctions based in formal theoretical analysis was almost entirely lacking from responses. Responses suggested that the logical rigour of narrative structure – plausibility – is an influence on the classification of a work as science fiction, and perhaps the structure of the narrative influences categorisation. To analyse this feature in more depth was beyond the scope of the survey, however, but may prove fruitful for further study.

The empirical data suggests that science fiction exists, in a real and permanent way, and is more than a fluid and mutable association of resemblances. Popular definition is not dependent upon abstract or unconscious factors, which may be features of academic definitions of FoE. The public recognise the categories independently of analytical or aesthetic considerations: they interpret the genre of the narrative as an assembly of terms and relationships combined with external influences. This contrasts strongly with definitions based on qualitative standards or theoretical structures, including those of FoE. The empirical evidence suggests the survey respondents are defining genres from a core of essential features, which are orbited by family resemblances and fuzzy sets. The influences of marketing and peers are included in the fuzzy sets of associations, and marketing categorisation may even be influenced by shared distinctions understood by the marketers, rather than being an entirely arbitrary designation. The focus of the respondents on science and technology provides us with a characteristic of human experience that identifies science fiction.

Whether a story is deemed ‘good’ or ‘bad’ has strongly qualitative characteristics which are independent of genre (Fig. 7). Less than 3 % of respondents made a differentiation between science fiction and fantasy based on theoretical distinctions of any sort, although many more respondents (those who are writers or editors of science fiction) might be considered experts

according to online survey response theories. The presence of a plausible narrative structure, based in logic, influences the classification of a work as science fiction, and the formal narrative structure implied by this may be an indicator that influences categorisation. To analyse this feature in more depth is beyond the scope here, but may provide the basis for further studies.

3 Theoretical Approaches to Science Fiction

Science fictional concepts are visible in work that significantly pre-dates the twentieth century origins of the name, but Hugo Gernsback's employment of the awkward neologism 'scientifiction' in *Electrical Experimenter* (Gernsback, 1916) was the first attempt to define this emerging genre. The easier-to-enunciate 'science fiction' was to become the dominant genre name within a decade. The inclusion of 'science fiction' in the titles of magazines containing fantasy, horror, thriller and detective stories – alongside 'scientifiction' – might have diluted the clarity of the public understanding of the genre from the outset rather than maintaining a clear concept of what 'science fiction' entailed. This diverse content is demonstrated in research that samples content from sf magazines (Menadue, 2017b, 2018a), and identifies sources that genre theorists and industry professionals have attempted to dismiss from the science fiction canon. We have found in our survey that science fiction is an extremely well-defined genre in the minds of the science fiction audience. This calls for an investigation of the science fiction genre as it exists and has been defined by specialists and theorists, and to attempt to explain differences between public and private definitions.

3.1 The Shock of the New

'Science fiction' emerged when science was 'the new', a wide range of exciting possibilities across a broader range of human interests (Cheng, 2012). John W. Campbell, editor of *Astounding Science Fiction* (*ASF*) between 1937 and 1971, called for technological science fiction, and included articles on scientific topics in *ASF*. Robert Heinlein, an independently minded writer who was successful enough to not be intimidated by Campbell's edicts (Heinlein, 1989), described the genre differently as 'speculative fiction' in his 1947 essay on writing:

There is another type of honest-to-goodness science fiction story that is not usually regarded as science fiction: the story of people dealing with contemporary science or technology. We do not ordinarily mean this sort of story when we say, "science fiction"; what we do mean is the speculative story, the story embodying the notion "just suppose—" or "What would happen if —." In the speculative science fiction

story accepted science and established fiefs are extrapolated to produce a new situation, a new framework for human action. As a result of this new situation, new human problems are created — and our story is about how human beings cope with those new problems. (Heinlein, 1991: 5)

Heinlein described the human experience of ‘science as new possibilities’ of the earlier part of the 20th Century. This accords with a paper analyzing responses to the Science Fiction and Fantasy: Your Experiences survey (Menadue & Jacups, 2018), which discovered a statistically significant correlation between readers’ experiences of science, scientists and science fiction, and ‘newness’ of thought and action. This classification of a form of literature by its association with ‘newness’ is much older, however. Aristotle’s definition of poesis (as “creative production” – not to be confused with the more narrowly defined modern use of ‘poetry’) could be describing science fiction:

the poet’s function is to describe, not the thing that has happened, but a kind of thing that might happen, i.e. what is possible as being probable or necessary... you might put the work of Herodotus into verse, and it would still be a species of history; it consists really in this, that the one describes the thing that has been, and the other a kind of thing that might be. Hence poetry is something more philosophic and of graver import than history, since its statements are of the nature rather of universals, whereas those of history are singulars. By a universal statement I mean one as to what such or such a kind of man will probably or necessarily say or do. (Aristotle, trans. 1920, 9)

Samuel Delany’s description in *The Jewel Hinged Jaw* of content distinction on the basis of ‘subjunctivity’ echoes Aristotle; defining content elements as the ‘could have happened’, ‘could not have happened’ and ‘have not happened’, he also adds the historical category ‘this happened’ of journalism – analogous to written history (Delany, 2009: 31-36). Aristotle’s description of ‘a kind of thing that might be’ is remarkably similar to Heinlein’s description of speculative fiction, and we argue that this is not coincidental, but that they both reflect the human experience of creativity – both mental and physical.

Aristotle’s emphasis on the ‘universals’ of poetry, a speculative form of literature, compared to the ‘singulars’ of history implies these are naturalistic distinctions. Our poetic, science fictional, visions of the future are thought-experiments about what might be real, or possible. This contrasts with history, and contemporary applied science, some of which – for example, the pervasive electronic surveillance of Orwell’s *1984*, mobile phones, spaceflight, cloning, killer robots... – has become realised after originating in the (unreal) thought experiments of science fiction. When content becomes physically, or culturally actualized, it passes out of the stuff of fiction and becomes reality: Aristotle’s ‘history,’ falling away from the core of science fiction. As Jean Baudrillard observed of the Apollo missions, once we have

observed men sent to the moon in a small metal box with a bathroom, this is no longer the stuff of science fiction (Baudrillard, 1991).

There have been other definitions of science fiction of varying degrees of utility; Roger Luckhurst noted in 2006 that Bruno Latour had stolen ‘scientifiction’ as his own neologism (Luckhurst, 2006). This indicates, ironically, that the failure of this term in the early 20th Century enables it to be ‘rediscovered’ as an alternative to the value-laden labels of ‘science fiction’ or ‘speculative fiction’ – the first term coloured by Campbell’s technology focus, the latter by association with the British ‘New Wave’ writers of the ‘60s and ‘70s. In *The Jewel Hinged Jaw* Samuel Delany dismissed “speculative fiction”, consigning Heinlein and the New Wave to a merely “historical reference” (Delany, 2009: x). Resurrecting Gernsback’s awkward term is unrealistic, but the enduring difficulties of rule-based classification of the genre include the seemingly insoluble problem of value-laden terminology. Finding a popular definition of science fiction, and using that as a basis for discussion, is a way of clarifying the real values of the genre.

3.2 The fiction of estrangement

Academic definitions of science fiction are distributed into three general categories: concept, context and content. Conceptual approaches are dominated by Darko Suvin’s statement in 1977 that “SF is distinguished by the narrative dominance of a fictional novelty (novum / innovation) validated both by being continuous with a body of already existing cognitions and by being a "mental experiment" based on “cognitive logic”” (Suvin, 2010: 67). Suvin proposed ‘cognitive estrangement’ as a quality which categorically defines science fiction (Suvin, 1979). Suvin borrowed openly from Bertolt Brecht and the Russian Formalists, particularly Viktor Shklovsky (Suvin & Tatsumi, 1985), sharing their focus on estrangement, and Suvin’s usage approximates the *ostraniene* of Shklovsky. Suvin’s definition might also be considered a sub-classification of Tzvetan Todorov’s all-inclusive description of fantasy (Todorov, 1975), but science fiction and fantasy are commonly used and specifically employed terms – as we find in our investigation – and it seems sensible to respect Suvin’s assumption of difference.

The meaningfulness of Suvin’s definition to a general audience has been questioned by other researchers in the field. Carl Freedman observed that Suvin includes Brecht, but excludes *Star Wars* and *Star Trek* from the science fiction canon. This distinction makes little sense to the non-academic (Freedman, 2000: 16-19). There are alternative and complementary critical definitions, and genre descriptions, for science fiction – and each has their own strengths and weaknesses. For example, Adam Roberts suggested that western science fiction is an

essentially Protestant form and fantasy is Catholic (Roberts, 2005: 59-60). Roberts suggests that the qualities of science fiction reflect Protestant pragmatism, in contrast to fantasy, which resonates with Catholic mystery and ceremony. While Roberts' definition seems sensible for some stories, and not only those with an overt Christian theme such as *A Case of Conscience* by James Blish, or *A Canticle for Leibowitz* by Walter M. Miller (Blish, 1963; Miller, 1960), it excludes both pre-schismatic and non-Christian writing.

Mark Bould and Sherryl Vint argue in *There is no such thing as science fiction* that “genres are never, as frequently perceived, objects which already exist in the world and which are subsequently studied by genre critics, but fluid and tenuous constructions made by the interaction of various claims and practices by writers, producers, distributors, marketers, readers, fans, critics and other discursive agents” (Bould & Vint, 2009: 48). John Rieder in *On defining SF, or not: genre theory, SF, and history* suggests that a comparative, mutable, genre definition located in factors and influences is not a definition at all, supporting the opinion of Bould and Vint (Rieder, 2010).

3.3 Writers vs. Readers

Professional authors tend to focus on content specifics. Stanislaw Lem stated: “it is the premise of SF that anything shown shall in principle be interpreted empirically and rationally. In SF there can be no inexplicable marvels, no transcendences, no devils or demons—and the pattern of occurrences must be verisimilar ” (Lem, Rottensteiner, Gillespie, D. S., & R. D. M., 1973: 28). The author Philip K. Dick also talked about the explicable:

Take psionics; take mutants such as we find in Ted Sturgeon's wonderful MORE THAN HUMAN. If the reader believes that such mutants could exist, then he will view Sturgeon's novel as science fiction. If, however, he believes that such mutants are, like wizards and dragons, not possible, nor will ever be possible, then he is reading a fantasy novel. Fantasy involves that which general opinion regards as impossible; science fiction involves that which general opinion regards as possible under the right circumstances. (Dick, 1999: xiii-xiv)

Editor and writer Frederik Pohl lamented a perceived fuzziness of the public perception of boundaries between science fiction and fantasy:

...science fiction is not, is positively not, fantasy...there is a tendency... to lump the two genres together. Bookstore proprietors, librarians, and casual readers have long blurred the differences in their own minds. What is worse is that in recent years the distinction has been made fuzzier still, even by some of the very institutions that were originally set up to defend sf against all other kinds of writing. For example—

1. The trade union of the people who write the stuff, the Science Fiction Writers of America, has changed its name to the Science Fiction and Fantasy Writers of America [SFFWA]... the academic wing of the field...routinely gives to works of fantasy the same attention once given only to science fiction...Science-fiction [conventions]...habitually give comparably equal time to the other genre. (Pohl, 1997)

Pohl's definition, however, is subjective, and symptomatic of the "ghetto effect" described by Wolfe and Weil in their consideration of the genre placement of Harlan Ellison (Wolfe & Weil, 1990).

Other writers also express strong opinions on permissible definitions. Margaret Atwood declared – countering Ursula Le Guin – that she does not write science fiction at all (Atwood, 2011). Science fiction consumers are quick to identify such 'shy-fi' authors as dissembling. All 24 public comments below Atwood's article define her work, like Orwell's *1984*, or Huxley's *Brave New World*, as science fiction. Reader 'Mmmrrrggglll' argues in her comment: "It's the community and its reaction to – and from – the wider world that gives it its names/ tags/ colloquialisms not the oddly narrow stereotypes of a single member of that community – albeit a relatively powerful one" (n.p).

Tautological assertions, such as Pohl's affirmation that science fiction is categorically not fantasy, or Atwood's claim that her work is not science fiction (because she says so) call for a more objective, shared, classification by a statistically significant number of people.

Ironically, our findings suggest that SFFWA members have a very clear concept of the difference between science fiction and fantasy regardless of Pohl's objections, and are in close accord with both him and Lem: that science fiction is 'positively not fantasy', and is an expression of scientific and technological rationalism rather than the inexplicable.

3.4 The Significance of Style

The editor of *Galaxy Magazine*, Horace Gold, provided the following manifesto on the back cover of the first issue:

Jets blasting, Bat Durston came screeching down through the atmosphere of Bbllzzaaj. He cut out his super-hyper-drive for the landing...and at that point, a tall, lean spaceman stepped out of the tail assembly, proton gun-blaster in a spacetanned hand.

Hoofs drumming, Bat Durston came galloping down through the narrow pass at Eagle Gulch. He spurred hard for a low overhang of rimrock. . . and at that point, a tall, lean wrangler stepped out from behind a high boulder, six-shooter in a sun-tanned hand.

"Sound alike? They should-one is merely a western transplanted to some alien and impossible planet. If this is your idea of science fiction, you're welcome to it! YOU'LL NEVER FIND IT IN GALAXY!"

(Gold, 1950)

Gold implied that the content of competing magazines was ersatz, impersonating ‘real’ science fiction by word-substitution, and promised that *Galaxy* would provide something new. We find, however, that vocabulary is a very strongly defining characteristic of science fiction and fantasy (Figs. 2, 3).

LeGuin argued the significance of style in her essay *From Elfland to Poughkeepsie in The Language of the Night* (Le Guin, 1973: 146). LeGuin’s examples of poor writing are more recent than Gold’s, and trace modern sf borrowing to corporate and political melodrama – a fact excruciatingly familiar to anyone sitting through the interminable council meetings and trade delegation plotting of the *Star Wars* prequels. LeGuin emphasises the importance of written style, which we might expect to be significant in genre differentiation, but we found in our survey that the perceived literary value of a story is independent of genre, and the quality of characterization is paramount (Figs. 1, 7). If the quality measure is general, the implication is that categorisation of sf is independent of style considerations. It may be that the use of standard science fictional terms or concepts is sufficient to define science fiction, independent of the rich experimental narratives of writers such as Samuel R. Delany (Alterman, 1977).

3.5 Science Fiction and Postmodern Genre Theory

We argue that the classical concept of *techne* best describes the core of the popular categorisation of science fiction rather than being subject to a fluid and mutable historiographic process of genre change that is particularly problematic if we employ genre for real-world research outcomes. We suggest that the danger of postmodern approaches to genre definitions is that they risk obliterating the very object of their study altogether, along with any value that it can add to real-world circumstances, and it is *techne* that is the historically continuous core of science fiction, around which other themes, motifs and tropes orbit. Our survey findings provide strong supporting evidence for this conjecture.

Science fiction has attracted increasing academic attention as it has become more culturally pervasive. John Rieder provides a detailed academic analysis of science fiction as a popular genre from the postmodern perspective (Rieder, 2010), describing Wittgenstein’s ‘family resemblances’, and Lofti Zadeh’s notion of the ‘fuzzy set’ (uncited) as existing ways of describing genre (195). Rieder draws on Kincaid’s interpretation of Wittgenstein to claim that sf has “no essence; no single unifying characteristic and no point of origin”, asserting that sf is merely a “mutable” (193) cultural construction: “whatever we are looking for when we look for science fiction” (201,203). Further, Rieder claims that the genre does not derive “from

the qualities of the object itself” (203), but is the “rhetorical act” of “labelling” (200). Science fiction is not a “set of texts” but a matter of “using texts” (197), and, paraphrasing Damon Knight (193), states: “we can simply point to a story and say it is sf” (201). In a painstaking effort to avoid saying anything that might be remotely construed as ‘essentialist,’ Rieder implies that no identifying features exist in the texts themselves. Combined with the insistence that the ‘rhetorical act’ of ‘labelling’ is decisive, the act of definition becomes tantamount to, and as meaningless as, pointing at a naked emperor and claiming that he is wearing science fiction. Rieder refers to Wittgenstein’s supposed “anti-essentialism” (95), which, in postmodernist terms, is equated with the relativistic view that there is no ‘referent:’ no common world, truth or experience to which language refers. However, philosophers have presented convincing evidence that Wittgenstein was not a relativist (Barrett, 1991; Coliva, 2010; O’Grady, 2004; Putnam, 1995), particularly in the terms conceived by postmodern theorists. O’Grady argues that Wittgenstein may have been a conceptual relativist, but although we may conceive the world through concepts, and different language groups may have different concepts, this does not deny that the ‘world-in itself’ exists – nor, most importantly, that truth exists (O’Grady, 2004: 332). Similarly, Kate Soper observes that, although inevitably conceived through our cultural understanding, the natural world still exists. As she drily comments: “it is not language that has a hole in its ozone layer” (Soper, 1995: 151).

O’Grady (2004), Barrett (1991) and Coliva (2010) affirm that Wittgenstein insisted on a common humanity, that our language structures – which produce our language games – spring from our common “form of life” (Wittgenstein, 1986: , PI 241). That we can understand foreign languages provides evidence of this: “The common behavior of mankind is the system of reference by means of which we interpret an unknown language” (Wittgenstein, 1986, PI 206). Wittgenstein held that it is our common human condition, our “basic physical, emotional and intellectual features which we share with all humans” (O’Grady, 2004: 328), which forms our language structures. Wittgenstein’s famous remark that “if a lion could speak, we could not understand him” (PI, II: 190) illustrates this commonality: we do not share this human ‘form of life’ with animals (O’Grady, 2003: 328). Human beings, however, do share “one picture of the world” which is “universal” (Coliva, 2010: 21-22).

When Wittgenstein discusses the word ‘game’, he refers to subsets or categories of game that can be defined as having one thing in common: for example, ball games and board games; played with either a ball or a board, respectively. A category, concept or definition does not *necessarily* preclude the possibility of singular, defining features. Our everyday understanding of a board game or a ball game is not undermined because these may not have

things in common with each other, or even other games, nor is it tautological to suggest that the definition is contained in the name itself. We call it a board game because of the action of playing a game on a board. It is a helpful description of something that exists, rather than an arbitrary classification. Similarly, science fiction and fantasy fiction are subsets within the overarching category of fiction, which, as the survey which supports our findings demonstrates, do contain defining features.

Rieder refers to ‘similarities’, ‘themes’, and ‘repetition’ within science fiction, but is shy of saying what these might be (unsurprisingly, having insisted that the genre cannot be defined “from the qualities of the object itself” (203)). He concludes: “Definition and classification may be useful points of departure for critical and rhetorical analysis, but [...] the project of comprehending what sf has meant and currently means is one to be accomplished through historical and comparative narrative rather than formal description” (206). We suggest, however, that the historical narrative is a secondary feature of what sf has meant and currently means. The primary feature is drawn from an enduring feature of human experience.

For the genre of science fiction to remain meaningful, we propose that similarities and family resemblances must refer to *something* within the object: the science fiction text. We agree that family resemblances and fuzzy sets are useful for exploring genre definition, but with the caveat that we must apply a more contextualised reading of Wittgenstein. In contrast to Rieder, we suggest that the concept of family resemblances, and the fact that these concepts spring from our common ‘form of life’, can usefully inform a more empirically based approach to sf genre theory.

Our investigation indicates that the Classical origins of science and technology – embodied as *techne* – provide the fundamental, and enduring, characteristic of human experience that enables us as individuals to readily identify science fiction. Richard Parry states: “Aristotle refers to *techne* or craft as itself also *epistêmê* or knowledge because it is a practice grounded in an ‘account’ —something involving theoretical understanding” (Parry, 2014: n.p.). Parry describes how these ideas became separated in Western philosophical and scientific traditions, into the applied, and the theoretical aspects of the human world, and clarifies that “some of the features of this contemporary distinction between theory and practice are not found in the relation between *epistêmê* and *techne*.” For the Greeks *epistêmê* and *techne* had common characteristics. *Techne* describes a way of doing, and being, which incorporates knowledge and skill, actual and theoretical, experiential and potential.

Galen (130-c.201AD) saw the human hand, the experiential human mechanism of physical creation, as not only invaluable in making tools, but those tools could be used to

extend the artistic, creative and imaginative capacity of humans beyond their physical limitations, including writing about such things:

With these hands of his, a man weaves himself a cloak and fashions hunting-nets, fish-nets and traps, and fine-meshed bird-nets, so that he is lord not only of animals upon the earth, but of those in the sea and the air also... being also a peaceful and social animal, with his hands he writes laws for himself, raises altars and statues to the gods, builds ships, makes flutes, lyres, knives, fire-tongs, and all the other instruments of the arts, and in his writings leaves behind him commentaries on the theories of them. (Galen, 2003)

Galen's description encapsulates the human physicality of *techne* as an integration of applied knowledge and imagination. More recently, Bernard Stiegler has described 'technics' in *Technics and Time* as "the horizon of all possibility to come and of all possibility of a future" (Stiegler, 1998: ix). He calls it : "*a process of concretization*" (22), and says that we should admit "the technical dynamic precedes the social dynamic and imposes itself thereupon" (67).

Science fiction, as creative writing about scientific, technology-focused and plausible worlds, may be a socio-cultural manifestation of the human concept of *techne*, which has been part of our experience of the world since, and before, the philosophers of ancient Greece added it to the lexicon. We use *techne* to describe the core of the categorisation of science fiction, not only because it can be justified by philosophical debate, but because it also mirrors the findings of our survey (Section 3.1.). We suggest that the essence of physical and mental tool-making is the core of science fiction, and the visible historical narratives of sf genre are merely the material through which this essential core, this 'star' of essence, sweeps: collecting and discarding new family members as it proceeds.

4 Implications

4.1 Survey

When asked to explain classification into science fiction and fantasy, free text responses are variable in depth and complexity, but the key word content is remarkably similar, and the words 'magic', 'science' and 'technology' dominate the responses (Figs. 1-4, Tables 1-3.). These are the substance of a core that is supported by a family of resemblances – aliens, space ships, dragons, quests – but not defined by them. The survey findings suggest there are core features of sf texts which enable their categorisation as science fiction or fantasy, and that for science fiction these are often closely associated with concepts and developments, both current and future, drawn from real science. This accords with the analysis of a previous survey which

discovered a statistically significant correlation between readers' experiences of science, scientists and science fiction (Menadue & Jacups, 2018).

From analysis of survey data, it proves possible to create a popular categorization of science fiction and fantasy without lengthy discussion of the aesthetic value or sociological basis of content. Content empirically defines science fiction and fantasy, and provides the clearest, least equivocal, and most verifiable, means of identifying popular comprehension of these genres.

4.2 Postmodernism

The danger of postmodern approaches to genre definitions is that they risk obliterating the very object of their study altogether, along with any value that it can add to real-world circumstances. Genres risk becoming arbitrary when they are divorced from the objects they are describing – affirming the need for a more practical, empirically based theory. The core of science fiction is the human embodiment of *techne*, and this drives an intuitive understanding of the subject. Readers are not simply pointing at texts and arbitrarily saying 'science fiction!' We suggest that what readers find most significant in defining science fiction – science and technology – is *techne*; the acknowledgment of the existence of an empirically based world, upon which the thought experiments and theories of science fiction are based. Once the imaginary in science fiction is actualized, it becomes history, and no longer a feature of science fiction categorisation.

Figure 8 illustrates how this core of *techne* is orbited by subject matter and concepts that may at any one time make up elements of the family of resemblances comprising the totality of science fiction, without dictating what may be included or excluded. The core of *techne* persists through time (the vertical arrow) even though fashions in science fiction, and real-world contexts of technology and science – from bone tools through to artificial intelligence – may change. Specific science fiction instances – such as Well's Time Machine, or Kubrick's HAL – are linked to changing fashions, or even technology, and are among the fuzzy-set of associated items that are included in science fiction.

Techne is empirical in the sense that science fiction refers to the experience of the existence of an empirically based world, and the empirical survey of science fiction readers

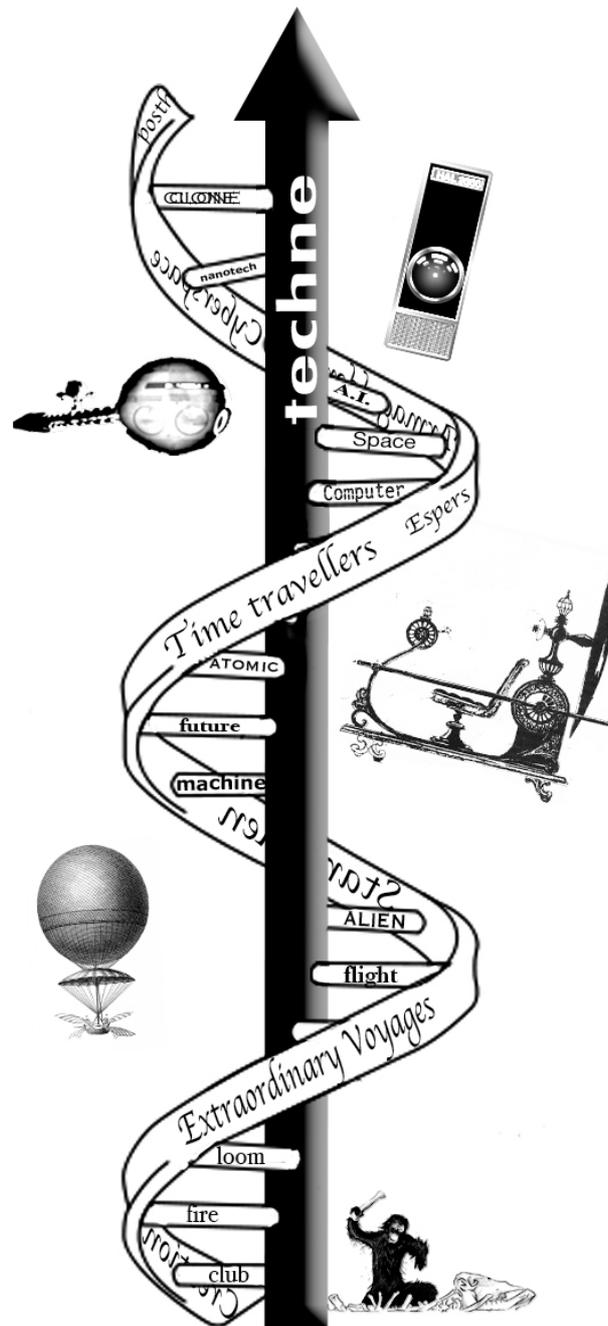


Figure 8. 'techne-fiction'

finds clear and practical categories that separate science fiction from fantasy literature. The difference between science fiction and fantasy is decided by mutually exclusive facts, and science fiction is easily recognised.

The academic definition of genres is the continuing subject of debate, and has inspired diverse FoE theories. We suggest that a reason for the multitude of academic theoretical approaches is because they tend to focus on transient surface features of the genre, and this obscures the empirical core of science fiction that general audiences find definitive. In contrast to pure research, applied research requires this more democratic definition. Wittgenstein's notion of family resemblances can explain the collection of 'things' that surround the core category classification, as well as the unproblematic retroactive classification of pre-sf work, as the family provides a way of identifying related content –not merely a set of clearly defined rules. But, it appears that underlying the way of understanding, there is a continuous, historical, presence, which explains why these categories exist. The specific terms in the context of the literature correspond well to Aristotle's use of the term 'techne' for what is commonly described as science fiction, and magic for fantasy. This practicality of popular definition has been recognised by some authors. Philip K. Dick was clearly amused by orthodox critical analysis of science fiction:

One time I read in a distinguished book of criticism on sf that in my novel *The Man in the High Castle* the pin which the character Juliana used to hold her blouse together symbolized all that which held together the themes, ideas, and subplots of the novel itself – which I hadn't known when I wrote that section. But what if Juliana, also not knowing it, had removed the pin? Would the novel have fallen apart? Or at least come open in the middle and exposed a whole lot of cleavage (which was why her boyfriend insisted she put on the pin in the first place)? (Dick, 1980)

J.G. Ballard criticised the gap between academic and non-academic interpretation of science fiction, styling the academic criticism as the “apotheosis of the hamburger,” unrelated to the origin or intention of writing, or the perspective of the reader (Ballard, 1991: 11). The intention here is to provide popular definitions for science fiction and fantasy to fill that gap, ones that can be used by interdisciplinary researchers, who want to employ safety-pins that are sharp, effectual, and not merely conceptual.

5 Conclusion

The people who consume and enjoy sf are their own arbiters of what it contains, and provide robust definitions based on simple categorical indicators. Engaging the public in applied research that borrows from science fiction calls for a shared understanding of what science fiction is, and accepting this popular comprehension of the genre is key to successful research outcomes in communication, advocacy and pedagogy that employ science fiction to effect results. The categorisation of works such as *Dune*, and the use of the term 'science fantasy' calls upon the two clearly defined categories of science fiction and fantasy, rather than creating

something distinguished by its own terminology, and this reinforces our findings that these genres are very clearly separated in the minds of individuals. Effective use of science fiction in research that features public engagement should acknowledge the persistent cores – science/technology for science fiction, and magic for fantasy – that reflect ‘the people’s choice,’ rather than relying on traditional academic definitions or the assertions of authors, which are not founded on empirical analysis of phenomena.

We suggest that the core characteristics of science fiction and fantasy, of *techne* and magic, have been reflections of a human way of thinking about the world for recorded history, and this is the human embodiment of *techne*, as the phenomenological experience of what it is to be human in an experiential, physically consistent and humanly modified and shaped world. This in-built comprehension of *techne* drives the genre categorisation of fictional works. Wittgenstein’s ‘family resemblance’ is a twisted thread wound around a persistent core of real and specific characteristics. As John Frow, concluding his work *Genre*, suggests: “Through the use of genres we learn who we are, and encounter the limits of our world” (Frow, 2006: 144). We would suggest that who we are, and the limits of our world, are fixed in certain specific dimensions, and this is reflected in our recognition of science fiction as *techne*. It is a ‘*techne-fiction*’ of plausible unrealities, inspired by the tool-using possibilities that came from the evolution of an opposable thumb. Kubrick’s ape throwing his bone club in the air (Kubrick, 1968), was not only showing us the dawn of technology, but also the dawn of science fiction.

6 Ethics Approval

Ethics approval was granted by the university human research ethics committee on 19th October 2015, approval no. H6299.

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8 Appendix

See attached file *TS Category Data.xlsx* for data used to create the Categorisation Tree presented in Fig 4., Section 3.