Audience Engagement Strategies in a Science Popularisation Podcast with a Focus on Metadiscourse

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Abstract

Scientific research has the potential to greatly impact the lives of ordinary people. It may inform decisions about the ways in which they live their lives. Primary outputs of this research into academic publications are often not useful for laypeople, both because the presentation of the information is too specialist or complicated, and because they contain sections such as methodologies which are extraneous to their goals of using the information in their everyday lives. Laypeople often rely, therefore, on popularisations of science to obtain the information, which are more linguistically and structurally suited to their needs. Within these popularisations, engagement strategies are vital for keeping audiences motivated to consume the content. The premise of this research is that science popularisation podcasts are a form suited to heightening audience engagement with scientific content. It investigates strategies of audience engagement in these podcasts quantitatively using a corpus analysis, in accordance with a metadiscourse framework. It also contextualises these findings by performing functional qualitative analyses. It finds novel uses of metadiscourse features to help to build audience engagement strategies, including non-typical organisational and guiding lexes and community-building language. Non-metadiscourse features also contribute to these strategies. It finally advocates for an audio-specific framework for metadiscourse, to allow for identification of extralinguistic and structural features, such as tone and repetition respectively.

1) Introduction and Background

The work of scientists and scientific communities is crucial for developing, enriching and enhancing our understanding of the world. Academic work provides insight into a broad range of fields, from healthcare to government policy, from ecology to religion, and countless others besides. Thus, this work has the potential to be a crucial driving force of change, both in the ways that we live our lives on a practical level, and the ways we think about things on a cognitive or ideological level. Publications of this academic work are, however, often unavailable to the general public. On the most literal level, this may be the result of information barriers such as paywalls or institutional access restriction. Figueroa (2022, p.41) refers also, however, to the "psychological paywall" by which she means the way that the language used in academic publications "gatekeeps" scientific research by using "arcane vocabulary and discourse structures" which seem to suggest that membership within expert communities is required to understand what is being discussed. This discourages non-academics from consuming the research in any meaningful way, thereby restricting the distribution of academic work which could impact the lives of laypeople.

The solution to this problem is not to change the form and language of research papers, since they serve the highly valuable purpose of information-sharing between specialists in their fields. They are carefully crafted to meet this goal, with methodology sections facilitating replication studies and detailed results sections allowing for careful examination of findings, for example. Instead, it must be recognised that laypeople could likewise benefit from having access to the research, and that their reasons for wanting the knowledge may be different. Allowing them this access requires for elements of how the research is communicated and presented to be changed, to successfully align with their reasons for wanting the information.

Cloître and Shinn (1985) suggest that there are four stages of scientific communication. Moving from the most esoteric and technical to the most accessible, the first stage is the "intraspecialist level", consisting of papers published in specialised journals. The second stage is the "interspecialist level", which may include interdisciplinary journals, or papers distributed to academics operating in the same field but with different specialisms. The third stage is the "pedagogic level", which consists of teaching materials, where theories are consolidated, and the paradigm presented as resolved. The final stage suggested is the "popular level", consisting of, for example, press articles and television documentaries. These are the publications expected to be consumed by lay audiences, whose concerns may be either purely curious or rooted in practical implications for their lives, and thus are far removed from fine-grained experimental and procedural details. The process of transforming the output of academies and academics into "popular level" forms that meet the needs of the lay public is called science popularisation.

Science popularisation is a complex task, which involves changing the semantic content of the research. This is necessary since the "voices of professional science" can often contain "forbidding" features (Hyland, 2010, p.118). For example, while a scientific paper may refer to a compound as "$H_2C=O$", a popularisation may instead refer to it by its more familiar common name, formaldehyde. The potentially "forbidding" equation form appropriate for "professional science" contexts has been adapted for contexts outside of the academy. Hyland points out that it is also necessary to adapt the forms in which the information is communicated, to meet the goals of ordinary people consuming scientific content, since "the science of the specialist does not look like the science of the layperson" (Jurdant, 1993, p.2).

Unlike scientists, laypeople are not consuming research with rigorous academic goals, such as intention to perform replication studies or inform their own research, in mind. Their goals may be, for example, to find out what is the best breakfast to eat before going for a run, to learn the cultural norms of a country before going on holiday, or simply to satisfy their curiosity and be entertained.

For these goals to be met, I argue that it is highly important for science popularisers to ensure that their audiences feel engaged by and with the content, so that they remain motivated to consume it. By "engagement", I refer to the process of consuming and interacting with content in a way that is meaningful in the context of their goals. This involves strategies that help to guide them through the discourse, which provides them with a better chance of retaining the information (Hyland, 2019). It also involves linguistic efforts to present the information as exciting and relevant, to increase motivation to consume content (Luskin, 1990). Finally, strategies that make audiences feel acknowledged appeals to the want for community and inclusion (Brown and Levinson, 1987). These considerations should result in a form that informs, entertains and includes the audience.

The podcasting medium appears suited to these goals. Podcasts employ guiding techniques to create a clear structure, to compensate for the fleeting nature of information delivered audibly; verbal signposting must be employed when there is no visual reference to return to Ye (2021). They are diverse in the vocabularies that they use (Reddy *et al.*, 2021), allowing for novel linguistic strategies to be used to make content interesting. Listeners to podcasts can use the digital environment to build communities to discuss episodes, for example in forums and blogging sites (McClung and Johnson, 2010). These factors allow listeners to engage

richly with the content, integrating it into their lived experiences (Pilkington, 2018, p.1). While the use of podcasts in formal classroom settings has been widely researched (eg, (Yugsán-Gómez et,al, 2019, Jarvis and Dickie, 2010) there has been little discussion of podcasts as informal learning tools for adult listeners. Nor has there been scholarly acknowledgement of the very valid audience goal of learning for curiosity's sake, to expand the mind and enjoy oneself.

I argue that a Metadiscourse framework is appropriate to apply when investigating engagement strategies in science popularisation podcasts. Metadiscourse is language which reflects efforts made by communicators to interact with their audiences appropriately, in the context of their needs (Hyland, 2010). Within Hyland's (2019) model of Metadiscourse, this involves two main "dimensions" – the "interactive" dimension, consisting of language which guides audiences through texts, and the "interactional" dimension, which encourage audiences to respond to texts by addressing them (directly and indirectly) and signposting the significance of the content. These dimensions encapsulate the engagement-building considerations I outline above - of guiding strategies, excitement and relevance strategies, and inclusion strategies - therefore I argue that a focus on metadiscourse in exploratory analyses may be lucrative and appropriate.

It is important at this stage to draw attention to a potential point of confusion as regards this research and Hyland's model. "Engagement Markers" are a category within his framework. These refer, however, to only "markers which explicitly build a relationship with the reader" (Hyland, 2005: 54). In this research, I expand the definition of engagement, to any meaningful interaction with the text facilitated by strategies which make the audience feel

guided, motivated to listen, and acknowledged. This expansion allows for discussion of strategies which are not explicitly relationship-building but do encourage cognitive involvement with the content. For example, being told that the podcast is about to move onto a new section does not explicitly build a relationship, but it does allow the listener to mentally prepare for a topic shift, and therefore make them feel more able to cognitively engage with the content without feeling lost. This research will, therefore, discuss engagement markers according to the definition in Hyland's framework when discussing metadiscourse items, but refer to my wider definition of "engagement" when discussing the main focus of this paper – functional engagement strategies.

For analyses of engagement strategies in podcast data to be to be thorough and representative, it is necessary to analyse large quantities of data. This helps to ensure that any conclusions formed reflect the language variety as a whole, rather than being a single feature identified in a single text. For this, I propose the use of corpus linguistics, which uses computerised tools to investigate a "large collection of authentic text" (Stefanowitsch, 2020, p.1) which is judged to be sufficiently representative of a language variety. The tools available include quantitative methods such as word frequency counters, as well as qualitative tools such as concordance line analysis, where examples can be expanded to show their context. The interplay between these tools allows for analyses to be performed both on a macro-scale and a micro-scale, giving thorough insights into the nuances involved in overarching patterns within language varieties (Reppen and Simpson-Vlach, 2020).

In this research, I will investigate the following research questions:

1) How frequently does the science popularisation podcast use metadiscourse to encourage audience engagement, as compared to other modes of science communication?
2) Which metadiscourse items are used notably more frequently/differently in the science popularisation podcast as compared to other modes of science communication?
3) What linguistic strategies of audience engagement can be identified in the science popularisation podcast by examining uses of metadiscourse?
4) How do non-metadiscourse features contribute to these audience engagement strategies?

I will use my insights from these questions to argue that:

- Linguistic strategies to engage the audience are highly important to consider when popularising science.
- The podcasting medium may be well-suited to attending to engagement needs when popularising science.
- A metadiscourse framework is appropriate to apply in the investigation of engagement strategies in a science popularisation podcast.
- Corpus linguistics methods provide appropriate tools to undertake metadiscourse analysis.

The research consists of three investigations. Firstly, there is a comparative corpus metadiscourse analysis which, obtains an exploratory, quantitative overview of the data. Then, there is a close qualitative analysis of a sample of the data, exploring some surprising

results from the quantitative data. Finally, there is a concordance analysis of a larger sample of the data to contextualise the quantitative results. Insights from these three investigations combine to inform conclusions, which address the research questions, and subsequently support my arguments.

2) Literature Review

This literature review will be split into two sections. In 2.1, I will discuss science popularisation, with a focus on considerations which must be made when producing popularisation texts to be engaging. Here, some background will also be given on podcasts, in the context of their potential benefits and drawbacks when popularising science. In 2.2, I will review of the frameworks and methods which may be appropriate to apply when investigating engagement strategies in science popularisation podcasts.

2.1) Science Popularisation

To popularise science is a complex task, with far-reaching implications in terms of public opinion on scientific matters. It has been suggested that people agree more confidently with knowledge claims made in popularisations than in articles created for expert audiences (Scharrer *et al.*, 2017), likely since the linguistic accommodations made for their non-expert statuses allow them to feel more secure in their own convictions. The importance of popularisations in people's lives makes it important to consider how they fit into experiences of the world. A "discourse" is a language-centred way of comprehending and engaging with the world, shared between participants in a particular situation or context. Discourse encapsulates three main "dimensions": language use, the communication of beliefs, and social interactions (Dijk, 2011:2). These dimensions allow those involved in the communication to interpret and mentally rearrange disparate pieces of information and reformulate them into organised accounts or explanations which fit the required context (Dijk, 2011: 2). In other words, discourse concerns the use of language to communicate ideas in social situations, and helps to organise the information to fit into contexts of use. Individual discourses are founded in pre-existing judgements, assumptions and ideological

challenges, which present the possibility for analysis, consensus, agreement or disagreement (Dryzek, 1997: 8). Those producing discourses are doing so in accordance with their own views of the world, which are open to being challenged by the reader or audience member. These views manifest linguistically through a process of framing, in which parts of a reality are carefully chosen to have attention drawn, and others are backgrounded or actively obscured (Egorova, 2018). A science popularisation discourse is then, a way of presenting information to fit its contextual goal of making information engaging and understandable for those without scientific training, and also one in which opinions and views may become apparent by what is backgrounded or foregrounded.

Encoded in the goal of popularisation is to emphasise "the uniqueness, relevance and immediacy of topics which might not seem to warrant lay attention by making information concrete, novel and accessible" (Hyland, 2010, p.126). Further expanding on these goals, Fu and Hyland (2014) suggest three conditions that must be met by science popularisers. These are:

1) To be able to linguistically express themselves in a creative manner to heighten interest in the topic.
2) To have a good understanding of their topic to ensure that they are presenting information accurately.
3) To have some understanding of who they are to be addressing.

To anchor this section of my review of literature concerning science popularisation I will discuss these considerations, under the headings of "2.1.1) Creativity and Interesting Content" "2.1.2) Informational Content and Accuracy", and "2.1.3) Audience Awareness and

Acknowledgement." The first and second of these sections address the engagement strategy goal of providing relevant and exciting content, and the third the goal of audience inclusion, acknowledgement and guidance (see section 1).

2.1.1) Creativity and Interesting Content

Scientific content could potentially be seen as daunting by lay-audiences. It is highly important, therefore, that the information is presented to them in a form that is sufficiently creative and interesting to override this potential to feel intimidated and keep them motivated to consume the content. This encapsulates both creative linguistic resources, and novel and stimulating modes of presenting information. These combine to help the audience to remain engaged.

As discussed by Hyland (2010, p.118), the linguistic forms in which arguments and information are presented is important to consider when popularising science. One way in which the form of the information presented may differ between academic publications and popularisations is in the different types of narratives produced. A narrative is "a particular way of reporting past events, in which the order of a sequence of independent clauses is interpreted as the order of the events referred to" (Labov, 2006, p.1). In other words, a narrative presents information sequentially, like a story. As well as being an imaginatively rich way to present information, narratives also serve an informational purpose, with readers being reported to understand chronologically presented information best (Ohtsuka and Brewer, 1992). Myers (1990, p.142) holds the view that academic papers are essentially an exercise in creating a "narrative of science", in which the "story" of a scientific investigation is presented with a focus on procedures, with attention paid to methods and the agents

carrying them out. Popularisations on the other hand construct instead a “narrative of nature”, where instead of the agents and processes of scientific discovery being the focus, the majority of attention is paid to the concept under investigation as it exists in the natural world. The “mystique” of science is removed “to portray research as an immediate encounter of a scientist with nature” (Fu and Hyland, 2014). This type of narrative serves the communicative purpose of science popularisations to entertain, often using creative linguistic strategies such as metaphor and personification to enrich information (Hyland, 2010).

Another strategy for encouraging interest in the content under discussion may be to create positive feeling around the field of science itself. This can be termed “celebratory discourse” in science popularisations (Bucchi, 1998) which can be described as “a celebration of science and its achievements and practitioners” (Pilkington, 2018, p.15). Pilkington (2018, p.15) discusses this celebration of the agents of science as an alternative to the removal of agents through narratives of nature. He claims that popular science books may “dramatize” scientific endeavours through “presented voices”, which show scientists as endearing figures, possessing qualities such as being emotive, creative and relatable. For example, a scientist embarking on a new research project may be presented as them saying, “I’m going to find out about X!” As Fu and Hyland (2014, p.15) put it, science is “brought to life” by attributions to named figures as opposed to “faceless scientists”. In other words, selecting a single named scientist and presenting scientific findings as their “voices” creates a rich character, which makes the sharing of scientific information seem more like a story. Within this story, the relationship with the partly created scientist character is more intimate, therefore less open to criticism, since they have been presented as relatable and human. This dramatization may alternatively take the form of ascribing agency to inanimate results, through strategies such as the passive voice and dummy “it” subjects. This creates characters from non-human entities

and thus separates human agents of science from any potential criticism, hence celebrating them (Hyland, 2010, p.123).

Scientists' "voices" may also serve the purpose within science popularisations of tracking the process of scientific investigation while removing the focus from actual procedures. Here, potentially emerges a third type of narrative beyond narratives of science and narratives of nature: "narratives of discovery". These place the focus on the genius intellectual activities of science and obscure experimental activity (Pilkington, 2018, p.75). Rather than revealing anything personal about the scientist's character, mental action verbs such as "wondered" are combined with hedges such as "if", to trace the path from hypothesis to discovery in scientific investigation. Scientific advancements are presented as having been made due to a scientist having "questioned whether" something might work. The genius mind of the scientist is presented as producing the results, rather than these being produced by hands-on procedures. This has been hypothesised as a strategy to establish a close relationship between the reader and the issue under discussion (Pilkington, 2018). To expand on this, the scientist is perhaps presented as having the same sort of inquiring mind as the reader, who may have been wondering the very same thing. There is then no stage in between the inquiry and the results to alienate the reader from the world of the scientist.

It is not only the linguistic content of science popularisations which affects how interested people are in the content. The affordances of the different modes by which the information is communicated must also be considered, especially in the context that people currently have more choice than ever in their media consumption (Aalberg, Blekesaune and Elvestad, 2013). There are many avenues by which people can acquire scientific knowledge, largely due to

technological advances and the internet which allow for digital forms of popularisation. Digital popularisations been hypothesised to have a "bridging role in society", giving less educated people access to information in a way that is more in line with communicative methods they are used to (Boukes and Vliegenthart, 2019). There are many ways this may manifest. The information is presented in a way that is more similar to spontaneous, real-life communicative contexts and is thus less intimidating to those unfamiliar with academic communication (Cho *et al.*, 2003). The multiple channels of input (for instance, sound and moving pictures) allow for harnessing of cognitive processing abilities beyond reading, which give more opportunities for information absorption (Keeter, 1993). In other words, if reading is difficult, people can receive the same information by listening or looking at a recording. These multiple channels also activate multiple senses, leading to multiple areas of sensory entrenchment in memory and increasing the chance of retention (Clark and Paivio, 1991). These factors combine to create an environment equipped to create interest in the content, through harnessing of creative resources to communicate information appropriately and broadly. In short, digital popularisations may allow people intimidated by written media access to science, due to the accessibility afforded by the alternative presentation of the information.

2.1.1.1) Podcasts

The podcast is a digital mode which I argue is especially suited to science popularisation. In the following few paragraphs, I will discuss popularising science in the context of the podcasting medium, in line with the focus of this research. I will discuss the advantages and disadvantages of audio-only formats, present modal features which may heighten audience

engagement, and consider how the tone and linguistic style of podcasts make them appropriate for science popularisation.

A podcast is an audio file which can be downloaded to an electronic device and played back at the user's leisure (McClung and Johnson, 2010). Podcasts have arisen in the digital age, in which new forms of media are changing the process of communicating science to mass audiences, through the obscuring of conceptual lines between public and academic circles (Trench, 2008a). It may even be the case that having scientific knowledge available, literally in one's pocket, makes the abstract world of science appear more immediate and real to the public. New forms of popular science such as podcasts may reasonably therefore be seen as fulfilling an intermediary function, between the sphere of science and the sphere of the general public (Moirand, 2003).

Initially, one may assume that the audio-only channel of input may be a weakness of podcasts as a communicative mode. Audio-only formats have been described as "ranking low on the scale of immersive environments" (Fryer, Pring and Freeman, 2013). This pertains to the fact that the single channel of input necessitates the listener to draw on their own imagination more so than images that come from the real world, therefore the resulting image may be far removed from what the speaker intends them to imagine. Crook (2002) however, regards this as a strength rather than a weakness, arguing that audio input creates a "theatre of the mind", where the harnessing of pre-stored images allows the listener to create a personal, therefore rich image built from their own experiences. Their level of understanding may subsequently be higher since they have been able to create links with their own lives. Murray (1997, pp:98-99) regards the single channel as neither a strength nor a weakness, arguing that our mind is a

powerful tool, encoded with the ability to “tune into stories with an intensity that can obliterate the world around us”. In other words, the mental imagery evoked by audio media can create mental visual imagery which is sufficiently strong to override the lack of visual input.

Another potential benefit of the podcasting medium is the fact that the audio-only format allows the listener to multi-task, for example they can listen during their commute or whilst preparing food (Perks and Turner, 2019). This increases the amount of time that they are able to consume the media. While their concentration will be impaired by their completion of a parallel task, they are still receiving a stream of input. This is highly valued in an educational context. In one study, for example, students rated podcasts higher than textbooks as tools for revision, as they were able to receive information even when not actively studying (Evans, 2008). When Figueroa (2022, p.41) asked her Twitter following to define podcasts, ease of consumption and ease of learning were mentioned frequently. For example, she received the replies “listening while learning”, “infotainment”, and “like a radio broadcast, except you can listen to it whenever and without a radio.” This can be considered in terms of the “opportunities-motivation-ability” framework (Luskin, 1990). According to this, there are three factors which affect people’s acquisition of knowledge.

This accessibility of knowledge that the podcasting media affords makes it a successful channel through which information can be disseminated beyond the limited accessibility that academia allows. Figueroa (2022, p.41), as discussed in Section 1, refers to the “psychological paywall” by which academic language “gatekeeps” scientific research by using “arcane vocabulary and discourse structures” suggestive of clauses of membership

within expert communities. This restricts non-academics' ability to consume the research in any meaningful way, thereby restricting the distribution of scientific and academic work. Successful podcasts, by contrast, have been found to employ "diverse vocabularies" beyond the typical lexicon of academic writing. This was discovered through analysis of how linguistic style relates to listener engagement. Along the metrics of vocabulary diversity, distinctiveness, emotion and syntax, popular "high engagement" podcasts were found to consist of varied lexical choices (Reddy *et al.*, 2021, p.9).

Figueroa (2022, p.41) discusses also the impassive tone of academic articles, which can reduce potentially emotionally rich topics to objects of cold, "dispassionate" theory. Podcasts, by contrast, "allow people to be outraged", an emotion recognisable by the listener which encourages them to engage critically with the material. This psychological enablement of "authentic engagement" facilitates conversations which help to move listeners away from the idea of "science as infallible". Such conversations may be instrumental in allowing more diverse participation in science, due to the felling of the "psychological paywall". Additionally, further emotional connection is afforded by the social aspect of podcast consumption, which is built as listeners discuss the show with fellow consumers (McClung and Johnson, 2010). Sharing of views and opinions between podcast-users has also been shown to positively impact a potential user's intention to listen to the podcast, which provides evidence that a community of listeners increases engagement (Mou and Lin, 2015). Additionally, this community element encourages the reader to engage with the content on an emotional, ethical or personal level, thus enriching the absorption of the content and moving the listener away from taking in the information passively (Pilkington, 2018, p.1). This increased cognitive engagement may help listeners to develop intellectual tools by which to integrate their new knowledge into their lived experiences.

Science communication podcasts have been explored in the context of reformulating scientific discourse. Ye (2021), for example, looked at the "60-second science", which condenses scientific information into 60 seconds, from a genre perspective, with a focus on the fact that the discourse was reformulated for diverse audiences. It was found that there was a distinct structure to the podcasts: Orientation, Claim, Credibility, Intro-Methods-Results-Discussion, Termination. This structure was interpreted as combining to create an engaging and inclusive environment, in which all members of diverse audiences felt welcome in the discussion. The investigation did not, however, perform in-depth contextualised analysis of individual linguistic features to confirm this interpretation, which my research hopes to contribute.

2.1.1.2) Section Summary

To summarise, it is important for science popularisers to make the content they produce narratively interesting and linguistically creative. This helps to override the potential for the potentially complex scientific information to intimidate audiences and creates a positive learning experience. Digital modes can be harnessed to assist this goal, as they use alternative channels of communication which may be more familiar to laypeople than the written mode of traditional science communication. Auditory media in the form of podcasts is one such channel, which may be especially suited to science popularisation due to features such as their tendency to employ diverse and inclusive vocabularies, and to maintain consistent structures to guide listeners.

The following section will address the potential difficulties when balancing the need to make content interesting and creative, with also making it accurate and well-informed. I will discuss how findings are framed to achieve different goals, the balance between concreteness and nuance in reporting to laypeople, and conditions that should be met in the popularisation process to maintain accuracy. Accurate information will make listeners more able to engage with the content meaningfully, as it will more reliably be able to inform their decisions.

2.1.2) Informational Content and Accuracy

Much prior work concerning the accuracy of the informational content of science popularisation comes from the specific field of science journalism. The insights from this work will be discussed here despite being concerned with a different mode of popularisation to the focus of this research, as the two genre overlap in their goals of disseminating scientific information appropriately to non-expert audiences.

Print journalism appears to be held in high regard by laypeople as a channel of accurate communication, with Kiousis (2001) finding newspapers to be rated as the most credible source of information across media channels. As (Bell, 1994, p.33) points out however, “there remains considerable mismatch between media reporting of scientific information and the public’s understanding of that information.” It is important to note firstly that print journalism is mediated through a number of channels, which have the potential to manipulate different aspects of the information. All news is filtered, at the very least, through an editor, who may operate at different levels of accuracy maintenance. The journalists themselves may also be contributing to this so-called “mismatch” through the processes by which they linguistically manipulate primary information for their publications. This may not be intentional. Some

journalists may be considered lay-people in their understanding of scientific matters (Bell, 1994) and have genuinely misunderstood the primary sources which they are popularising. The nature of a journalist's job, in which they are often given a tight deadline in which to write about something of which they have little prior knowledge, causes difficulties in producing accurate content which they themselves understand.

A more cynical angle concerns deliberate manipulations to the informational content, to make for a better story. As Breeze (2015, p.1) notes, often "the original sober account of laboratory findings is hardly recognisable in the ensuing newspaper stories, which proclaim a dramatic discovery that will have an immediate impact on readers". For example, a secondary finding which is more headline-worthy may be foregrounded, or a particular result inflated. A sympathetic view of the motivations behind these manipulations recognises that there is some sensitivity here to the hypothesised goals of laypeople (see Section 1), who may be more concerned with entertainment than informational rigour. More concerning to consider, however, is the potential for inaccuracies to deliberately frame certain agents or entities in an exaggeratedly positive or negative light, or to sensationalise events to instil a sense of catastrophe (Bell, 1983). An example of this is emotional and sensationalised reporting of the science behind vaccines, which during the Covid-19 pandemic aligned public concerns with the media's desire to find an impactful story (Breeze, 2020).

Breeze's work illustrates the difficulties of combining entertainment concerns with information sharing in science journalism. Bednarek and Caple (2017, p.3) term the entertainment value of journalism as its "newsworthiness", and note the importance of "proximity, negativity, superlativeness, timeliness and unexpectedness" when choosing or

constructing a story. The need to balance engagement with credibility involves a selection process of considering what findings may be impactful on the world, which may jointly be construed as "dramatic or extraordinary". The outputs following this selection process tend to be "human interest narratives" consisting of "simplified and stereotyped imagery and more colloquial emotion-laden language", (Molek-Kozakowska, 2016, p.158) even when the coverage ought to be more objective and scientific (Calsamiglia and Van Dijk, 2004, Myers 2003). This is relevant across popularisation forms, where informative goals must be balanced with entertainment to ensure that the non-specialist remains engaged and interested.

The conflicting interests of science journalism between information and entertainment (henceforth "infotainment") lead Molek-Kozakowska (2016, p.158) to conceptualise science journalism as a "hybrid discourse". She advocates for a methodological framework specific to this hybrid discourse, which examines:

1) The number of voices and sources provided, and how many identity positions this creates.
2) Evidentiality, which concerns the source of the knowledge – whether it is sensory experience, participation in a process or event, inference-based, reproduced evidence from an outside source, or hearsay.
3) Epistemic stance, concerning the certainty afforded to a proposition through decisions such as modality choices ("X will happen", "Y might suggest").
4) Expressions of proximity, whether spatial, temporal or evaluative.
5) The extent to which apparent common ground is linguistically created between scientists and readers.
6) The extent to which information is presented using emotion-laden words.

She asserts that examining these linguistic choices can help to reveal how information is foregrounded to make certain aspects appear relevant in a text. Awareness of the manipulative effect of these choices could help to mitigate the potential for subjectivity and inaccuracy in informational content.

2.1.2.1) Section Summary

To summarise, to achieve their different goals, an original scientific publication and a popularisation will differ in their levels of detail and accuracy. There is a likelihood that details may be obscured or excluded in a popularisation, such as the details of experimental design, qualifications in results, and possible alternative explanations. The inevitable tendency to compare popularisations against their source materials means that these changes in textual focus may be interpreted as losses (Fahnestock, 2004). In discussions of the informational content of science popularisations, however, it is important to remember the goals of making information "concrete, novel and accessible." (Hyland, 2010, p.126). To make something concrete involves removing some nuance, to make something novel involves prioritising excitement and entertainment, and to make something accessible involves simplifying it. Adapting the level of accuracy cannot be viewed in this context, therefore, as an entirely negative process of reducing quality and truth-level. Rather, it is sometimes a necessary consequence of popularising science, which arises as the information is recontextualised towards the goals of non-specialist audiences. As discussed in Section 1, Krimsky (1988) similarly points out that experts and members of the public may have different concerns when it comes to what aspects of science are reported, and the information may be refocused to reflect this. In short, the "loss" interpretation fails to consider the fact

that the reframing is not necessarily a deficiency, merely an adjustment required to meet the different needs of a different audience.

In the following section, I will discuss in more depth the considerations of audience needs when popularising science. I will address the difficulties of designing communication to a mass audience when demographics may be unclear, the need to consider prior audience knowledge and present information at an appropriate level, the need to guide audiences to ensure that they feel supported, and the benefit of attending to interpersonal needs such as politeness and inclusivity to create positive experiences for the audience. These positive experiences will encourage them to engage with the content, as their interpersonal needs are attended to.

2.1.3) Audience Awareness and Acknowledgement

The science being communicated in popularisations may be highly complex. It is important, therefore, for the text producers to be aware of the audience they are addressing, to communicate the content effectively. This involves knowing at which level to pitch information to be appropriate for their knowledge bases, constructing appropriate textual interpersonal relationships with the audience, and ensuring that the audience feels welcome, valued and welcomed in the discussion.

The stereotypical “dominant view” (Myers, 2003, p.266) of popularisations takes a deficient view of the audiences it is addressing. It sees popularisation of science as a process of one-way simplification of information; scientific publications are seen as prestigious originals,

translated for an audience assumed to be highly uninformed. According to Myers, (2003, p.266) this rather simplified view rests on five assumptions:

1) That scientists and their institutions are the sole authorities as to what ought to constitute “real science”.
2) That the reading public are an entirely uninformed “blank slate” when it comes to scientific knowledge.
3) That knowledge transfer occurs only in one direction: from science to society, with no transfer in the opposite direction.
4) That scientific content can be conceptualised as the information contained within written statements.
5) That the process of “translation” involves changing not only the textual form of the information, but also the information itself, where it is “simplified, distorted, hyped up and dumbed down”.

I will attempt to challenge each of these assumptions in detail, to explain why this deficient view is both inaccurate and unproductive when popularising science. Firstly, if it were true that only science and scientists may dictate what constitutes scientific information, there would be no debate to be had – the world would quietly concede to the superior knowledge of a universally agreed upon institution or voice of authority. This raises a number of difficulties. For example, how would this voice be selected? It could not be a matter of prestige, since equally revered academics may present compelling evidence in support of completely conflicting hypotheses. Even if a voice were to be selected, what would happen if highly compelling evidence were presented which appeared to disprove its theory? Would the pre-selected dominant entity take priority, or would there need to be a formal shift in consensus? How would this consensus be communicated? This is quite plainly not the current

reality – hence the downfall of the first assumption. Instead, scientific consensus is a process constantly in flux, which changes as new compelling evidence from informed scientific voices is presented. One only has to look at the ever-shifting proclamations of which foods 'will definitely cause cancer' in the media that arise as new discoveries are made, to see that there is no one authoritative voice.

To address the second assumption, it cannot be assumed that lay-people are entirely uninformed about a topic. Luzon (2013) gives the example that if somebody has a child with a rare disease, they may hold specialist knowledge of that disease beyond even that of medical professionals who may otherwise be assumed to be the voice of authority. This also raises an opposition to the fourth assumption. Surely the specialist knowledge acquired by this hypothetical caregiver, through observation of and interaction with their child, could be considered scientific content? Oxford Languages defines "science" as "the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment." The practice of engaging each day with the child, testing therapies, observing results and reflecting on how best to proceed appears to fit this definition. Even if not written down and published in an academic paper, the information the caregivers have acquired may well be extensive, nuanced and - perhaps most pertinently - rooted in reality, and thus may have practical and replicable implications in the real world. To relate this to the third assumption, here information gathered by a so-called uninformed member of the public may feed back into the scientific domain, resulting in the transfer of information from society to science. Bucchi (2008) provides specific examples of domains where the lines between specialist and popular levels may be blurred, due to factors such as immersion in a particular culture or proximity with affected parties.

Likewise in opposition to the third assumption, the need for the public to actively interact with science has been recognised in policy documents in many countries, evident from the keyword shifts such as "from 'public awareness of science' to 'citizen engagement'; from 'communication' to 'dialogue'; from 'science and society' to 'science in society' (Bucchi, 2008, p.68) – all of which suggest a blurring of the lines between the domain of science and that of society (Wilsdon, Stilgoe and Wynne, 2005) (Trench, 2008b).

As regards the "translation" process discussed in the fifth assumption, in which information is "simplified, distorted, hyped up and dumbed down" (Myers, 2003, p.266), Luzon (2013) proposes an alternative term: "discursive recontextualization". In this view, the pertinent aspect of science popularisation is not necessarily the basic regurgitation of facts, but the reporting of knowledge for different purposes (Hyland, 2010). To elaborate, the popularisation of science is not reduced to a process of stripping down complicated information to its bare bones for an intellectually deficient reader; rather it is recognised that information needs to be presented in different ways for lay readers compared to academic readers, whose reasons for seeking the information will be different. For example, laypeople may wish to focus on the practical implications of a study rather than the (potentially linguistically specialist or complicated) methodology, since they will not be replicating the work themselves – rather wish to know only about the parts relevant to their own lives (Krimsky, 1988). Attention to this in popularisations manifests linguistically in many ways, such as the avoidance or immediate glossing of terminology and jargon, the on-the-fly insertion of clarifications, and the use of figurative language to compare complex processes to a familiar concept for ease of understanding (Hyland, 2010).

For communication to be successful, the communicator must be somewhat aware of their audience's goals, conventions and points of reference (Bizzell, 1993). Discussions of awareness of the audience when communicating must consider the concept of "audience design" (Bell, 1984, p.145). This refers to the fact that speakers curate their speech according to who their audience is (Clark and Murphy, 1982), mediated by considering the appropriateness of doing so in a particular setting, or when discussing a particular topic (Bell, 1984). This may involve a process of accommodating to the addressee of the speech, by making one's own speech as close as possible to that of the listener for a higher chance of successful communication, and of approval. This, is termed "accommodation", in which convergence occurs on levels such as speech rate, accent, content and number of pauses (Giles and Ogay, 2007, p.293). In the context of science popularisations, audience design may primarily be a case of communicating in a way as similar as possible to the language of the predicted addressee, whilst also being aware that the language needs to be able to fit the communicative goal of information sharing.

The "design" aspect of audience design may be complicated by the constraints of mass media communication. The speaker has no conversational partner towards whom to converge. The speaker is additionally, unlike in face-to-face interaction, cut off from the opportunity for immediate feedback about whether the message was successfully transmitted. A podcast listener cannot turn immediately to the host and request that they rephrase something. This means that any accommodations made must be towards "an image, an ideal, a perceived class of persons" (Bell, 1984, p.192). In other words, the speaker must, to some extent, guess who their audience may be, and adjust their language towards a hypothesised audience. It has been

hypothesised that the most successful strategy here may be to “Aim Low”, which means to design communication to be understood fully by the least knowledgeable of the addressees (Yoon and Brown-Schmidt, 2018, p.566). This runs the risk, however, of being insulting to the audience, while being too vague risks leaving them confused (Horton, 2008). An experimental study found that in multi-party conversation speakers tended to use a combination approach, designing speech to integrate the knowledge and perspectives of participants on all levels (Yoon and Brown-Schmidt, 2019,). In cases of multiple levels of expertise needing to be addressed, this approach may be the most successful compromise between not patronising the most knowledgeable parties, but also not alienating the least.

The concept of “register” is important to acknowledge when considering adapting language towards a designed audience. A register is a language “variety associated with a particular situation of use” (Biber and Conrad, 2009, p.8). Register analysis is a way of functionally analysing why particular linguistic choices may be appropriate for the communicative purposes of stretches of language. The register perspective recognises the systematic nature of variation in linguistic choices such as the appropriate pronunciation, word choice and grammar in a given situation, informed by factors such as speaker goals, relationship proximity, circumstances of production and speaker characteristics (Biber and Conrad, 2009:2-4). Also highly important are the “situational characteristics” of the communication, which include consideration of where the communication took place, the number of interactants and the immediacy of feedback, and the mode (whether written or spoken) (Biber and Conrad, 2009:31). The register of a text then can be described as the way in which it has been produced, as a result of acknowledging the contexts that surround it. These contexts include both the real-world situation in which it is being used, and the people involved in the situation. In science popularisation, the register needs to be appropriate for mass

communication to lay-audiences with infotainment receiving goals, who may be multi-tasking.

To address the specifics of the choices that need to be made when designing language for particular audiences, especially in contexts of designing for non-expert audiences, specificity and detail of description must be considered - for example, whether “horse” will suffice as a descriptor of an animal or whether in the context it needs to be specified that it is a “stallion”. There is potential danger for a speaker to be too egocentric when describing entities, assuming their knowledge base to be the default, which may lead to communication breakdown (Fukumura, 2015). This conundrum has been termed the “curse of knowledge” (Hinds, 1999, p.206), where “insufficient adjustment” is made to the knowledge status of the addressee, since the expert is so informed on the subject that they take certain details as given.

An important dimension to consider when determining specificity of language use is the closeness of the relationship between the speaker and the addressee. In mass media communication “proximity” or interpersonal closeness of relationship must be “constructed”. Hyland (2010 pp.119-126) discusses five strategies for constructing proximity textually. These are:

1) Organisation, the process of constructing rhetorical patterns which best meet the communicative needs of the receiver.
2) Argument structure, which shapes basic material towards what the receiver is predicted to want to prioritise in a given situation (for example novelty or newsworthiness) and highlights the most salient information in the communicative

context. This also involves accommodations towards the identified or assumed prior knowledge of the addressee, and may require processes such as transformation of jargon into simpler lexes, or insertion of clarifications and definitions.

3) Credibility, which explicitly marks sources of information which are seen to hold validity.
4) Stance (see Section 2.2.1.2), which positions the addressor as holding a certain view and harnesses strategies such as hedging and attitude marking.
5) Engagement markers (see Section 2.2.1.2), which build inclusion and make an effort to communicate as directly as possible with the reader, in the absence of two-way conversation. Pronouns are a powerful tool here.

To frame these strategies in a real-world context, (Frobenius, 2014) explored linguistic methods of community construction in communicative situations with minimal feedback, by looking at audience design in vlogs (video blogs). Features of interest included reference to the themes of previous vlogs, to create a "participant status" as a loyal community member with knowledge of previous output. Also noted were uncertainty-reflecting if-clauses such as "if you're interested", which conceded to the vlogger's lack of certainty about the opinions of their audience, and also helped to create the sense that the viewer had some control over future output – thus creating a sort of pseudo-interaction in an otherwise one-way transfer of information. This study draws attention to content-creators' awareness that it is beneficial to address audiences in digital environments as though they are able to respond, even if they are not. Similar features may be observed in science popularisation podcasts, to contribute to the goal of community creation.

Proximity construction may involve a process of taking certain things for granted as regards the appropriateness of language choices for a mass audience, or "presupposing" certain information. A presupposition is a proposition or use of language that the speaker does not feel the need to elaborate on, since the context is deemed to be sufficient for comprehension (Simons, 2003). Presuppositions relevant to audience awareness in science popularisations concern the knowledge or points of reference the addressee may have to draw upon to understand the information being shared. Specifically, the concept of "cultural presupposition" (Ping, 2002, p.133) must be addressed, as it encapsulates many of the opportunities for communication to break down due to unfounded assumptions of shared points of reference. Cultural presupposition refers to the often unspoken, assumedly basic and obvious underlying assumptions, beliefs and ways of thinking that are supposedly encoded into a culture. To relate this to the potential for egocentricity as discussed by Fukumura (2015), such cultural presuppositions may impede mass communication and hinder the goal of science popularisation of communicating science to ordinary people. For example, the descriptor "about the height of (X celebrity)" will be no good to a listener trying to imagine the size of an animal if they do not know who the celebrity is. This potential for communicative danger may be termed "assumed familiarity", in which it is assumed that communicative participants share "common ground". Allan (2013) gives an example of the potential intricacies of common ground assumptions, using the example of somebody being described as acting like "Huck Finn" – a highly American reference point. Some people may have absolutely no idea what this descriptor refers to. Some may have the general idea that he is a character in an adventure story. It is likely only Americans however, or people interested in American culture, who have access to the nuanced information that the character also represents ideas about rebellion, open living and freedom. Their understanding of the person being compared to is therefore incomplete due to a cultural presupposition.

Another aspect of being aware of one's audience is ensuring that the communication is operating at an appropriate level of politeness. Politeness in communication is often discussed in the context of face-work (Goffman, 1955, p.213). "Face" is defined as "the positive social value a person effectively claims for himself by the line others assume he has taken during a particular contact." In other words, it concerns a person's image of self, informed by how they feel they are perceived by others. Attending to somebody's face involves a process of balancing between their "positive face" and "negative face". Positive face refers to the need to feel approved of and appreciated by others, and the want to be included in a community. Negative face refers to the need to feel free to act as one chooses, and not to feel imposed upon (Brown and Levinson, 1987). These needs contradict somewhat, in that membership in a community may threaten one's independence - hence maintaining face is a delicate conversational process. Strategies to attend to positive face needs include acknowledging interests, using in-group identity markers and including the person in an activity. Strategies to attend to negative face include hedging, apologising and minimising imposition. An appropriately achieved balance between these considerations can help to create a content, acknowledged podcast audience.

One way of attending to the negative face need of little imposition may be to take care to attend to the co-operative principle (Grice, 1975). The co-operative principle aims to facilitate effective communication, through attention to four dimensions, or maxims. These ensure that an audience's time is not unnecessarily taken up, since the information is maximally efficient. The maxims are as follows:

1) Quantity. Give as much information as required, and no more.

2) Quality. Do not say what you believe to be untrue or say what you do not have evidence for.
3) Relation. Keep the information you give relevant.
4) Manner. Do not be obscure or ambiguous, remain brief and organised.

It may sometimes be beneficial, however, to break or "flout" these maxims, especially in the context of science popularisation. For example, the use of figurative language, a rich storytelling device which attends to both entertainment and information needs, violates the maxim of quality by obscuring information. Overgeneralisation, sometimes necessary in popularisation to attend to the reduced level of specificity required in explanations, violates the maxim of manner. Presupposition, necessary in cases of mass communication with no on-line feedback, violates the maxim of relevance (Brown and Levinson, 1987). Overall then, as regards politeness when popularising science, the goal of creating a welcoming environment may be assisted by performing politeness-maintaining facework. The co-operative principle however, which also aims to maintain politeness, may be flouted to assist infotainment goals. A balance must be achieved between these two considerations.

2.1.3.1) Section Summary

To summarise, science popularisers must constantly consider their audience when producing their content, to allow for the greatest chance that they will have a positive learning experience where they are both informed and entertained. This is difficult, however, because of the mass nature of their communication, where audiences may be diverse in terms of both demographics and prior knowledge bases. This difficulty can be mitigated by not relying too heavily on cultural references and pitching information at a middle ground between over and

under explaining. Interpersonal considerations such as constructed proximity and attention to politeness can also help to create positive experiences, which heighten chances of content engagement.

2.1.4) Science Popularisation Summary

To summarise this section of the literature review, science popularisers must consider aspects of entertainment, information accuracy and sufficient accommodation to their predicted audiences when producing their content. These considerations must be aligned with their goals to dually inform and entertain, as is in line with the goals and motivations of their audiences. Podcasts appear to act as a suitable mode for science popularisation. Reasons for this include the potential to invite passionate conversation between community members, to employ diverse language to both enrich and exemplify information, and the ability to utilise generic structural features which help to guide the listener. These benefits combine to create audience engagement strategies. The next section will suggest methodologies and frameworks appropriate for investigating audience engagement strategies in science popularisation podcasts.

2.2) Tools and Analytic Frameworks

The following sections 2.2.1 and 2.2.2 will discuss potentially appropriate tools and frameworks to investigate strategies of engagement within science popularisation podcasts. Both benefits and drawbacks will be acknowledged and discussed, and justification for their overall suitability for the investigations provided.

2.2.1) Metadiscourse

'Metadiscourse' is language which "helps readers to organise, interpret and evaluate what is being said". It concerns how text producers adapt their language based on their context-based "estimation" of which choices will be best for their audience. This estimation is informed by the audience's predicted "personalities, attitudes and assumptions" which inform how much "elaboration, clarification, guidance and interaction" they may need. If successfully achieved, a text producer's use of metadiscourse reveals their sensitivity towards and understanding of the community they are communicating with (Hyland, 2017, p.17). Metadiscourse features help to facilitate effective communication by increasing readability and building a relationship with the addressee, and may also assist in encouraging audiences to support a position held by the addressor (Crismore, Markkanen and Steffensen, 1993). Metadiscourse does not add any informational content to communication; rather it helps to organise and classify information, and helps the reader to interpret and evaluate what has been said or written (Kopple, 1985).

It is useful here to briefly consider the function of different types of language, and where metadiscourse may fit into a functional linguistic model, to make explicit the role it plays in communication. Halliday and Webster (2009, p.262) suggest three distinct functions that language performs. The ideational function involves informational content related to experiences of both inner and outer worlds. The interpersonal function performs a mediator role between actors, and involves aspects of personality, feelings, emotions, stances and social meanings. The textual function encapsulates all language which helps to construct a text, including features which establish context, aid organisation and create cohesion. Metadiscourse tends to be either interpersonal or textual (Kopple, 1985). Metadiscourse items

which help to facilitate textual interaction can be considered interpersonal. Metadiscourse items which link and semantically relate propositional content are textual in nature. These jointly contribute to the engagement goal of allowing meaningful consumption of content (see Section 1).

Hyland (2019) provides a highly comprehensive model for metadiscourse, which categorises the different types of metadiscourse that may be used in a text, and how they might be used. I will describe this model in detail, as the metadiscourse features it describes will be prevalent in my investigations. The model was developed with written text in mind, so not all categories are of use when considering other forms of media. This will be discussed further in Sections 4.2, 4.3, 7 and 8. The model is, however, highly useful as a categorisation tool for different types of metadiscourse. Within this model, a distinction is drawn between two broad classes of metadiscourse, which is then further split into ten sub-categories. The two broad classes are:

1) The interactive dimension. These features generally have a guiding function within a text. Items in this class are also devices which reveal the writer's knowledge of their audience. This includes accommodations made for the prior knowledge they are expected to hold, interests they are expected to have, processing abilities they are expected to possess and expectations they are assumed to have. In practice, these items are likely to facilitate textual organisation.

2) The interactional dimension. Items in this class facilitate interactions the addressor makes with the text, in terms of intrusions and comments they make. These

interactions may encourage the reader to also respond to the text, either consciously or unconsciously, as they tend to be evaluative or engaging in nature.

The ten sub-categories will now be briefly outlined. Within the interactive metadiscourse class, there are:

1) Transitions. These express grammatical relations between main clauses, and include items such as “in addition”, “thus”, and “and”.

2) Frame markers. These fulfil a sequencing function and differentiate discourse acts and textual stages. Examples may be “finally”, “to conclude” and “what I mean is”.

3) Endophoric markers. These refer the addressee to other sections of the text. Examples may be “see Fig 1”, “see above” and “see 2.1”.

4) Evidentials. These point readers outside of the text towards other information or provide the source of information. Items include “according to X”, “Z feels that”.

5) Code glosses. These signal that new information is soon to be discussed and “elaborate propositional meaning”. They may also “implicitly elevate the status of material” in the mind of the reader and mark it as deserving of careful attention, by making it clear that it required “careful elaboration or clarification” (Aull and Lancaster, 2014, p.164). Examples are “called” “such as” and “to put it another way”.

Within the interactional metadiscourse class there are:

1) Hedges. These soften the strength of a conviction. They may also anticipate potential criticism. In popular science, they may perform the specific function of indicating that something is a new concept in science, and cannot yet therefore be absolutely verified (Fu and Hyland, 2014). Examples include “appearance-based evidential verbs” such as “it seems”, mental process verbs such as “indicates” , “modal verbs of probability” such as “might”, approximate adverbs such as “generally” and “downtowners and minimisers” such as “somewhat”. (Aull and Lancaster, 2014, p.160).

2) Boosters. These emphasise certainty around a topic or proposition, or perform the function of closing opportunities for dialogue to decrease the possibility of opposition. Examples are intensifying adverbs such as “absolutely” (Aull and Lancaster, 2014, 160).

3) Attitude markers. These are expressions of how a writer feels about a proposition, involving feelings, reactions to events, and judgements and evaluations of actions and entities (Martin and White, 2005). These evaluations may not genuinely belong to the writer themselves, rather anticipate what the reader may think (Fu and Hyland, 2014) or aim to evoke similar evaluations in the reader, guiding them towards a mutual opinion. Items may include “shockingly”, “unsurprisingly” and “I agree.”

4) Self-mentions. With these, a writer explicitly refers to themselves. This may be to present themselves as a scholar, to express an opinion, to announce a goal or to

use themselves to illustrate a point (Hyland, 2001 p.221). They do this largely with pronouns, such as “I”, “we” and “our”.

5) Engagement markers. These are items which perform a relationship-building function within the text and ensure that the audience’s want to be acknowledged is met, by inviting them to participate in the argument (Hyland, 2005 p.54). Examples include “you can see that”, “consider” and “notice.” (For discussion of the distinction between engagement strategies and engagement markers in this research, see Section 1).

Hyland (2019) goes on to discuss the potential implications of the inclusion of metadiscourse items in texts, in terms of the contributions they can make to its interpretation and reception. He proposes that metadiscourse “provides a context” for propositional information, situating it logically into a stretch of discourse. He states that the inclusion of a personal voice into a text leads to more attention towards and engagement with material, then argues that the personal voice also helps to combine the theoretical word of academia with the real world. Addressees are also hypothesised to be more likely to be persuaded by the content, and more likely to understand and be able to recall information from it. This is assisted by the increased coherence afforded and the relations between ideas which are made explicit by interactive features. These claims have some experimental backing, with Crismore and Vande Kopple (1988) reporting that students learnt more from using texts which featured the metadiscourse feature hedging, than those where hedges were omitted.

Hyland (2019) then addresses the ideological dimensions of metadiscourse, highlighting its role in making writer uncertainties explicit, and thus making readers aware of the potential

subjectivity involved with so-called "truth" claims. This is facilitated by features which point towards the text producer's feelings about a proposition, concerning factors such as power and status which may be exploited to guide towards a position. Finally, comprehension-based functions are addressed, with Hyland referring to the reduced cognitive processing that the addressee must perform due to, for example the highlighting functions of code glosses and the idea-linking functions of transition markers. He points out the inclusive environment created by the features intended to concede to recognition of addressee needs and desire to be included in a dialogue, in line with the interactional conventions of a given community.

2.2.1.1) A Metadiscourse Research Case Study: Self-Mentions

Some metadiscourse features can be explored in considerable depth. It is beyond the scope of this research to consider all of these. One sub-category, however, which has been researched widely is self-mentions, which Proctor and Su (2011) term "a perfect tool for rhetorical purposes". For example, Perdue *et al.*, (1990) note the power of "we, us, ours, they, them and their" to imply in-group or out-group status. The inclusive pronouns "we, us and ours" are likely to attract, they note, positive connotations of solidarity and teamwork, while "they, them and their" have a distancing effect, with negative connotations of exclusion and extra-group membership. I argue that interpersonal factors are a major consideration when encouraging engagement – the focus of this research. I will, therefore, dedicate a brief section to research surrounding self-mentions, as a relevant example of in-depth research on metadiscourse items.

Tang and John (1999, pp:31-33) consider the potential role-assigning functions of first-person pronouns in academic writing, identifying "identities" that can be constructed within a

research piece. These are presented on a continuum of most to least "powerful author presentation". The identities are:

1) Representative, acting as a marker for shared prior knowledge ("as we already know…").
2) Guide through essay, signalling sections and fulfilling a transition marker purpose ("In this essay, I will discuss…").
3) Recounter of the research process, describing the steps taken towards the completion of the paper ("I administered the questionnaire to two groups…").
4) Opinion-holder, performing an attitude-marking function ("I agree with X.").
5) Originator, where the writer projects themselves as the first to propose a new direction or the first to identify a problem ("Part of the problem here, as I see it…").

The pronouns become more and more exclusive as the roles travel down the continuum towards the least powerful author presentation. The "we" in the representative role includes readers in the group of people with prior knowledge, where the "I" in the originator role presents the writer as acting alone with a novel thought (Dobakhti and Hassan, 2017).

Keller (1979) likewise draws attention to the concept of roles in his classification of linguistic "gambits". These are semi-fixed expressions which facilitate various speaker roles, through four main functions:

1) Semantic framing, which introduces what somebody is about to say: "What I mean is…"
2) Social signalling, which expresses somebody's wish to take part, receive an answer, or terminate a conversation: "I have something to add to that…"

3) State of consciousness signalling, which expresses somebody's readiness or unreadiness to receive information, or an attitude towards what has been said: "I feel that…"
4) Communicative signalling, which helps the speaker to "hold the floor" or establishes that their speech has been understood: "Is that clear?"

These features help to ensure that the roles necessary for effective and authoritative communication are successfully performed.

The strongest conative effect in Perdue *et al.* (1990) was found when the prime was "we". It was also the most strongly represented pronoun in Kuo's (1999) exploration of how the use of personal pronouns displays scientific writers' perceptions regarding their own roles in research, and their relationships with projected audiences within and outside of the scientific community. In a science communication context, exclusive "we" refers to the writers themselves, and inclusive "we" could refer to either the writers, the writers and the audience, the discipline as a whole, or humanity as a whole (Kuo, 1999). This "humanity as a whole" usage has elsewhere been termed "generic use" (Quirk and Crystal, 2010:353) and "impersonal use" (Kitagawa and Lehrer, 1990). The intimacy and relationship-building affordances of inclusive "we" have been noted in the context of textual interaction as involvement-enhancing strategies. Additionally, by aligning themselves with the reader through creation of this relationship, the writer may be mediating the responsibility they hold for what they are saying and representing themselves as somewhat vulnerable (Kim, 2009). It is important to interrogate who "we" is at various junctures of science communication, in

order to establish whether the public is being implicitly included in or excluded from the conversation (Spoel *et al.*, 2023).

2.2.1.2) Metadiscourse and Stance

I will now move away from self-mention research as an example of investigations into specific metadiscourse items, to discuss a concept relevant to the study of metadiscourse: stance. Stance has been variously defined by different scholars. It has been conceptualised as use of linguistic resources to express a reaction towards events in and states of the world (Kockelman, 2004). It has been discussed as encapsulating the text producer's judgements, assessments and feelings (Biber *et al.*, 2021: 966) as well as their commitments to truth and opinion claims. This involves strategies used to either highlight or conceal their responsibility for or involvement with the claims being made (Hyland, 2005: 176). Stance also involves linguistic efforts to position oneself strategically with other subjects in terms of opinions and worldviews, with sensitivity towards sociocultural context and how this may impact the success of the reception of their convictions (Du Bois, 2007: 163). This involves the building and signalling of relationships with others, using both linguistic and other methods in processes of pseudo and real interactions (Johnstone, 2009). Through all of these processes, the text producer creates an identity, which is inclusive of their values, positions, convictions and their relationships with the addresses (Pho, 2013: 3). This identity manifests through their linguistic expression of their relationship to their talk, in features such as certainty about their assertions and their closeness to their communicative partners (Kiesling, 2009). Taking advantage of a well-expressed stance can have many positive effects for the text producer in terms of ease of communication. It can afford them to, for example, argue their position more effectively, create a more balanced argument through acknowledgement of alternative views,

evaluate the work of others in a nuanced way and establish solidarity with readers, helping them to remain engaged with the content (Hyland, 2004). Stance and metadiscourse are then, closely conceptually linked, as both are concerned with linguistic interactions between addressors and audiences, which make texts more accessible and interesting for the audience.

Many stance-taking linguistic devices overlap with items and categories in Hyland's (2019) metadiscourse framework. A useful case study of this is Aull and Lancaster's (2014) investigation into markers of stance in novice and advanced academic writing. This study is especially relevant here, due to its focus on student academic writing, which generally takes the form of reformulating the publications of senior academics. This is a goal which partly overlaps with the goal of science popularisation, in that the primary output of scientific research is recontextualised. The difference is that the new context remains in the realm of academia. A case of category overlap is in the code glosses which were identified. They were found in this study to fulfil two broad stance-taking purposes. Firstly, they “reformulate” information with phrases such as “in other words”, with the intention of further explaining a point or making it more specific and thereby salient. Secondly, they “exemplify” information with phrases such as “for instance”, which allows for the point to be further illustrated with examples. Also identified in the corpus and in Hyland (2019) are hedges and boosters. Analysis of the distribution of these commitment-modulating features across varying proficiencies of academic writing concluded that more advanced writing is richer with hedges while beginner writers tend to boost more, perhaps concerned about making sure their point is conveyed and thus overcompensating. Hedging strategies were further analysed as skilful ways by which to concede to the lack of a pre-established stance in the “not already aligned reader”, and to help them towards a stance through “careful negotiation of subtle shades of meaning” (Aull and Lancaster, 2014, p.167).

Aull and Lancaster (2014) also noted stance-taking linguistic categories which are not represented in Hyland (2019). They refine Hyland's "transition marker" category, and specifically identify "concessive/counter" connectors such as "however", which identify points of potential contention or flaw in argument, or open the dialogue for alternative viewpoints. They also identify "counter" connectors such as "in contrast", which more explicitly indicate a distinctly opposing viewpoint whilst also implicitly marking it as valid as there is no value judgement encoded. These strategies are treated functionally as markers of counterexpectancy (Martin and White, 2005), where the clause before the marker identifies an interpretation in need of refinement, and the clause following it introduces the view presented to be more accurate.

Another category of stance-taking devices that is not identified by Hyland is disclaimers (Abdi, Rizi and Tavakoli, 2010). These are devices which addressors use to mitigate the possibility of an indefensible interpretation of what they are saying. They include items such as "it should be noted that" and appear to anticipate the critiques of the imagined audience. Functionally, they differ from hedges in that hedges express caution by admitting the limitations of the proposition, while disclaimers tend to firmly assert what something is not. This is evident from their tendency to include negative particles such as "no", "not" and "only."

A sub-category of stance-taking devices which have been afforded great attention are those which signal evaluation, which Kockelman (2004) describes as "moral obligation and epistemic possibility". Hunston and Thompson (2000, p.5) conceptualise it more broadly, as

“expression of the speaker or writer’s attitude or stance towards, viewpoint on, or feelings about the entities or propositions that he or she is talking about.” In other words, linguistic features which express some sort of duty, or assess the validity, truth, or strength of a proposition. Also involved are expressions of a speaker’s mood or feeling. These examples and usages align well with Hyland's (2019) categories of hedging, boosting and attitude marking. Also involved may be evidentials, which by their very existence modulate the value of a proposition by ascribing it to a source, with either positive or negative effects and intentions depending on the stance the text producer wishes to take. Hunston and Thompson (2000, pp.6-11) provide three potential functions of evaluation:

1) To express the opinions of the text producer, and thereby express their system of values and entrenchment in their community.

2) To create and sustain a relationship between the text producer and the addressee.

3) To help to organise the discourse.

Evaluation may be performed in highly subjective ways, and rich with implicit value. This diversity means that analysis need not be single-faceted, rather can be performed on a lexical, grammatical and textual basis (Biber *et al.*, 2021).

2.2.1.3) Section Summary

To summarise, a metadiscourse framework may be appropriate to apply when investigating strategies to encourage audience engagement in science popularisation podcasts. This is because it concerns uses of language which reflect adaptation to audience needs. The framework considers both the practical organisational changes which create a less taxing

experience for the audience, and language choices which encourage participation in the discourse, through relationship building and signalling of interesting and relevant content. The following section will suggest corpus linguistics as a method to apply when investigating metadiscourse in science popularisation podcasts, and will also address potential drawbacks that will need to be acknowledged.

2.2.2) Corpus Linguistics

To comprehensively investigate metadiscourse in science popularisation podcasts, I will use corpus linguistics. A corpus is a "large collection of authentic text" (Stefanowitsch, 2020, p.1), on which linguistic inquiries can be performed. Corpora are based on "naturally-occurring" observable and countable structures and patterns of use as opposed to intuitions. Computerised tools allow for the examination of "previously untraceable" features and patterns of language across vast quantities of data (Biber, Conrad and Reppen, 1994, pp.170-171). This has led to corpus linguistics being described as a "powerful tool" for investigating uses of language (Schmidt and Rodgers, 2020, p.89). In this study, corpus linguistic methods can be used to perform metadiscourse analysis on a large quantity of podcast data, using the search terms from which (Hyland, 2019) built his metadiscourse framework as a starting point. This is partly motivated by the fact that Hyland (2017, p.17) himself notes the use of corpus methods in metadiscourse analysis to investigate the "persuasive structuring of discourse" and "the contribution of cohesive features to writer-reader understandings." In other words, metadiscourse-focussed corpus investigations can give insight into how language is used both to present information in a particular way – in this case, as relevant and interesting - and to increase comprehension within audiences.

Effective corpus building is a task which must be approached carefully, to ensure that accurate and representative data can be gathered. The corpus must have been judged to have been representative of the language variety under investigation. This involves ideally having a "thorough definition" of the language users, and careful consideration of appropriate sampling methods (Biber, 1993, p.243). It must also have a sufficient number of words or tokens to be considered a robust object of study. A corpus must ideally be completely absent of input from a linguist or data-gatherer, even in the cases of corpora complied specifically for investigative purposes (Sinclair, 1996). The final evaluation of the representative success of corpus design must consider, firstly, the range of types of text, and secondly the range of "linguistic distributions" displayed (Biber, 1993, p.243). If these design conditions are judged to be sufficiently met, the process of doing corpus linguistics can result in lucrative studies of "real life" language use (McEnery and Wilson, 2001, p.1), from which valuable quantitative data can be collected. From these insights, phenomena which may otherwise be obscured by isolation of individual pieces of textual data can be identified (Alonso Almeida, 2015).

Alonso Almeida (2015) suggests corpus linguistics as an effective way to carry out stance research, which is relevant here due to the overlap between stance and metadiscourse discussed in Section 2.2.1.2. He notes the use of concordance tools, where search terms can be expanded to view the words that surround them, to examine contextual meanings. Hence, features need not be treated in isolation – rather patterns of usage can be identified in the real-world contexts in which they appear in the natural language data. Corpus software allows for the combination of quantitative techniques such as frequency counting (where the number of times a word is represented in the corpus is displayed) and qualitative techniques such as concordance line annotation, where results are expanded to show the surrounding language, to allow for examination in context. This means that analyses can be performed at both a

macro-level and a micro-level. Quantitative data can be provide an overview to be probed by qualitative investigations for detail and nuance (Reppen and Simpson-Vlach, 2020).

To provide an example of a study which used corpus to investigate stance markers, Khamkhien (2014) investigated markers of evaluative stance in the discussion sections of research articles. By using corpus techniques to analyse research articles on applied linguistics and language teaching journals, various patterns of stance marker usage were identified, such as variable uses of epistemic modality markers, communication verbs, "it" clauses and personal pronouns. This research was said to challenge the perception that academic writing is impersonal and objective, and instead provides evidence of relationship-building through the use of devices which help readers to "organise, interpret and evaluate the propositional content." Additionally, and highly relevantly to this study, these features suggest that writers try to create a shared world with their readers, where the reader is encouraged to share the writer's view. This is rather at odds with the literature discussed in Section 2.2.1.2, which suggests that stance-taking features and metadiscourse in fact help to achieve objectivity and a sense of scholarly modesty by modulating truth claims by hedging. This investigation therefore invites discussion about the balance between being persuasive and being tentative in academic writing. This is further complicated in the context of popularisations, where the further consideration of making the content entertaining may decrease the likelihood of being tentative, since strong convictions are more dramatic. This balance between information and entertainment is an area which my research hopes to provide insight into.

Corpus methods may also be appropriate in this research due to their ability focus on identifying “pervasive” linguistic features in a variety (Biber and Conrad, 2009:6). These are features which are abnormally common in the given variety, as compared to other text types. In other words, it is the extent to which they appear rather than their raw frequency which is important. This approach is useful when examining metadiscourse features, many of which are very high frequency words, such as the transition marker “and” and the pronoun “I”. It is not noteworthy in the slightest that these appear in the texts, but it may be noteworthy if they are more or less pervasive as compared to other texts. For example, comparing the metadiscourse in science popularisation podcast data to a corpus of non-podcast science communication may reveal language specifically suited to communication in audio-only formats.

There are potential drawbacks of using corpus linguistics to investigate metadiscourse and engagement strategies, which are largely due to the nature of metadiscourse items themselves rather than limitations of the corpus methods. No completely exhaustive list of metadiscourse items can ever be created, thus no complete list of search terms can be produced. Words may perform metadiscourse functions in novel or idiosyncratic ways or be modulated by extra-linguistic features not expressed in the data – for example the tone something is said in may change it from a neutral statement to an attitude marker. These can all be driven by context, which may either not be clear in the corpus data, or be too nuanced as to be intricately understood (Kiesling, 2009). The failure of typical corpus-based approaches to take into consideration generic features (Chang, 2012) requires that this step be taken manually by the researcher. In other words, it becomes necessary for them to perform pre-processing steps such as filtering for insightful data as opposed to that which is simply a surface reflection of the context of the corpus itself. This has the potential to be highly time-consuming and labour

intensive. As put by Alonso Almeida (2015), it is the "pragmatic nature" of stance-taking language that causes this limitation, as the various contextual factors which inform both production and reception necessitate "visual inspection" before data is collected by the computer software.

There are also potential drawbacks for using corpus methods on mass-media data. The nature of mass-media communication means that robust audience design (see Section 2.1.3) in which language is carefully tailored towards a specific audience is not possible. This means that a "thorough definition" (Biber, 1993) of the language users cannot be established, since it is not clear exactly to whom the addressors are designing their language. These drawbacks are, however, outweighed by the great benefit of being able to analyse such large quantities of text with relative ease, providing insightful overviews of data which can be examined in detail through triangulation with other methods.

2.2.2.1) Section Summary

To summarise, a metadiscourse framework may reveal strategies of engagement in science popularisation podcasts, through identification of language which attempts to guide and interest the listener. These features may build to give a clear view of the register of the text, constructed to match the situational context of the listeners' goals. The tools of corpus linguistics allow this investigation to happen on a large scale, making use of a large volume of texts. Corpus tools can be employed to carry out both quantitative and qualitative analyses, which can facilitate both macro-scale overviews, and detailed analyses. The concepts of metadiscourse, register and corpus linguistics can, therefore, be used in triangulation to carefully analyse engagement strategies in science popularisation podcasts.

The next section will outline the aims and research questions of this research, to make explicit the questions it attempts to answer and the insights into audience engagement strategies in science popularisation podcasts it aims to provide.

3) Aims and Research Questions

The overall aim of this research is to investigate how producers of science popularisations keep their audiences motivated to continue engaging with the content. Engagement is conceptualised as meaningful interaction with the content, allowed for by language which helps to guide audiences, to increase motivation by presenting information as exciting and relevant, and makes their interpersonal needs feel attended to. The main initial investigative focus will be on the use of metadiscourse to construct engagement strategies. When the data is examined in context however, it will become important to acknowledge non-metadiscourse items which also contribute to audience engagement. A full explanation of how this will be approached can be found in Section 6.1.

This research aims to investigate the following questions:

1) How frequently does the science popularisation podcast use metadiscourse to encourage audience engagement, as compared to other modes of science communication?
2) Which metadiscourse items are used notably more frequently/differently in the science popularisation podcast as compared to other modes of science communication?
3) What linguistic strategies of audience engagement can be identified in the science popularisation podcast by examining uses of metadiscourse?
4) How do non-metadiscourse features contribute to these audience engagement strategies?

I will firstly use corpus methods to obtain an exploratory, comparative, quantitative overview of the data. Then, a close qualitative analysis will be performed on a sample of the data, to explore some surprising results from the quantitative data. Finally, concordance analysis will be performed on a larger sample of the data to contextualise the quantitative results. The final discussion will be of engagement strategies identified following these investigations.

4) Investigation 1: Corpus Metadiscourse Analysis

This section will discuss the data used, analysis performed and results obtained from the first stage of analysis: a quantitative, comparative analysis of different corpora, which are united by science communication goals. This will help to address research questions 1 and 2:

1) How frequently does the science popularisation podcast use metadiscourse to encourage audience engagement, as compared to other modes of science communication?
2) Which metadiscourse items are used notably more frequently/differently in the science popularisation podcast as compared to other modes of science communication?

Frequency counts of metadiscourse items across corpora will reveal quantitative differences in their usage, which may provide insights into specific uses of metadiscourse items in science popularisation podcasts. These metadisocurse items may act as markers for the location of engagement strategies (see Section 2.2.1) as their linguistic functions align with engagement goals and concerns.

4.1) Data

The main dataset used was a corpus of transcripts of episodes of the podcast 'No Such Thing as a Fish' (subsequently NSTAAF). The podcast is broadcast weekly and is affiliated with the QI production company. It is hosted by four core presenters (Dan Schreiber, James Harkin, Andrew (Andy) Hunter-Murray and Anna Ptaszynski), all of whom either are or were at the time researchers for the television show QI. The podcast won the Heinz Oberhummer Award

for Science Communication in 2019, hence its appropriateness as the focus of this study – it has been externally judged as effective in popularising science and been awarded a high accolade for such. The description of the podcast on its website (Quite Interesting Ltd, 2022) says that the hosts "share the most bizarre, extraordinary and hilarious facts they've discovered over the last seven days." In this description, it is clear that the podcast attempts to achieve the hypothesised goals of science popularisation podcasts (Figueroa, 2022) of informing whilst also entertaining.

The corpus comprises 657,797 words and contains 100 episodes of the show. The episodes range in length from 25-55 minutes long. The dataset was obtained directly from one of the podcast hosts, by email. According to the host, the transcripts were produced by an auto-transcription software with reasonable accuracy, but some manual correction was required in cases of extreme and obvious errors. This was a process of reading the transcripts and checking any visible errors against the audio files. As this was a manual process, absolute accuracy cannot be verified, however no major errors were noted throughout the analysis process.

To contextualise later discussions, I will briefly explain the structure of an episode of the podcast. Each episode is split into four sections. In each section, one of the hosts presents a "headline fact". To begin with, the host presenting the fact elaborates on it. Then, the other hosts present related information that they have researched, guided by the content of the headline fact. For example, one headline fact in the corpus, presented by Andy, is "When squirrels are attacked by snakes, they increase their blood pressure so much that their tail

gives off more infra-red radiation and it makes them look bigger." Once Andy had elaborated on this fact, the other hosts presented research on squirrels, blood pressure and infra-red.

Four other corpora were used for comparative purposes in Investigation 1, with the intention of identifying potential unusual or unique usages of metalanguage particular to the podcast. These were:

- The British Academic Spoken English Corpus (BASE). This is a corpus comprising 1,477,281 words, consisting of 160 lectures and 160 seminars, recorded between the years 2000 and 2005 at the University of Warwick and the University of Reading. The academic disciplines represented are arts and humanities, life sciences, physical sciences, and social sciences.

- The British Academic Written English Corpus (BAWE). This is a corpus comprising 6,968,089 words, consisting of 2761 pieces of academic assessed student (Undergraduate and Taught Masters) work evaluated to be “proficient”. Each piece is between 500 and 5000 words long. The disciplinary areas represented are arts and humanities, social sciences, life sciences and physical sciences.

- The English Wikipedia corpus. This is a corpus of the English version of the internet encyclopaedia Wikipedia, extracted in 2014. The corpus comprises 1,356,523,079 words.

- The ScienceBlogs corpus. This is a corpus comprising 103,175,233 words, containing posts and comments from the website ScienceBlogs.com, a science information non-profit, from the years 2006-2014.

These corpora were chosen for comparison since they all share some element of the goal of scientific information sharing with the podcast data, but have attributes or purposes that are different. The BASE corpus shares the element of being a spoken mode, but differs in that there is a visual element as the audience was in the room with the instructor and could see them. The ScienceBlogs corpus shares an informal tone, but differs in that it comprises written text, rather than transcribing spoken language. The BAWE corpus shares the goal of communicating scientific findings but differs in the level of formality of the style of communication. The Wikipedia corpus likewise shares the goal of communicating information, but does not have an entertaining focus. These similarities and differences allow for the pervasive features (see Section 2.2.2) of NSTAAF to be made explicit.

4.2) Methods

Hyland (2019) provides a list of the search terms used to identify, build and refine the categories of Metadiscourse he proposes in his framework (see Appendix). These search terms formed the basis of the first stage of analysis, which was a corpus analysis of the distributions and functions of metadiscourse across comparative corpora. The goal was to identify pervasive metadisocurse features within the NSTAAF corpus which set it apart from the other corpora, in alignment with its contexts of production and communicative goals (see Section 1).

Some pre-processing was necessary, since some of the terms did not lend themselves to being frequency searched and would have caused excessive confusion later in the process. For instance, the empty slots indicated by "X" in the endophoric markers such as "Fig. X" would have caused problems, so this category was excluded. It would have required trying many different variations, for example some texts might not abbreviate and instead keep the full word "figure". It would also have been difficult to know how high to go when searching numbers. This decision was justifiable also since these search terms are appropriate only to written text and would have provided little insight beyond this very surface difference between corpora. Additionally, this helped to maintain a focus on NSTAAF (where these markers would have been largely absent due to the audio-format) as the main object of study.

On closer inspection of the search term list, it became clear that some terms may have had polysemous meanings which would have skewed results. This manifested in two ways. Firstly, some terms had a metadiscourse use, and also had a use from a completely different grammatical category. For instance, the verb "show" appears in the list as an engagement marker, but the noun form also appears in the corpus, for example in "television show." These were mostly easily resolved by specifying the part of speech using tags. More problematic were terms which had alternative metadiscourse functions not captured in Hyland's list. For example, "first" was used as a sequencing marker, as in Hyland's list ("the first thing they noticed") but also had an engagement marking function when used to express the novelty of something, for example "she was the first to ever do so." Sixty-one words with potentially polysemous meanings were identified, and the extra stage of analysis undertaken to mitigate this problem will be discussed below.

The NSTAAF corpus was loaded into the software SketchEngine (Kilgarriff *et al.*, 2014), which contains many corpus tools. The comparative corpora were already pre-loaded into the software. The concordance tool was then used to find and record the raw frequency and the frequency per million words for each search term on the refined list, in each corpus. The frequencies per million words were focussed on in subsequent analyses, since this normalised data mitigates the limitation of the different corpora sizes.

For words with polysemous meanings, a random sample of up to 100 usages in context were extracted. Close reading was performed on each of the examples, to establish how the words were being used, and the number of relevant uses were recorded. The number of relevant uses were then used to adjust counts. For example, in the NSTAAF corpus, the word "second" was used as a sequencing marker ("the second thing we need to talk about…") rather than as a unit of time ("a one-second gap…") or an engagement marker ("the second person to climb…") five times out of the 100. It was assumed then that 5% of the usages of "second" in the whole corpus were sequencing markers, so 5% of the raw frequency was calculated and recorded. This came out at 10.81. This was then divided by the total number of words in the corpus, then multiplied by a million to find the frequency per million words, which came out as 344.51 per million words. This was then recorded as the count for the sequencing marker "second". This adjustment is inevitably an approximation, which assumes that the sample is representative. It goes some way, however, towards increasing the accuracy of the counts.

4.3) Results and Discussion

The full list of search terms with their frequencies per million words can be found in the Appendix.

Firstly, I will present and discuss an overview of the main findings of the frequency analysis. Then, I will discuss analyses which break the findings down into smaller categories. There will then be an even more precise discussion of individual search terms which are noteworthy in their specific apparent usages in NSTAAF. Finally, I will suggest subsequent appropriate stages of analysis, based on the combined insights from these discussions.

4.3.1) Overview

For a reminder of metadiscourse categories and illustrative examples, see Section 2.2.1. Figure 1 shows the percentage of each corpus that was made up of the metadiscourse search terms from Hyland (2019).

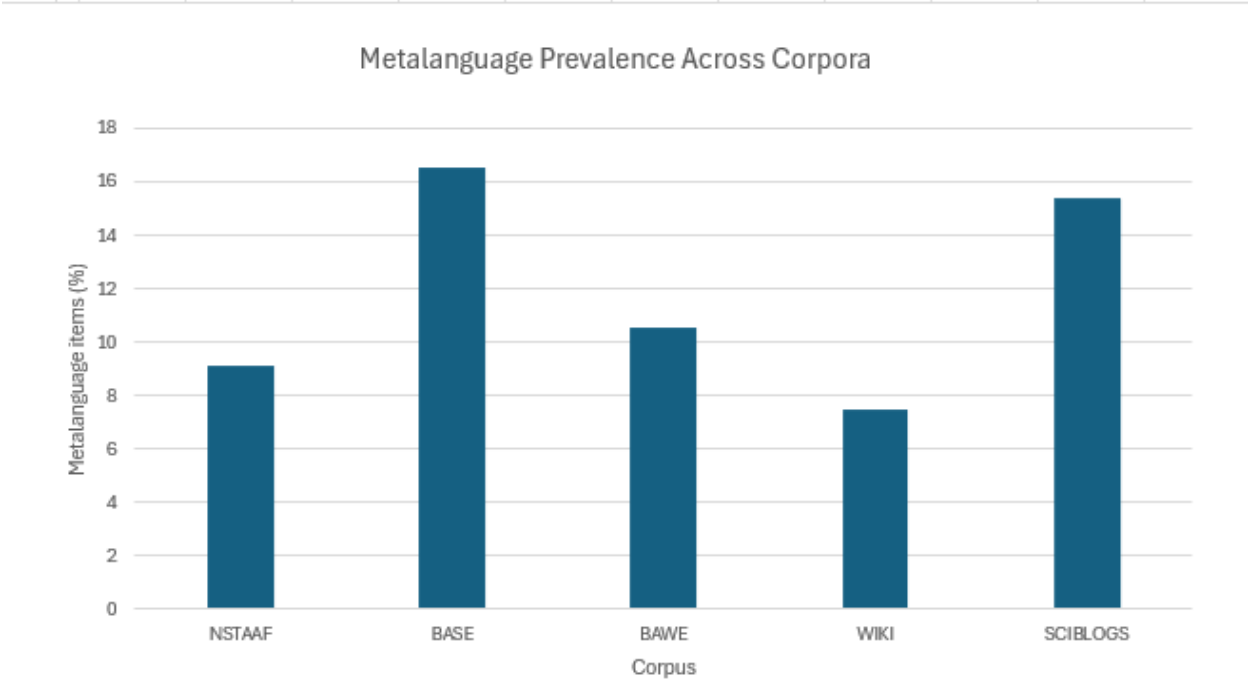

Figure 1: Metalanguage Prevalence Across Corpora. Abbreviations: NSTAAF – No Such Thing as a Fish. BASE – British Academic Spoken English. BAWE – British Academic Written English. WIKI – Wikipedia. SCIBLOGS – ScienceBlogs.com:

To firstly address the comparative corpora, BASE being the highest is likely a result of the interactive nature of the corpus. The transcribed lectures and seminars contain sections such as questions and answers, in which there is interaction between speaker and addressee in real time, as contrasted with the delay in ScienceBlogs which arises as a result of computer mediation. ScienceBlogs remains the second highest despite this, as the corpus contains comment sections, where often there are strings of conversation and discussion. In BAWE, the metalanguage can be assumed to serve more of a persuasive purpose, attempting to convince the reader of their convictions or results. Hyland (2019) notes this persuasive purpose in his investigation into interaction in writing. Wikipedia being the lowest is consistent with it being essentially a fact-providing service with no need to build a close relationship with the reader.

To turn the focus to NSTAFF, the science popularisation podcast having the second lowest frequency of metadiscourse items is somewhat surprising, as its "infotaining" goals may be assumed to invite high counts of interactive and interactional features. Additionally, metadiscourse could be assumed to be high due to interactions between the four hosts. A possible explanation is that the procedural work and guiding is aided by the format of the podcast itself. For example, a hypothetical string of discourse explaining what might be to come – "and now for the next ten minutes we are going to discuss a fact found by Anna…" – is able to be reduced to a phrase such as Example 1, below:

1) *"And now onto fact number three, and that is Anna…"*

This is possible since every episode follows the same format, so the audience already knows that the section termed "fact number three" will consist of. Another possibility is that the conversational nature of the podcast allows for novel forms of metadiscourse, not represented in Hyland's search terms or discoverable through keyword/key N-gram lists, since they may consist of novel and unique usages that arise idiosyncratically from natural language. Analysis of the data in context could provide insight into these possibilities.

4.3.2) Interactive Versus Interactional Metadiscourse

To break the results down further in accordance with Hyland's framework, Figure 2 shows which proportions of the metalanguage in each corpus was made up of interactive (guiding) versus interactional (relationship-building) metalanguage. In general, interactional metadiscourse is more prevalent than interactive, with the exception of the Wikipedia corpus. The difference is the most stark in corpora with genuine two-way interaction.

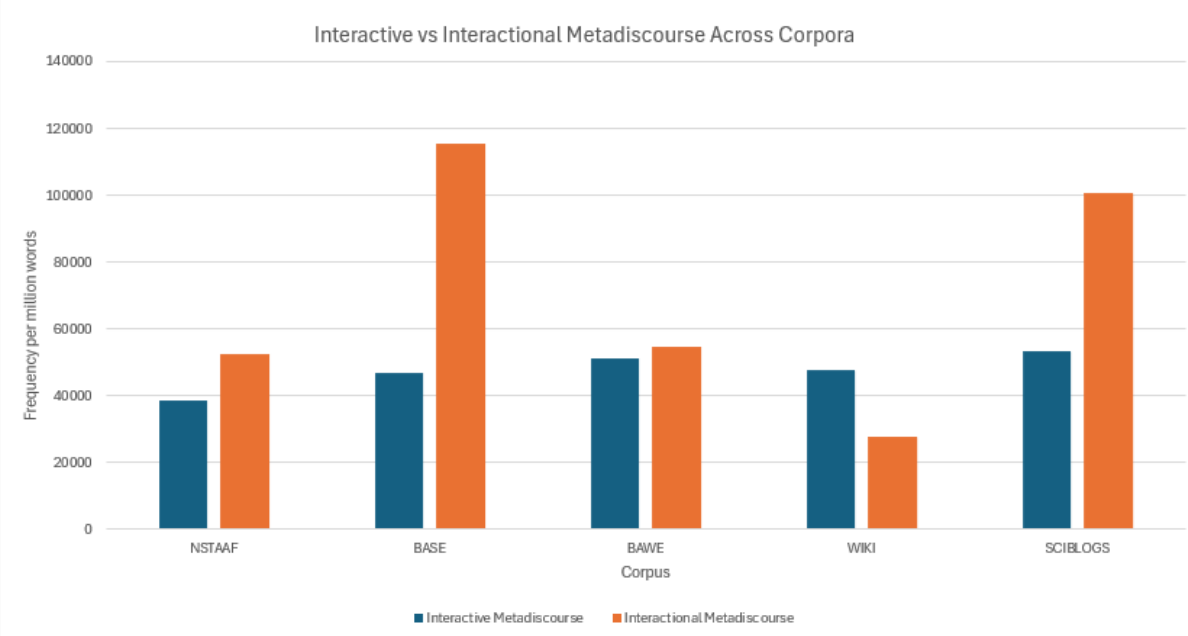

Figure 2: Interactive and Interactional Metadiscourse Across Corpora

I will firstly address the comparative corpora. The prevalence of interactive language in ScienceBlogs may be due to its status as a "hybrid" genre between spoken and written language, (eg, Wiktorsson, 2018) especially considering the interactive comment section. For instance, "for example" which is suited to written language appears 164.38 times per million words, and "called" which is perhaps more appropriate to spoken language 216.83 times per million words, which is a relatively similar frequency. The overall number is higher therefore, since both modalities are represented in the search terms. In contrast, other corpora appear to have a bias towards one style over the other. In BAWE, for example, "called" appears 144.99 times per million words and "for example" 401.62 times, a bias towards the more formal construction. Additionally, there is a need to attribute information formally in BAWE to maintain academic rigour, where there is not in other corpora. "Cited", for example, appears 187.13 times per million words in BAWE, and only 4.02 times per million words in NSTAAF. BASE could perhaps be expected to behave similarly to BAWE in terms of interactional metalanguage due to the shared academic context, but is lower. BAWE's high proportion of interactive language in spite of the lower representation of more informal search terms is likely, again due to its requirement to coherently construct an academic argument for the best chance of convincing the reader of the ideas (Hyland, 2019). For example, the transition marker "as a consequence" appears 20.27 times per million words in BAWE, and not at all in NSTAAF where there is no formal argument construction. BASE can perhaps however rely on visual aids to achieve the cohesion which BAWE relies on transition markers for – for example there may be a PowerPoint slide titled "consequences"

which the speaker can elaborate on without using phrases such as “as a consequence”. Wikipedia can similarly rely on visual elements such as section headings like “Early years” (which will not be represented in the search terms) to perform this metadiscourse work.

The high prevalences of interactional metalanguage in BASE and ScienceBlogs is likely due to the two-way conversations afforded by the contexts. There are real communicative partners rather than constructed or imagined addresses, physically in the room and computer-mediated respectively. In these corpora, the relationship-building stakes of the interactional language are therefore higher, since there is more chance of feedback. Academic writing in the BAWE corpus may have features such as critical analysis and opinion-forming on a particular paper or theory. Here, the relationship building attempts and thus prevalence of interactional metalanguage arise from the persuasive goal of the writing. It has the highest frequency across corpora, for example, of the hedge “should” at 949.23 per million words (contrasted, for example, with 389.73 per million words in NSTAAF), which is suggestive of the building of a relationship where the writer is attempting to convince the reader that something ought to be done or thought. Wikipedia being lowest again, is consistent with its impersonal information sharing goals.

To focus now on NSTAAF, it contains the lowest frequency of interactive metadiscourse and the second lowest frequency of interactional metadiscourse. As regards interactive metadiscourse, to reiterate, NSTAAF can perhaps rely somewhat on the consistent format of the show to condense potentially long, metadiscourse-rich stretches of language into fixed phrases, which perform guiding work. The comparatively low frequency of interactional metadiscourse is somewhat more surprising, especially since the four hosts interact with each

other as well as with the audience. Again, it is possible that unrepresented forms of metadiscourse are used which are not found in the search terms, due to the spontaneity of the conversational genre. A contextualised qualitative analysis of a sample of transcripts could provide insight into this, by revealing novel or idiosyncratic usages.

4.3.3) Individual Metadiscourse Categories

Table 1 and Figure 3 show the frequency per million words within the individual categories of metadiscourse.

	NSTAAF	BASE	BAWE	SCIBLOGS	WIKI
CODE GLOSS	5679.67	12549.8	4526.8	8147.63	5053.03
EVIDENTIALS	83.04	104.75	1293.12	655.44	439.48
SEQUENCING	5828.52	4196.26	2484.71	3145.91	3430.14
LABEL STAGES	32.82	288.15	718.33	1356.46	604.75
TRANSITION MARKERS	24761.1	27960.2	39847.8	37073.74	35809
ANNOUNCE GOALS	583.26	1849.11	1533.42	1129.84	841.16
SHIFT TOPIC	1647.32	3089.6	845.35	1554.72	1257.9
ATTITUDE MARKERS	1975.69	2697.43	2750.39	4654.92	1213.54
BOOSTERS	10977.6	14495.7	9081.86	20172.13	3274.15
SELF-MENTION	12153.2	25160.7	4990.05	22973.44	1561.51
ENGAGEMENT MARKERS	16834.9	53953.6	23427.5	33220.18	14077.1
HEDGES	10536.6	19289.6	14235.1	19649	7293.21

Table 1: Frequencies of metadiscourse category items across corpora (per mil words). NSTAAF highlighted as focus of study.

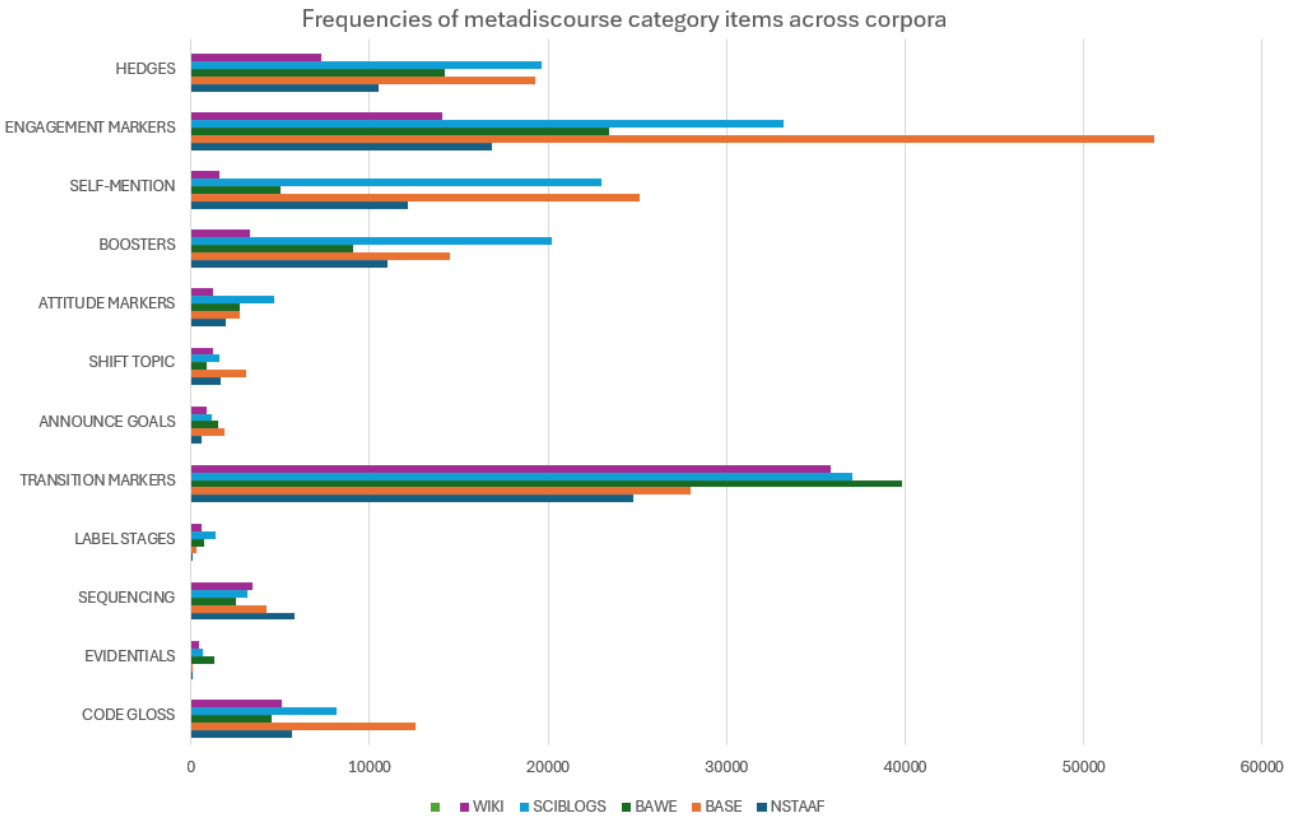

Figure 3: Frequencies of Metadiscourse Category Items Across Corpora (per mil words)

Again, I will begin by addressing the comparative corpora. The BASE corpus had the highest frequency across five metadiscourse categories, which I will address in turn. These were: code glosses, announcing goals, topic shifting, self-mentioning, and engagement marking. The high prevalence of code glosses may be because of the need to explicitly linguistically signal when an explanation is to come in the spoken mode of BASE, while in the written form of BAWE, which had the lowest count of code glosses, it may be obvious thanks to

features such as punctuation marks. For example, in BASE the speaker used the code gloss "that is" in Example 2 below:

2) *"It was translucent, that is semi-transparent…"*

A writer in BAWE could hypothetically express the same thing using brackets – "it was translucent (semi-transparent)". "That is" appears 606.87 times per million words in BASE and only 5.9 times per million words in BAWE. The high frequency of announcing goals may be explained by its teaching purpose, as students may wish to know in advance what they expect to learn from the lecture and seminar, to organise their notes and focus on the most salient information. This may also be the reason for the high frequency of topic shifting. The frequent self-mentions in BASE may be a rapport building strategy with the in-the-room audience, for example in the case of anecdotes, or when phrasing an activity as a joint enterprise. This appeared in the corpus in cases such as Example 3 below.

3) *"Now we're going to start looking at…"*

Similarly, the engagement markers in BASE are likely means of eliciting interaction from the students, for example when asking questions, requesting volunteers, or prompting them to picture things in a certain way. For example, it has the highest frequency of the phrase "think about" at 401.93 per million words, with the next highest being in ScienceBlogs at a much lower frequency of 132.38 per million words.

The ScienceBlogs corpus had the highest frequency across four metadiscourse categories, which I will again address in turn. These were: label stages, attitude markers, boosters and

hedges. Cohesive markers may help to strengthen arguments in ScienceBlogs, by bringing what may be passionate and therefore somewhat disorganised ideas together. This may be in the posts themselves, where the more informal register invites a personal and passionate style. It may also be in the comment section, in the case of a real-time discussion or argument where somebody is attempting to get their point across. For example, it has the highest frequency of "in short" at 17.69 per million words. Example 4 shows a rather confrontational example of this usage:

4) *"In short, don't meddle."*

This appeared at the end of a long argument about the ethics of a post-mortem experiment. The comment section can perhaps also be assumed to be the location of much of the attitude marking, where opinions on the content of the posts could be shared and discussions take place. Potentially suggestive of this is the higher prevalence of attitude markers which express incredulity. It has the highest frequency, for example, of "shocked", "surprised" and "remarkable". These markers are suggestive of a passionate or emotional response, which prompt engagement with the comment section in the first place. The high frequency of boosters is further suggestive of these responses, as they are likely used to strengthen arguments. This can be inferred by the high frequency specifically of highly certain boosters, such as "incontestable" and "incontrovertible". By contrast, the high frequency of hedges may be a way of attempting to prevent discussions in the comment section from becoming heated, by not presenting one's contributions in a confrontational or arrogant manner. For example, it has the highest frequency of "from my perspective" which appears to be a strategy of presenting what they are saying as mere opinion and not claiming it to be fact.

The BAWE corpus had the highest frequency across two metadiscourse categories: evidentials and transition markers. The high prevalence of evidentials in BAWE can likely be attributed to the need to reference sources in academic writing. “Cited” for example appears 187.13 times per million words, with the next highest being ScienceBlogs at a much lower 38.33 times. Similarly, the high frequency of transition markers reflects the academic requirement to organise information logically for ease of understanding.

The Wikipedia corpus did not have the highest frequency in any metadiscourse category, and had the lowest across five categories – all interactional categories. This is not surprising, since there is no need to form a relationship with the reader of objective facts.

To turn now to NSTAAF, the corpus has the highest frequency in only one metadiscourse category: sequencing markers. This is possibly reflective of the audio format. There is a need to consistently remind the listener of the chronology of information, since the information they are being presented with is fleeting and does not exist in an easily returnable-to written form. The sequencing markers likely also perform cohesive work in terms of the structure of the podcast, for example when the sections of the podcast are separated using phrases such as “our second fact…”

The NSTAAF corpus receives the lowest frequency across four metadiscourse categories, the greatest number after Wikipedia. These are evidentials, label stages, transition markers and announcing goals. The low count of evidentials is perhaps consistent with the hypothesis that science popularisations are concerned with a “narrative of nature” over a “narrative of science” (see Section 2.1.1), therefore findings do not need to be attributed to anybody and

can be presented as though they function outside of institutions, in the real world. The low frequencies of label stages, transition markers and announcing goals is perhaps more of a surprise, given the previously discussed need for extra guidance in audio formats. It is possible that the semi-scripted nature of the discourse means that the information is already well-organised and that the pre-defined sections of each podcast episode make organisational metadiscourse redundant. The need to announce goals may not be quite so necessary in NSTAAF due to the podcast's "infotainment" purpose, which in contrast to BASE, has no rigorous academic goal. It is perhaps unnecessary to explicitly signal what the audience needs to pay specific attention to, as they will not be tested on the information. For example, "want to" appears at a frequency of 1110.13 per million words in BASE, in uses such as Example 5 below:

5) *"Today I want us to look at two things…"*

The frequency is much lower in NSTAAF, at 470.08 per million words, and usually concerns the podcaster's personal goals as opposed to learning objectives, as evident from phrases such as Example 6:

6) *"I just wanted to look into infra-red for a moment…"*

To briefly conclude this section, many of the quantitative results are unsurprising, for example the low interactivity of the fact-providing Wikipedia corpus, and the high interactivity of the BASE corpus where there is an audience present. The results for NSTAAF, however, are often unexpected, producing lower comparative frequencies than might be expected. Further contextualised investigation is required to explore why this may be the case.

4.3.4) Notable Individual Items

The following section will focus on the NSTAAF corpus, and concern individual search terms that appear notably more frequently or infrequently in NSTAAF as compared to other corpora. This will allow insight into uses of metadiscourse items which are particular or unique to the podcast corpus.

4.3.4.1) Interactive Metadiscourse

Some of the differences in the frequencies of individual search terms between the NSTAAF corpus and comparative corpora are easily explainable due to the modes of the corpora. In the entire category of label stages for example, which consists of nineteen search terms, only seven appear at all in NSTAAF. The most frequent is “so far” which has a frequency of only 16.07 per million words. The unrepresented search terms are generally cohesion markers which assist reader comprehension of written text, for example, “in conclusion” and “to summarise.”

To move to other metadiscourse subcategories where certain terms are infrequent in NSTAAF, the code gloss “such as” appears only 11.38 times per million words, compared to 830.83 in BAWE, 576.57 in Wikipedia and 209.6 in ScienceBlogs. It is closest in frequency to BASE, where “such as” appears 111.58 times per million words. This illustrates the fairly obvious similarity in the two spoken corpora, that more formal linguistic code glosses which lend themselves to written text, are comparatively rare. More common in both of these corpora are code glosses which act as markers of repetition or reframing such as “that is”

which appear to function to aid comprehension. “That is” appears 606.87 times per million times in BASE and 205.91 times in NSTAAF, contrasted with 5.9 times, 55 times and 92.44 times in BAWE, Wikipedia and ScienceBlogs respectively. These elaborative and repetitive verbal signposting phrases may appear more frequently in the spoken corpora due to the fleeting nature of the information (Ye, 2021). When information is spoken rather than written, it disappears once the speech has terminated, in contrast to written genres where the reader can easily return to it by simply looking up. Repetition, signalled by these code glosses, is a strategy that needs to be used more frequently therefore, to embed the information which cannot easily be returned to, in the mind of the listener.

NSTAAF also uses “really” with a code glossing function more frequently than the other corpora. This usage contrasts a previous predicted thought or piece of information with a signalled alternative, acting as a counterexpectancy marker (Martin and White, 2005), which could be seen as a strategy for highlighting novelty through a code gloss. It is used in this way 319.35 times per million words, in phrases such as “it was really meant to be…” The listener is being told that information they have, either from previous experience or what they have been told prior on the podcast, is going to be challenged. This creates interest in the information that is to come and primes them to have an open mind. This usage is not found at all in BASE or ScienceBlogs, and only 49.03 times per million words in BAWE and 4.79 times in Wikipedia.

NSTAAF appears to have a different approach to transition markers to the other corpora. It is the only corpus which uses transition markers other than those listed in Hyland’s search terms. “Indeed” is used in this way 65.42 times per million words, for example in Example 7:

7) *"Indeed, in these small fields of sediment transport…"*

"Now" (at a frequency of 51.97 times per million words) is also used as a transition marker, as in Example 8:

8) *"Now, I got this from Bill Bryson's book…"*

Even within these examples, it is clear that these transition markers are used for diverse purposes – here alone to expand on information and to attribute a source. This may be a reflection of the spoken genre, as these transition markers appear to have no real meaning behind them, and are instead filler words. They signal a new string of discourse without any indication of what the next content is going to be. This may be because in the conversational style of the podcast, there is no defined goal of a stage of discourse so the purpose does not need to be defined. This is perhaps further exemplified by the relative scarcity of goal announcing metadiscourse in NSTAAF. "Focus" for example appears only 14.06 times per million words, compared to 173.64 times in BASE, 329.76 times in BAWE, 157.8 times in Wikipedia and 115.96 times in ScienceBlogs. "Aim" appears only 8.04 times per million words in NSTAAF, compared with 109.31 times in BASE, 284.3 times in BAWE, 76.57 times in Wikipedia and 47.05 times in ScienceBlogs. Again, this may be because the information is being presented as an informal conversation with no goal-orientated stages which need to be signalled. This avoids intimidating the listener by making it appear as though they might be tested on the information, and overall creates a less intimidating environment in which to learn.

4.3.4.2) Interactional Metadiscourse

The tone of attitude markers which appear more frequently in NSTAAF than in the other corpora appears to be more emotional. This is in line with the "diverse" (Reddy *et al.*, 2021, p.9) and emotionally charged (Figueroa, 2022) vocabularies employed by podcasts. For example, "amazing" appears far more frequently, at 375.67 times per million words, than the other corpora. It appears 16.51 times per million words in BASE, 3.24 times in BAWE, 10.03 times in Wikipedia and 65.24 times in ScienceBlogs. This is perhaps an implicit marker of the hosts framing themselves as being at a similar level of expertise to the listener. By using this somewhat emotive attitude marker, they are indicating to the listener that they too are experiencing novel and exciting information for the first time, thus creating a sense of a shared journey of discovery. This is further exemplified by the comparatively frequent use of "unbelievable" in NSTAAF, at 15.4 times per million words compared to 2.28 in BASE, 1.08 in BAWE, 1.11 in Wikipedia and 7.61 in ScienceBlogs. In expressing their disbelief, they are presenting science as something exciting and novel, which they are experiencing anew, like the listener. This constructed unified experience allows for more meaningful engagement, as the audience does not feel as though they were learning alone.

Explicit introductions of attitude markers are also frequent in NSTAAF, with "think" being used to introduce opinions, as in Examples 9 and 10, 305 times per million words.

9) *"I think it was a good idea."*

10) *"I think it was horrible."*

This explicit opinion-signalling from a speaker presenting themselves as on a similar level to the listener encourages them to likewise consider their thoughts on the information. “Find” is used similarly, appearing 305 times per million words, as in Examples 11 and 12.

11) “*I find it fascinating”*

12) “I find it hard to believe.”

Some boosters appear to be used notably more frequently in NSTAAF as compared to the other corpora. For example, “definitely” is used 105.8 times per million words while only 39.85 times in BASE, 24.23 times in BAWE, 6.55 times in Wikipedia and 81.07 times in ScienceBlogs. This is perhaps due to the tradition of removing hedging and increasing certainty in non-academic genres (Breeze, 2015), hence the second most frequent usage being found in ScienceBlogs. The information is presented as definite since the communicators are conceding to the wisdom of academics, taking what they are saying as fact, and distributing it as such. This is not consistent, however, when the lexis used are more traditionally academic or scientific. For example, “prove” has the lowest usage in NSTAAF across the corpora, appearing 22.77 times per million words, as opposed to 107.03 in BASE, 198.05 in BAWE, 93.19 in Wikipedia and 206.38 in ScienceBlogs. When it does appear in NSTAAF, it quite often relates to the validity of the secondary information being presented rather than of the primary research, shown in Example 13:

13) “I can’t prove this as a fact”.

This perhaps relates again to the creation of a “narrative of nature” (Hyland, 2010) as opposed to a “narrative of science” (Myers, 2003). Here, science is presented as something

that happens in the world independent of human activity, so the academic act of "proving" something is less required than the real-world state of "definitely" being a certain way.

Additionally, words most commonly used as sequencing markers notably take on an engagement marking function in NSTAAF. "First" is the most common of these, at 711.33 times per million words. This is generally to signal the novelty or newsworthiness (Breeze, 2020) of something, as in Examples 14 and 15 below:

14) "She was the first person to do that."

15) "It was the first time that had happened."

This is a way of making the information sound important to the listener and thus heightening its presented validity as something to pay attention to.

Hedges in NSTAAF appear to be most frequently in the form of taking ownership of the information, by combining a hedge with a self-mention. "Think" (which does not appear on Hyland's list as a hedge) is used at a frequency of 2371.39 per million words, usually in phrases such as in Example 16:

16) "I think it's to do with food."

The word "think" as a hedge has been fairly widely discussed as a way for writers to "distance themselves from the proposition they are communicating" by not implying that it is

fact (Prokofieva and Hirschberg, 2014, p.1). Its absence from Hyland's list is therefore reflective of the list's specific focus on written academic discourse. It is the combination with the self-mention (which adds intimacy and removes the generic objectivity of academic discourse) which means that it is not on the list, rather than its non-status as a hedge.

The hedging usage is found less frequently in the other corpuses, at 187.25 in BAWE, 47.28 in Wikipedia and 651.39 in ScienceBlogs. The closest in frequency is BASE, at 2153.8. The similarity in these two corpora is perhaps a reflection of the relationship-building potentials of the spoken modes, since the intimacy automatically created by having an actual voice adds a humanity to what is being said, which is further strengthened by an expression of doubt. This makes the speaker appear fallible, therefore closer in knowledge to the assumed uninformed audience. The higher frequency of "apparently" in NSTAAF also points towards an admission of being at a lower intellectual status than the academics whose work they are communicating. It appears at a frequency of 328.79 per million words, as opposed to 37.57 in BASE, 23.39 in BAWE, 35.24 in Wikipedia and 169.18 in ScienceBlogs. The word functions as an admission that the information is being regurgitated as the host does not have sufficiently robust knowledge to verify it completely.

4.3.5) Section Summary

The results of the quantitative corpus investigation produced some surprising results. In the NSTAAF corpus, there was a lower-than-expected frequency count of metadiscourse features across most categories. This is especially surprising given the multi-host format of the show. Interactions are happening between hosts as well as with the audience, which could be assumed to produce higher frequency counts of interactive and interactional features.

Additionally, interactive metadiscourse may have been expected to be more frequent due to the auditory mode of the podcast. As discussed in Ye (2021), the fleeting nature of auditory language, where one cannot return to text if they miss something, could be expected to necessitate more guiding language, to remind audiences where they are in the discourse.

The next section presents a qualitative analysis of a sample of full podcast episodes, where full transcripts will be analysed according to Hyland's metadiscourse framework. This provides insights into the unexpected corpus results, with the surrounding contexts allowing for examination beyond quantitative counts of raw frequencies. This will further contribute to the research goal of identifying engagement strategies.

5) Investigation 2: Qualitative Analysis

Many of the frequency counts of metadiscourse items for the NSTAAF corpus, as compared to other corpora, were unexpected. It could have been assumed that interactional metadiscourse specifically might have been far more frequent, given that the four hosts interact with each other as well as with the audience. Additionally, interactive metadiscourse may have been expected to be more frequent due to the guiding requirements of an auditory mode (see Section 1).

Contextual examination of these surprising results may provide insight into why frequency counts might have been comparatively low. It could be the case that the list of search terms used did not accurately captured features performing metadiscourse functions in the NSTAAF corpus.

Analysing full episodes in context may identify uses of metadiscourse that are not represented in the list of search terms initially used to build the framework. It was this initial search term list which was used in the corpus analysis. Identification of unrepresented items will provide a more accurate picture of the metadiscourse items that appear in the corpus. These can then be used for their intended purposes: to identify strategies of audience engagement in the NSTAAF corpus.

The identified items can be integrated into a new search term list, which can then be applied to the NSTAAF corpus. The new search terms can then be expanded for concordance line analysis, and the contextualised data will hopefully begin to reveal audience engagement

strategies. In other words, the accurate search terms may act as signals for where audience engagement strategies exist within the corpus, since (as discussed in Sections 1 and 2.2.1) the hypothesised functions of metadiscourse align with the goals of audience engagement strategies.

5.1) Methods

I took a random sample of 10 full transcripts of NSTAAF, using an online random number generator. This was 10 out of 100 episodes, so roughly 10% of the data (give or take, given the difference in episode lengths). These episode transcripts were loaded into Nvivo14 (Lumivero, 2023), a software designed for qualitative analysis.

The data was coded according to the categories outlined in Hyland's metadiscourse framework (Hyland, 2019) (see section 2.2.1). A functional approach was taken, where any language which appeared to be performing the functions of the categories was included in the code. For example, the phrase "fact number [X]" performed a frame marking function within the podcast, and was coded accordingly.

There are three intentions behind this analysis. Firstly, I intend to identify any language which performed the metadiscourse functions outlined by (Hyland, 2019), but which was not represented in his provided search term list. This is to provide insight into surprising results from the quantitative analysis, as discussed in Section 4, such as why there are comparatively low frequency counts of interactional metadiscourse despite hosts addressing both the audience and each other. Secondly, I intend to potentially identify metadiscourse usages

which are specific to podcasts, thus expanding Hyland's framework beyond written text. Thirdly, I intend to identify items which could be added to a search term list for a third investigation, to identify strategies of audience engagement in the podcast data.

5.2) Results and Discussion

In the following section, I will present and discuss the results of the qualitative analysis. Identified metadiscourse features are underlined within longer illustrative examples. Metadiscourse categories are discussed in turn, with interactive metadiscourse addressed first and interactional metadiscourse second. Within these broad categories, sub-categories are discussed in alphabetical order. For a reminder of the categories discussed throughout the explanations, see section 2.2.1.

5.2.1) Interactive Metadiscourse: Code Glosses

Some of the code glosses identified which were not represented in Hyland's search terms were very similar to those on the list. For example, these included "meaning that" and "the idea was that", which are relatively similar to "this means" and "that is". This potentially highlights a methodological limitation in using the search terms used to build the framework as items to focus on, as potentially rich quantitative data may be lost due to small variations in word choice.

There were some code glosses which seemed to perform specific work in ensuring that the listener was orientated in a general topic area, in preparation for discussing something specific later in the discussion. Phrases performing this work included "this is to do with…" and "so, this is…" An example can be seen in (17).

17) *I did not do that, to people at home. I wouldn't do that. But <u>this is about</u> the Winter Olympics.*

This allows the listener to mentally prepare for the information that they are about to receive, and pre-emptively contextualises the discussion. Additionally, it may allow them to decide whether it is something they are going to enjoy listening to, or if they would prefer to skip to the next quarter of the podcast for something they are more interested in. This choice helps them not to feel trapped in or tied to something they may not find enjoyable, thus appeals to their negative face (Goffman, 1955).

An appeal to positive face by contrast, comes from code glosses such as "it should be said" as shown in Example 18.

18) *So we know what they did by what the Spanish said, although <u>it should be said</u> that the*

Spanish did lie a lot because...

Yeah, why wouldn't they?

They defeated them.

Exactly.

The modal "should" expresses responsibility for the fact that there is a listener need that ought to be attended to – in this case the need for contextual information about the validity of the sources under discussion. Abdi, Rizi and Tavakoli (2010) term these markers "disclaimers", which anticipate critiques from the imagined audience. Attention to this need

shows an understanding of the need to guide the audience through the conversation, providing extra parenthetical information as deemed necessary.

5.2.2) Interactive Metadiscourse: Evidentiality

Many of the evidentiality markers are paired with rather vague references to sources, in phrases such as "one paper I read" and "there was a study done where…", which are not referred to with any more specificity later. Example 19 shows an instance of this.

19) I was going through a bunch of studies that have been done over the years as they often are into parenting and that seems to be roughly the average.

There are a number of reasons why the evidentiality might be expressed in this way. Firstly, it may simply align with the mode of the podcast, with the more conversational tone lending itself to anecdote-like self-mentions rather than an agentless or passive construction such as "Stephen Fry's Mythos book says…" Secondly, it is consistent with the hypothesised "celebratory discourse" (Bucchi, 1998) of science popularisations, where the agents and methods of both primary scientific research and secondary dissemination of this research are explicitly discussed and highlighted, in order to celebrate an interest in science. Thirdly, self-mentioning may perform something of a hedging function. This concerns the fact that many of the information sources within the podcast are not in fact peer-reviewed papers. Some examples of what they are instead are given in 21 and 22.

21) *I was reading about the earliest modern trampolines, and I was I went to the Olympics website because they've got a history of trampolining on there…*

22) *I found a Facebook page called Samoan quotes and sayings.*

Hedging the use of these sources with self-mentions acknowledges the fact that they may not be robustly verifiable. They are not presented as absolute fact, only as what "I" have found.

5.2.3) Interactive Metadiscourse: Frame Markers

Many of the frame markers found were referential to the logical unfolding of the podcast episode. Phrases such as "just back to" and "some other things on" express logical relations between the prior information and the information that is to come, to help the listener make mental connections between what might otherwise be disparate pieces of information. Further discussion of these phrases is found in Section 6.2.3.1, in the context of Facework. An example of this is 23.

23) *Oh, just stuff on the UN, I didn't realise this, but I think maybe it's quite well known that the UN…*

Sometimes, these logical progression, orientation-type frame markers are used to elevate the topic to a more extreme level of interest, as in 24.

24) *There's an even more embarrassing thing.*

"Even more" encodes the fact that the "thing" previously discussed was already embarrassing, therefore anything subsequent that is worse must be highly interesting. Here then, a frame marker is also performing engagement work, signalling to the listener that they ought to continue listening to find out the "even more" exciting information.

Much frame marking was performed by "did you know" variant constructions. Some examples are given in 25 and 26.

25) *So <u>did you know</u> the first cricket balls were rolled along the ground?*

26) *<u>Do you guys know</u> about Simon Haiha, who I'm almost certain that's not how you pronounce his name?*

Semi-fixed phrases such as these implicitly encode a lot of meta-data about the mission statement of the podcast. "Did you know" is often used in conversation and in print to introduce new, quirky or consensus-questioning information – perfectly aligned with a "fun facts" podcast. It is therefore the perfect marker to introduce new information in a science popularisation, infotainment podcast. Its specific appropriateness for this type of text is likely why it does not appear in Hyland's search terms.

Frame markers are also sometimes playful, with hosts introducing a mini-quiz or guessing game among themselves to elicit information in a pseudo-interactive manner. An example of this is 27.

27) *I have a test question for you guys.*

Yes.

The company Kelloggs, who's it named after?

John Kellogg.

John Kellogg.

John Kellogg.

Incorrect.

Oh.

This type of frame marker also encourages engagement, as the listener is likely to mentally join in with the game. This interactive element is potentially also more likely to make them remember the information when it is eventually given to them, due to the active effort they made to arrive at it themselves (eg Sánchez, Diego and Fernández-Sánchez, 2017, Yang, Razo and Persky, 2019).

5.2.4) Interactional Metadiscourse: Attitude Markers

There is attitude marking work performed in the podcasts which was not represented by Hyland's search terms. One feature which marked attitude in a novel way was repetition of something surprising from a second speaker, marking an attitude of incredulity. For example:

28) *It can do that up to 70 hours straight.*

Wow.

Yeah.

And the thing is...

70 hours?

Sometimes the repetition is less direct, in that it does not reference a word or phrase that was mentioned recently, but the general topic under discussion. This is shown in 29 where the example follows a long stretch of conversation about elephants. Here, the attitude marking forms a dual purpose of attention refocussing, reminding the listener of what is being spoken about.

29) *And the other thing they do is they hop from footprint to footprint.*
What?
Elephants?

This strategy of using repetition to show incredulity implies a sense of wonder at the information being displayed, giving the impression that the information is so incredible to the host that they need to hear it repeated to believe that they have not misheard. The hearer is positioned to be excited by the content provided.

Similarly, attitude is sometimes marked by non-lexical features such as a sarcastic tone, as in 30.

30) *He sounds like a reliable man to be doing science.*

Here, the sarcasm was obvious from the surrounding context, which was a discussion of a scientist who used to perform experiments while intoxicated (the hypothesis that this was said in a sarcastic tone was also checked by listening to the audio file). In other cases however, the

tone may not be clear from the transcript data. This suggests the need for a different coding scheme for podcast data, rather than using the pre-existing metadiscourse framework.

Another attitude marking feature which was not represented in the search terms Hyland used to build his framework is exclamations. These tend to be either single words exclaimed in response to new, shocking or exciting information. Example 31 shows a use of "Wow!"

31) *His descendant is the current president of Chile.*

Wow!

Subtly different is when single words or fixed phrases are uttered in a more subdued manner, often as a marker of disapproval or disbelief of something negative. In 32, a single word and a fixed phrase are used in quick succession to mark solemn disbelief at somebody's actions.

32) *Because he killed probably 0.6% of all the Soviet fatalities in the Winter War were down to him.*

Geez.

Oh my goodness.

Attitude is also marked by hosts expressing their opinions, preferences and recommendations. In 33 for example, one of the hosts comments on a theory that caught his attention, marking an attitude of curiosity and intrigue.

33) *And I liked, I think it was him who was pointing out one of the ways that things could be misinterpreted…*

Marking an attitude towards one theory or hypothesis among many may implicitly signal to the listener that they too can form opinions on theories, hypotheses and scientific issues.

In 34, a host marks his attitude to an information source, using the phrase, “I highly recommend…”

34) *Honestly, I highly recommend Puzium.*

In explicitly marking their own feelings towards the source, the host is implicitly increasing its credibility, thus making the information they are presenting appear more robust.

An attitude marking phrase is also used in the introduction to every episode, shown in Example 35.

35) …we have gathered around the microphones with our four favourite facts from the last seven days…

Stating from the top of the episode that the facts are the hosts’ “favourite” gives incentive to pay attention, since the positive attitude must have been earned.

Finally, some words are used to mark attitudes of intrigue, humour and general interest which are not represented in the search terms. These include “funny”, “crazy”, “cool” and “weird.” Such terms likely do not appear in Hyland’s list due to the differences in purpose and intention between science popularisations and academic writing. Attitudes such as these are

more in line with an entertainment rather than an informative goal, and thus are present in the podcast data.

5.2.5) Interactional Metadiscourse: Boosters

Some boosters were found in the podcast data which were not in Hyland's list of search terms. These were items which increased the conviction or strength of the information being presented, by asserting precision, exclusivity or certainty (Hyland, 2019). Examples 36 and 37 show some of these usages.

36) *But the amazing thing about this is that we can study exactly what happened and the influence of the Spanish by looking at this one glacier.*

In 36 it is the benefit of the particular methodology of the discussed study which is being discussed, which is somewhat at odds with the tendency of science popularisations to remove methodologies and create instead a "narrative of nature" (Hyland, 2010). Instead, here, methods are being explicitly pointed to and praised.

37) *...I didn't really know that you could just cut into the side of a tree*
and it just comes out.
Not any old tree.
You could point out, it has to be a maple tree.

In 37, the phrase "has to be" asserts the necessity for a specific detail to be adhered to during a process. Again, the focus here is on a method, putting the human agent back into the

science under discussion. This could be a strategy for making science appear more accessible to lay audiences, humanising phenomena and making them appear more reachable.

5.2.6) Interactional Metadiscourse: Engagement Markers

For a reminder of how Engagement Markers in Hyland's framework are being distinguished from engagement strategies in this research, see Section 1.

Much engagement marking work between the four podcast hosts is performed in the form of questions, not picked up in the search terms. This absence of questions in the search term list is the result of it being mainly focussed on written, academic discourse, with a single author. The mode and format of NSTAAF allow for relationship building between hosts, as well as between the hosts and the audience. Some of the questions, for example, are requests for new information, which will provide elaboration on the discussion. Examples of this can be seen in 38 and 39.

38) *How many astronauts were there in 1934?*

39) *Do we still not know what those knots mean?*
We're getting close.

Both of these questions appear to intend to elicit context. In 38, this is context for quite how rare the individual being discussed was in their field, which makes the information seem more novel and exciting (Hyland, 2010:126). In 39, the new contextual information elicited about advancements in the investigation of the phenomenon (in this case a complex system of encoding information in knotted strings) creates excitement surrounding a methodology.

Again, this is at odds with the observed tendency of science popularisations to create a "narrative of nature" (Hyland, 2010).

Some questions serve the purpose of eliciting information about the host's life, as can be seen in examples 40 and 41.

40) *Have you got a lot of snow in Australia?*

No, but apparently nowhere does any more, so it's actually playing to our favour.

41) *Does your child cry much?*

No, not too much.

Oh really?

Because a lot of children do, I've read.

According to evolutionary biologist David Haig, this might be to stop their parents from procreating and having another baby.

In both of the above examples, one host is using their knowledge about another (that they grew up in Australia and that they have a child) to introduce some real-world, personal context to the information (Hyland, 2001: 221). In 40, this could be seen as also acting as a sort of evidentiality marker. The host is not using a paper to verify that it does not snow much in Australia, rather a real person's experiences. In 41, it appears to more-so perform a dual engagement and transition marking function, using the specific question about the host's child to introduce theories about infant behaviour in general.

Questions are also used to request repetition or clarification of something that has previously been said. Example 42 shows this.

42) *What was his name, sorry?*

Charles Granville Bruce.

Somewhat similarly, 43 shows a question being used to provide clarification by proposing an appropriate familiar concept, for the listener to compare with the novel concept being described.

43) *But in those days, they weren't going as fast where they, is this like a modern bullet train?*

This could be interpreted as an appeal to audience design, attending to the listener's positive face (Goffman, 1955) and need for clarification or familiarity, in order to feel included in the discussion. Examples 38 to 43 could all, in fact, be seen as a strategy to delicately attend to the need to balance between positive and negative face needs. In all cases, the hosts, having prepared for the podcast, likely already have the knowledge they are requesting. The multi-host format allows them to request information on behalf of the listener, in a way that does not make them feel patronised or uninformed for needing context or repetition.

Another use of questions is to check within the group whether the information was engaging in an act of communicative signalling (Keller, 1979). Example 44 shows a typical manifestation of this.

44) *And there are also ones that are called Lupers, which are sheep that climb on top of each other to try and get over the wall.*

Wow.

Isn't that cool?

Wow.

While the question is primarily addressed to the other hosts, as evident from the fact that a response is elicited, the question also invites the listener to evaluate their opinion on the information. They are implicitly encouraged to agree, since the question is rather rhetorical in nature, but welcome to disagree.

5.2.7) Interactional Metadiscourse: Hedges

As discussed previously, some hedging items similar to those on Hyland's list were found, highlighting the potential methodological problem with using the list used to create the framework in analysis. These were largely adverbs which reduced the certainty or strength of propositions, such as "theoretically", "presumably", "supposedly" and "technically". These have similar meanings to, for example, "broadly" and "maybe" found in Hyland's search terms.

Much of the hedging performed refers to science as a whole, using the pronoun "we" to refer to the universal (Quirk and Crystal, 2010) and then stating that the knowledge the scientific field has as a whole is incomplete or uncertain. An example of this is seen in 45.

45) ...he invented a difference engine, which was like an early prototype of the computer and people aren't really sure whether he made it.

Sometimes the hedging is in the form of a question between hosts, as shown in 46.

46) *Is there a theory as to why he couldn't wear them twice, or do we not know?*
We don't really know, I think it's just because he's so important and it's an ostentatious show of wealth, isn't it?

Again, here the "we" is used to represent the general knowledge of society as a whole.

A great deal of the hedging is self-mentioning in nature. For example, in 47.

47) *As I read this the other day, I haven't got the full details here, but there's a species of crab…*

The host is hedging the quality and completeness of the information by admitting that it is incomplete. Hedging such as this is perhaps suited to popularisations, as the information being shared is secondary. It has been transformed at least twice, from findings to academic paper, then to popularisation, potentially with another interim step of another output such as a newspaper, blog or website.

Another way in which this information quality hedging manifests is in when the hosts speculate about what may or may not be an outcome of or reason for something. This is often in the form of phrases such as "I guess" and "I suppose." Examples of these are seen in 48 and 49.

48) *Do you know, in 1960, for the 1960 Winter Olympics, one of the cities that bid was Karachi in Pakistan?*

Wow.

They do have Himalayas there, I guess.

49) *So all we know is through oral history, which is always going to be entangled, I suppose, with myth.*

The hosts also hedge the quality of their information-sharing, in terms of how likely it is that they have properly understood what they have learned, or how well they are reproducing it for the popular audio format. Potential issues of pronunciation came up a number of times, as in 50.

50) *So this is called the Sondoon Cave in Vietnam.*

Apologies if I mispronounced that.

Another aspect of the information that is hedged is how close the hosts' description is to the phenomenon they are trying to describe. This is often in the form of phrases such as "kind of", "sort of" and "stuff like that", which admit that the description is not an exact match for the subject under discussion. Here, a "conceptual pact" (Horton and Gerrig, 2002) is formed with the audience, where both parties are aware that the description is one of best fit. Examples are 51 and 52.

51) *And so we know exactly which year it is by looking down in the ice cap.*

Oh, like tree rings kind of thing.

52) It's on the Pearl River and the idea is it's going in between the coal pickup point to the power point and when it docks, it sort of plugs itself in and recharges its batteries and the time it takes to load and unload is roughly the time it takes to charge up.

5.3) Section Summary

To summarise, NSTAAF uses metadiscourse features unrepresented in Hyland's list of search terms, to encourage audience engagement. These include features specific to audio modes, such as tones of voice which indicate surprise and cynicism. They also include structural devices such as repetition, and lexical choices suitable for a more informal register.

The next section will return to corpus methods to investigate audience engagement strategies in the NSTAAF corpus. An updated list of metadiscourse search terms, informed by the results of Investigation 2, will be used to identify stretches of language which perform audience engagement work, and these stretches of language grouped into engagement strategies. There will also be discussion of the contributions of non-metadiscourse features to these strategies as their importance becomes apparent.

6) Investigation 3: Qualitative Corpus Analysis

The insights provided by the close reading of a small sample of episodes in Section 5 highlighted the need to examine the NSTAAF data in context, to identify and explore in detail engagement strategies used which are not captured by metadiscourse frequencies alone. An updated list of metadiscourse items in the NSTAAF corpus will help to identify stretches of language performing engagement heightening functions, which can then be collated into engagement strategies. These strategies may also contain contributions from non-metadiscourse items that help to achieve engagement goals, which will be addressed. For an explanation of how these non-metadiscourse features will be approached see Section 6.1. The insights from this analysis will help to address the following research questions:

1) What linguistic strategies of audience engagement can be identified in the science popularisation podcast by examining uses of metadiscourse?
2) How do non-metadiscourse features contribute to these audience engagement strategies?

Answers to these research questions will contribute towards the overarching goal of this research, to investigate strategies of audience engagement in science popularisation podcasts.

6.1) Methods

In this investigation, I returned to corpus methods, but moved away from quantitative frequency counting, towards qualitative concordance analysis. Firstly, I produced a wordlist, keyword list, a most frequent N-grams list and a key N-grams list in SketchEngine, for the NSTAAF corpus. The top 30 results were focussed on, which was appropriate for the

timescale and scope of this project. Then, informed by the lucrative results of treating Hyland's categories functionally in Section 5, I identified items in these lists which performed metadiscourse functions but were not represented in the list of search terms. For example, "just" - identified as having a frame marking function in Section 5.2.3 - appeared frequently enough to make the top 30 list of metadiscourse features, so was added. The final list of search terms is given in Figure 4.

Search Term	Frequenc	Per Mil Words
And	19602	13126.2
I	11936	7992.78
You	10994	7361.98
So	8245	5521.15
But	4273	2861.36
Think	3979	2664.48
Go	3973	2660.46
Because	3303	2211.81
Do not / don't	3289	2202
Know	3249	2175.65
We	3224	2158.91
Would	3193	2138.15
Say	3157	2114.04
About	2528	1692.84
Really	2510	1680.79
Then	2487	1665.39
Called	1704	1141.06
My	1529	1023.87
Your	1507	1009.14
Use	1477	989.05
Could	1253	839.05
Just	1237	813.69
Find	1231	824.34
Actually	1227	821.64
See	1208	808.92
First	1073	718.52
Wow	1037	694.41
Have to	1012	677.67
Quite	872	583.92
Now	851	569.86

Figure 4: Final Search Term List

The updated most frequent 30 metadiscourse items were searched for in SketchEngine. For each search term, a random sample of 100 of their concordances were expanded. These contextualised results were then annotated, with an initial focus on how the metadiscourse features appeared to be used to encourage audience engagement. This involved annotating how the metadiscourse features were used to guide listeners through the information (Hyland, 2019), to present the information as exciting and relevant (Luskin, 1990), and to make them feel acknowledged and included in a community (Brown and Levinson, 1987) (see Section 1). Patterns began to emerge in these annotations, which allowed for the creation of functional categories of audience engagement strategies. Some of these were informed by the

prior literature, for example the category “Creating Celebratory Discourse” (Bucchi, 2008). Others were created within this analysis, for example “Demystifying the Research Process.”

As functional categories arose and were annotated in context, it became clear that it was not only the metadiscourse features that were contributing to audience engagement. The strategies appeared to use both metadiscourse and non-metadiscourse features to guide, inform, excite and interact with audiences. To give an illustrative example from the data with will be expanded on in section 6.2.1.4, a strategy identified as presenting information as exciting and relevant was to highlight its “Newsworthiness” (Bednarek and Caple, 2017, Breeze, 2020). Newsworthiness is partly constructed by metadiscourse features, such as the attitude marker “weirdly” which alerts the listener to the novelty of the information. Non-metadiscourse features also contribute to newsworthiness, such as the use of superlatives such as “largest” to indicate the exceptionality of something. The factual propositional information encoded in these superlatives means they do not qualify as metadiscourse. Their contributions, however, to the functional categories make them worthy of analytical discussion.

Once the concordance analysis was complete, I annotated 10 full sample episodes (approximately 10% of the data) for uses of the engagement strategies that I had identified. This was to confirm that they legitimately appeared in the natural data in its full form. A couple of categories for which I did not find sufficient confirmation of were excluded from the analysis. Those which remained are discussed in the following section, alongside contextualised illustrative examples.

6.2) Results and Discussion

Throughout this discussion, linguistic features which contribute to audience engagement (as opposed to exclusively metadiscourse features, as in Section 5) are underlined within longer, contextualised examples. Functional categories are split into firstly strategies to create interesting and relevant content (6.2.1), secondly strategies to create accessible content for listeners (6.2.2) and finally strategies to create content which acknowledges and includes the audience (6.2.3).

6.2.1) Strategies to Create Interesting and Relevant Content

The following section concerns strategies identified as efforts to create content which is interesting or relevant for the listener, to motivate them to continue listening even if the content might be complex or intimidating.

6.2.1.1) Countering of Folk Knowledge/Assumptions

There are many possible ways to make scientific content engaging in popularisations. A strategy that NSTAAF appears to have used on multiple occasions is to correct or challenge folk scientific knowledge. An example of this is Example 53, where the (pertinent, incidentally, to the field of linguistics) common folk belief of Inuit people having 100 words for snow is addressed.

53) The thing with the Inuit I think is that you could technically say that they do have a hundred words for snow, but the way it is is they have one or two or maybe four or five roots, which kind of means snow, and then the rest of them you can just put like a

prefix or a suffix after it to make another word, which means this type of snow or this type of snow. So it's snowing a bit or it's snowing a lot or 98 other variations.

A number of metadiscourse features are present in this example. Information is hedged, firstly in terms of how the conclusion may have been reached in the first place. The adverb "technically" signals that if the information were interpreted in a very specific way, the assumption could be construed as correct, but in practice, the language does not function that way. This is an especially appropriate word to use in the context of a science popularisation, as technicality is not what is required for lay audiences (Krimsky, 1988). Recontextualising what is "technically" true into how the language actually functions could be seen as an acknowledgement of the level of information that the listener wants. The lay audience is not concerned with theoretical technicalities, rather with how phenomena operate in the real world. The phrase "do have" then acts as a booster for the initial folk knowledge, acknowledging that it is not completely unfounded and that the listener's assumption that it was true is reasonable, helping them to not feel unintelligent and therefore welcomed into the discussion. The transition marker "but" signals the addition of specificity, clarifying without disregarding the folk knowledge.

The strength of James' conviction in his own understanding of the correction is hedged with "I think." This acknowledges that he is presenting secondary information and has undergone the process of trying to understand it himself, which may mean that there are inaccuracies in his explanation. He is therefore distancing himself from the information (Prokofieva and Hirschberg, 2014) to mitigate the strength of the conviction. This warns the listener that as this is a popularisation, the information accuracy may be less robust than an academic

publication. The self-mentioning nature of “I think” also performs some subtle personality construction work, helping to create a humble character who is not excessively confident. “So” at the end of the explanation of morphology acts as a consequence transition marker, signalling that an illustrative example of the result of the process described is to follow. The result is a summing up of that section, and in this specific context, signals that the overly simplistic folk knowledge has been corrected.

On some occasions, the multi-host format of the podcast allows for hosts other than the one correcting the folk knowledge to act as a representative sample for the general population. An example can be seen in 54.

54) *I have a test question for you guys.*

Yes.

The company Kelloggs, who's it named after?

John Kellogg.

John Kellogg.

John Kellogg.

Incorrect.

Oh.

Here, Anna introduces a new section of the episode with the phrase, “I have”, used as a frame marker then asks a question, the anticipated answer to which is a piece of folk knowledge. The assumedly desired response of three incorrect answers is given. This strategy of using a question to elicit engagement from the other hosts (see Section 5.2.6) allows for the listener’s folk knowledge to be corrected, without making them feel inferior for being wrong. The fact

that all three members of the group, acting as a representative sample of the listener population, were incorrect serves two engagement purposes. Firstly, it justifies this stretch of conversation, proving that there is incorrect folk knowledge that needs to be corrected. Secondly, it aligns the listener with the position of the hosts. They can then enter into a shared experience of learning the truth from the host in "expert" role for that time, which creates solidarity and helps with relationship-building (Crismore, Markkanen and Steffensen, 1993). It is ambiguous as to whether the incorrect knowledge was genuine, or pre-scripted as a deliberate strategy to align the hosts with the listeners. Either way, the result of presenting the hosts as having the same knowledge base as it is predicted the listener has is the same – knowledge is corrected without threatening the positive face (Goffman, 1955) of the listener.

On one occasion, the strategy of using the countering of assumptions as an engagement strategy is explicitly referred to. In a humorous exchange shown in 55, Anna invites Dan to imagine a version of the podcast where this was not the strategy chosen.

55) *We got the word from the French, and in English, it predates the word Theism by over a hundred years. So atheism was the first thing, and then we got Theism afterwards.*

Oh, no.

That was interesting.

That is interesting.

That is absolutely opposite of what I thought would have been.

I think that's why, you know, I think that's why I mentioned it.

If all my facts were exactly what you felt they were going to be, then this would be a very boring podcast.

This is prompted by Dan pointing out the obvious, using the booster “absolutely” to strengthen his experience of having his assumption challenged. The self-mention “I thought” is humorous in this context, as it implies that he was the only person to possibly have made that assumption, while it is quite clear - if nothing else from the attitude marking from the other hosts of “that is interesting” which indicate surprise - that the countering of expectation was the point of the fact. The result of the exchange is that the strategy of encouraging engagement by correcting and countering assumptions is made explicit.

6.2.1.2) Creating Celebratory Discourse

An engagement strategy observed to be typical of science popularisations (Bucchi, 2008) is linguistic effort made to celebrate the field of science itself. This appears to manifest in NSTAAF, in occurrences of the hosts commenting on the quality of the information itself, rather than the phenomenon. This happens in the opening section of every episode, where it is said that the podcast will consist of the hosts’ “four favourite” facts. It also happens in the main discourse of the episodes, for example in 56.

56) *My fact this week is that dead geckos still stick to walls.*
It's just pleasing, isn't it?
Just a nice fact.

The attitude markers “pleasing” and “nice” modify the concept of a fact itself, creating celebratory discourse surrounding the method by which information is packaged. The engagement marking question “isn’t it?” between the hosts seeks approval from both the other hosts and the listeners, gathering a consensus on the positive feeling.

Similarly, the following Example 57 shows positive attitude marking towards scientific curiosity, when the quality of a question posted on a forum that James found is mentioned.

57) *...and the question was as time passes do relics perform less miracles just because, like the gecko on the wall, after half an hour it will fall off, has it got a period of actually running out. And everyone obviously said no on the forum but yeah I just like that as a question.*

The self-mentioning attitude marker "I just like that" modifies the very act of curiosity that the anonymous poster performed. James's sharing of his opinion that to question was a positive thing to do may encourage the listener to engage with scientific information in a similar way and receive similar positive evaluations from the host. This would attend to their positive face need to feel approved of.

Also attitude marked are described processes of scientific research. Take example 58.

58) *It's interesting looking at the techniques that they tried to teach the dolphins with. One of the techniques I thought was interesting was she painted her face white…*

Here, the process of performing research into the techniques used are attitude marked as "interesting". The continuous form of the verb "looking" presents this research process as ongoing and dynamic, as though it's something that the host is continually enthusiastic about. Later, the techniques themselves are likewise marked as "interesting", with the self-mention "I thought" creating a link between the research and the opinion. By claiming ownership of the attitude marking with the self-mention, the host is creating a personal narrative of

discovery (Pilkington, 2018, p.75) by which the "interesting" process of research led to the discovery of an "interesting" technique. As often, "I thought" also performs hedging work, not claiming the attitude marked to be a universal opinion and thus not coming across too strongly.

To provide another example of attitude marking research processes, in Example 59 Dan describes how the process of research led him to discover something new and exciting.

59) *It's incredible, they're my favourite sheep in the world, they are the best sheep.*
Is it tough competition up there?
To be honest, I didn't have a favourite until I researched this one, but now, I definitely
do.

Dan describes how the process of research led him to discover a favourite kind of sheep – something he did not even consider having before. This is a rather humorous example, but does illustrate how positive feeling surrounding scientific curiosity is created. This is further expressed with the booster "definitely" strengthening the conviction of his opinion, and the emphatic, superlative threefold attitude marking of the sheep themselves as "incredible," "favourite sheep in the world" and "best sheep." These enthusiastic opinions were only formed following research, and perhaps if the reader were to engage similarly in acts of scientific curiosity, they too could experience such strong emotions. The emotive, non-objective phrasing of this evaluation may also make the science under discussion appear less formal and intimidating, helping to avoid the so-called "academic gatekeeping" (Figueroa, 2022) which may occur in science communication. These usages also perform a subtle

hedging function, removing objectivity from the quality of or engaging nature of the information by implicitly admitting that the host may find it uniquely interesting, due to their own experiences or interests.

Not all attitude marking which contributes toward celebratory discourse surrounding science is explicitly positive. Example 60, for instance, is taken from the end of a long description of a scientist's explanation of how to create a fossil from one's own excrement.

60) *That in theory is how you make your own fossil poo if someone wants to start getting going on that. Unbelievably weird thing to do.*

The attitude marked here is that the activity was "weird". While not explicitly celebratory, it does contribute to the discourse of science being interesting. To listeners, something being strange might be just as appealing in terms of engagement as it being positive. Thus, attitude markers that communicate strangeness may be just as effective in creating celebratory discourse as those communicating positivity.

Sometimes, non-positive attitude marking towards research processes can be expressed through tone. Take Example 61, where it is contextually and auditorily clear that the host is being sarcastic.

61) *My fact this week is that since 2007, the Wikipedia, Brian Henderson has made more than 50,000 edits, and all of them are exactly the same.Tracking down articles, using the words comprised of, and changing them to consist of. That's dedication.*

I love it.

Yeah.

What a great guy who's definitely not wasting every minute of his life, doing something

that serves no purpose.

This evaluation is humorous, but also encourages the listener to likewise form opinions on how necessary certain intellectual pursuits are. The attitude marking through tone is an affordance specific to the auditory mode of the podcast. This especially helps the podcast to achieve its dual information and entertainment goals, as the sarcastic tone allows for humour to be automatically encoded into the evaluation.

In Example 62, non-positive attitude marking of scientific research is personalised with a humorous anecdote about unsuccessful research.

62) *So, when I started researching this fact on bananas, I thought I hit a jackpot moment because I discovered on Twitter there was an account called @truebananafacts... Unfortunately, really disappointing, let me give you a few examples of the facts. Bananas are actually very bad and not good. Just kidding. They're really healthy. 420 retweets.*

Here, the contrast between what Andy initially "thought" he had found and what it turned out to be creates a humorous narrative of struggle. This is further dramatized with the idiom "jackpot moment", which adds an emotional dimension to the initial moment of triumph, humorous since it was a rather mundane research activity being performed. The subsequent discovery of the useless source is attitude marked as "really disappointing", strengthened by

the adverb “unfortunately”. The harnessing of the frustrating process to present a humorous narrative to the audience creates the impression that even if not always fruitful, scientific research can be fulfilling and enjoyable.

An alternative way to celebrate science - especially in the context of a popularisation, where accessibility is paramount to the goals of the discourse - may be to make the act of engaging with science seem less intimidating for the listener. Verb choices when describing intellectual and research activities may inform how accessible science is presented as being to the audience. Presenting scientific or research activities through mental verbs may remove some “obscurity” from explanations (Pilkington, 2018). An illustration of this may be seen in 63.

63) *I was thinking about MPs doing kooky stuff in Parliament.*

Andy chooses to frame his research as a single mental process of “thinking about” rather than an active process such as “researching”. This reduces the cognitive effort that is presented that he performed, making the exploration of science seem less taxing. Additionally, the adjective “kooky” assists in making the subject of research sound unintellectual and accessible, as well as entertaining.

In the following Example 64 the primary activities of scientists are similarly verbally modified to sound unintimidating and passive.

64) *So the best method in the early 2000s, which came up with the total number of 1596, which is very precise, was to go around looking for panda excrement…*

The verbal phrase “to go around” creates a meandering image, at odds with images of scientific rigour and precision. This makes the work of the biologists (who were carrying out investigations into panda populations) sound passive and undemanding. The attitude marking of this being “the best method” and the boosting of the subsequent results as “very precise” creates a narrative in which successful results can be obtained with untaxing methods, thus making presenting the scientific pursuits under discussion as accessible and thereby engaging.

6.2.1.3) Listener Inclusion in Explanations

A frequent strategy for creating engagement using metadiscourse items is to include the listener in explanations. This may be through making them linguistically active in processes, framing events as though they were there or phrasing things as though the listener has a duty to perform certain actions or take a certain stance (Kockelman, 2004).

Explanations of scientific procedures are often phrased as though the listener is carrying them out, using the pronoun “you” followed by a verb as an engagement marker. An example of this is 65.

65) Clever, so you teach them to recognise a human word for seaweed, and then they make their own sound for that seaweed.

Putting the listener into the scientist role when explaining concepts or processes makes them feel involved in the procedures. It may also enrich the mental images they produce, since they may imagine themselves taking an active role in what is being described (eg Reddan, Wager

and Schiller, 2018, Goldwasser, 2024) In 65 the transition marker “then” also assists with the creation of a procedural narrative, into which the listener is invited as a character. This is a different strategy to the complete removal of agents of science, which more explicitly builds engagement since the listener replaces the scientist in the narrative. Here, the narrative of scientific procedures is still suppressed, but rather than being completely omitted, it is brought into the realm of the listener’s experience and invites them to take over the exploratory role of the scientist. This helps to remove the conceptual barrier between the world of science and the world of the layperson.

Including listeners in explanations also helps with the visualisation of information. This is often done by introducing hypothetical scenarios. For example, an explanation of how a chemical reaction takes place is introduced in a hypothetical scenario, in Example 66.

66) *Let's say you've got a jar of honey.*

Yeah.

And you left it in a sealed dry room for 2,000 years.

The engagement-marking fixed phrase “let’s say” acts here as a directive to imagine the situation. The imagined situation is again enriched with the engagement marker “you”, which encourages the listener to mentally insert themselves into the scenario. This example also displays how concrete, real-life scenarios can be used to explain abstract concepts. The chemical process is not discussed in the arena of equations or scientific formulae, but in the real-life terms of something the listener likely has in their cupboard. This aids the visualisation process and has the dual purpose of making the digestion of scientific information a less intimidating process.

Example 67 shows an instance of the listener being included in a specifically humorous description to enrich the description of an event. Here, the breaks that early competitors in the sport of race-walking took are compared to pit-stops taken in Formula 1 races.

67) But if they were racing as well, I do love those naps as the kind of like, the Formula 1 pit stops.

Yeah.

Yeah.

But you'd go in and have a three-hour nap and then you'd wake up and be like, oh, I'm still two laps ahead.

While you were napping, people would come in and change your things very, very slowly.

The comparison is useful, as an assumed familiar concept to assist the conceptualisation of the new concept. The lack of accuracy of the comparison is drawn attention to with the hedge "kind of like", but the later elaboration assists the conceptualisation goal, rather oxymoronically as the tightness of the comparison breaks down. The absurd image of people coming to "change your things very, very slowly", in ironic reference to the notorious high-speed of Formula 1 pit-stops, exemplifies in a humorous way how a pit-stop would need to be adapted for race-walking, which implicitly helps the understanding of the sport. This also creates some cohesion, reminding the listener of the previous discussion in the episode of how the races would take several days. The humorous extension of the legitimate base comparison has, therefore, implicitly increased the understanding of the information.

6.2.1.4) Creating Narratives of Nature

As is consistent with prior literature on the reporting style of science popularisations when describing entities or concepts (Section 2.1.1) NSTAAF appears to construct "narratives of nature" (Hyland, 2010). These narratives are chronological and place the focus on the entity or concept itself, rather than the work of the scientists undertaking the investigation. Presenting information as a narrative has been found to increase retention (Ohtsuka and Brewer, 1992), and is also compelling (Hyland, 2010), thus to do so attends to both the informational and entertaining goals of the podcast.

Transition markers play a significant role in the creation of these narratives. "And" for example often appears medially between different stages of a long, chronological explanation of a process, acting as a structuring device to break a long stretch of descriptive speech into digestible stages. The most frequent collocate of "and" is "then", with the two words combined fulfilling a sequencing function. Example 68 shows an example of this sequencing function, in a narrative of nature about a poisonous frog.

68) *It takes from it the venom, and the toxin from the toad, and then it lets it drip back to its backfangs as well. And it keeps it in these little, I think, pouches, and then it bites something, and it uses the poison that it's carried over to kill its enemy.*

Absent from this description is the work of the people who discovered and disseminated information about this process.

The hedge “would” combines with the verbal process “be like” to attribute a voice to non-human animals, removing human agents of science from the narrative (Hyland, 2010). In the following Example 69, for instance, a voice is attributed to an elephant to illustrate its behaviour through a comparison to a human thought process.

69) *...elephants would be like, “stay away from the massive 20 times the size of us things over there…”*

The attribution of a voice contributes to the creation of a narrative of nature by giving it a clear protagonist. Another example of this can be seen in 70, where the verb “say” (a Code Gloss in Hyland) is a marker for voice attribution, where again a behaviour is explained through personification.

70) *...to attract smaller cane toads to them, of their own species who come and approach them to say, hey, man, nice wiggle, and then they eat them.*

This also provides a further example of the transition markers “and then” being used in combination in a narrative of nature.

The transition marker “but” also assists in the creation of a narrative of nature. This is often in the context of a description of the development of the field of science itself, where the responsibility for the change is placed upon the entity under investigation itself, rather than the investigations of a scientist. In Example 71, “but” and “it turned out” combine to signal a shift from believing one hypothesis to believing another.

71) …they heard a load of like bubbles underneath the sea and they thought it might have been like a Russian submarine or something like that, but it turned out to be herrings communicating with to each other.

The shift is not presented as a process of knowledge gaining (for example, "X discovered that it was herrings communicating"). Rather, it is presented as something that happened passively within nature and changed the consensus by its own volition.

The complete removal of an agent of science does not hold consistently across the corpus. An alternative strategy found is to make a single or named scientist a character in the narrative of nature. A strategy for character creation is to use the "presented voices" (Pilkington, 2018:15) of scientists. For example, the self-mention "I" is used to attribute made-up quotes to scientists, as in Example 72.

72) I'll get back at him. I'll invent something that's so good, he won't ever be able to take part in it…

This example also humanises the inventor by presenting his reasons for his endeavours as emotionally motivated, thus making the narrative more engaging through humour and relatability, attending to the entertainment goal of the podcast.

Superlatives such as "first" are used to justify why a particular "character" is worthy of being named, as in Example 73.

73) *Um, yeah, so speaking of women and computers, first person to write computer code was a woman…*

These usages create a pioneer type character, worthy of specific note for changing something within the scientific field or being the first to do something in a particular way. The transition marker "also" is likewise used to present a given character as special, by referring to their dual functions or attributes, as in 74.

74) *However, she is amazing. She is a not only a great computer scientist. She was also a us navy rear admiral.*

These multiple areas of expertise not only increase the authority of the character as somebody to pay attention to, but also increase the likelihood of positive audience engagement – even if they were not interested in computer science, they may be interested in the Navy.

6.2.1.5) Newsworthiness

Various metadiscourse strategies appear to be used in the podcast to emphasise the "uniqueness, relevance and immediacy" (Hyland, 2010: 126) of the information being presented, to increase engagement by encouraging enthusiasm about or interest in what is being described. This can be conceptualised from a functional point of view as "newsworthiness" strategies (Bednarek and Caple, 2017, Breeze, 2020), where contributing factors to whether something is "newsworthy" include whether something is presented as temporally or culturally relevant.

One way in which newsworthiness is created is by asserting the timeliness of the information (Bednarek and Caple, 2017, p.3). This is often with phrases such as “this week”, “has just been discovered” and even phrases as timely as “happening now”, as in Example 75.

75) But this is about the Winter Olympics ,and I'm really excited because the opening ceremony is happening now as we're doing this podcast.

Reference to recency increases the likelihood of engagement with the podcast, as recency means that there is a chance for the listener to engage with the discussion in real time. With specific reference to Example 75, for example, the listener could turn on the television and watch the Winter Olympics and relate the information they have been given in the podcast with what they see on screen. They may even decide to share the facts with fellow viewers, thus increasing the social aspect of being a podcast listener (McClung and Johnson, 2010).

Additionally, timeliness is attended to in the introduction to the podcast, where the phrase “last seven days” is used, shown in Example 76.

76) ...and once again, we have gathered around the microphones with our four favourite facts from the last seven days, and in no particular order, here we go.

This presents the research process undertaken as recent, giving a sense that the show they are going to listen to is fresh and novel.

The booster “found” contributes to the newsworthiness of presented information when it collocates with expressions of time, as in Example 77.

77) *They found this out quite recently, because if you know that they breathe through, you know they breathe through their anuses.*

Here, “found” boosts the discovery and makes it sound trustworthy and credible, while the adverb “recently” contributes to its newsworthiness as something cutting edge and up to date.

Another newsworthiness increasing strategy is to use superlatives to make an event, concept or entity seem singular and exciting (Bednarek and Caple, 2017). In Example 78, for example, the audience’s enthusiasm about the information is encouraged by the superlative “the first ever”.

78) *My fact is that the first ever instrument made for food quality control was built to test*

the consistency of jelly.

Other superlatives are signalled by -est suffixes, and include “coldest” and “largest”, as seen respectively in Examples 79 and 80.

79) *It is the coldest place on Earth for its altitude.*

80) *It's called the Kelchia ice cap and it's the largest ice cap in the tropics.*

Attitude markers such as “weirdly” contribute to the novelty of the information, as in Example 81.

81) *How many, if you fit it all on to Blu-ray discs?*

Is there a weirdly small number?

Yeah, weirdly it is quite small.

200 million.

The repetition in this example further emphasises the novelty, with the multiple voices boosting the effect since more than one person agrees that the information is strange. This consensus of strangeness may also assist in making the listener feel less alienated from and therefore more engaged with scientific discourse, as the podcast hosts agree that there is something strange about the information, creating common ground (Allan, 2013) .

The phrase “got anything” (one of the most frequent N-grams in the data) appears to perform a newsworthiness function, in structures such as “has anyone got anything else before we move on?” In these contexts, it seems to act as a frame marker. Phrases such as this signal that the hosts will soon transition to the next section of the show unless there is anything of great importance. Thus, it acts as a social signal (Keller, 1979) that the information that is about to come cannot possibly be missed out since it is so interesting. It is often followed by a phrase containing some sort of positive attitude marker, as in Example 82.

82) *I'm going to have to move us on in a few minutes, so if anyone's got anything else, -*

There's a very cool thing about Scrabble in Senegal, where it's an official sport…

This sometimes appears to have been pre-scripted, as in Example 83.

83) *Anna have you got anything you want to add?*

So, the largest dinosaur ever found has been discovered…

Here, the question was directed specifically to Anna, potentially because Dan was aware that she had prepared a superlative-containing, newsworthy fact that she had not managed to contribute yet.

A way of achieving novelty outside of metadiscourse is through humour, shock value, and "unexpectedness", (Bednarek and Caple, 2017, p.3) created by the semantic content of the information. This can be seen in the Keywords list generated for the podcast, in which many of the words are vulgar in nature or refer to the semantic field of the body – often culturally taboo parts. Represented in the top thirty keywords are "penis" "poo" "testicle" "anus" "fart" "phallus" and "urinate". One of the best ways to encourage people to become engaged with science is perhaps to focus on taboo elements. To use anecdotal evidence, I asked my mother (a librarian) for suggestions of science books to give to children for Christmas. Her verbatim response was to "Start with anything that mentions poo!" Mentions of these taboo lexes is also at odds with the "forbidding" (Hyland, 2010:118) vocabulary used by academic publications and allows the listener to feel more relaxed in scientific discussions since the topics are humorous.

6.2.1.6) Highlighting Relevance

Much linguistic work appears to have been performed within the podcast to show why the audience ought to care about or pay attention to the information they have been given. This

may come at the end of a description of something being used, as in 84 where the importance of a previously discussed fertilizer is made explicit.

84) *And that was what made it possible to grow huge maize fields, because it's much richer. They wouldn't have done it without that fertilizer.*

This signalling of the use of a process or entity once it has been developed is often marked by the transition marker "then", as shown in 85.

85) *So that is, that would be quite good to have.*
That'd be good.
And then they could collect it all and power a bus.

Here, "then" signals the description of a function, with the modal verb "could" hedging the idea as a possible application rather than one which has already been developed.

The hedge "would" is similarly often used to describe potential applications, by constructing a hypothetical scenario. The hedging effect of "would" is weaker than with "could", as the prediction is presented as closer to definite. This is shown in Example 86, where a potential consequence of implementing the results of a study is expressed.

86) *There would be a lot fewer people hit by cars,*

This particular example also contributes to celebratory nature of science popularisation (Bucchi, 2008), implicitly advocating for scientists to be taken seriously outside of the academy.

Another linguistic marker for signalling the point which appeared multiple times was the code gloss "the idea is", an example of which can be seen in 87.

87) Yeah and the idea is that the baby then gets more resources because it doesn't have to share it with brothers and sisters which means in theory they should do better in life which means they should reproduce more and then...

This follows the description of a theory that babies cry to discourage their parents from reproducing, which in isolation sounds rather absurd. Linguistically signalling the motivation behind the development of the theory however makes it sound somewhat more robust, thus making the listener more likely to engage with it – whether they believe the theory or not.

The transition marker "because" is also used to explicitly signal why something was done, as in Example 88.

88) So, he was doing this because it was a massive rise in STIs…

The explicitness of these signalling devices appears especially attuned to lay audiences, since to the unindoctrinated general public, the methods and behaviours of science may seem strange – it may not be immediately obvious to them why something was done.

Another strategy of signalling why a listener should think something is important is by linking it to everyday life (Breeze, 2015). In Example 89, Dan uses a self-mention to do this, seemingly using himself as a substitute for the everyday person.

89) *I've just got a couple more things on exclamations. So one that I use all the time is holy moly.*

The listener is encouraged to be interested in the etymology of this everyday phrase, since it is something mundane which they may not have considered could have interesting origins. The phrase “all the time” signals this link to the everyday.

The engagement marker “don’t” appears often with “you” and “have to” in the context of signalling the point or function of a process or object, to create a problem-solving narrative. Take the following Example 90.

90) I think, again, it's kind of cutting corners because then you don't have to lift your pen from the page.

This negatively polarised structure allows for contrast between the deficient reality and a hypothetical improved reality, if (in this case) the hypothesised writing system with heightened efficiency were to be adopted. The second person pronoun “you” prompts the listener to imagine these changes being implemented into their own lives, thus making their evaluations of the proposed changes more positive. This, again, contributes to the celebratory discourse of popular science.

“About”, used with a code-glossing function of elaborating on the specifics of a fact, signals the most important aspect of information being given, as shown in Example 91.

91) *Yeah, it's all about the mass.*

This guides the reader on what to concentrate on, allowing them to effectively pick out pieces of information from what they are being told.

6.2.2) Strategies to Create Accessible Content

The following section concerns strategies identified as efforts to create content which is accessible to the listener. This involves efforts to guide them through the discourse, so that they feel able to engage with it without becoming lost. It also involves strategies to present science as something which is on an intellectual level that is appropriate to them.

6.2.2.1) Demystifying the Research Process

A goal of engagement in NSTAAF is to demystify processes of research. This includes instances where they form hypotheses from information that has been shared, ponder possible reasons for phenomena, or evaluate processes – sometimes in real-time, during the podcast. Talking through research processes helps to guide the listener, as they can follow how conclusions are being arrived at.

An example of theorising why something may exist in real time is seen in 92, where James describes his theory as to why drawings of snails have been found to be prevalent on 11th Century manuscripts.

92) *You know when you're just sat there doodling*
One of the things you doodle is like a spiral
And sometimes you just draw a spiral
You might then turn it into a snail…

Here, James uses what is assumed to be a fairly universal experience to hypothesise about why a phenomenon exists. He is constructing an "originator" role for himself through this hypothesis, projecting himself as the first to propose a theory (Tang and John, 1999:31-33), but his use of engagement markers also includes the audience. The second person pronoun "you" invites the listener into this universal experience, encouraging them to evaluate whether they think that the hypothesis might have some validity. The experience is hedged with the modal verb "might", which admits that not every single listener may have had this experience. The fact that this hypothesis is built in real time, with the pronouns inviting the listener to join in with the activity, encourages them to cognitively engage with the podcast more actively, considering the information they have been given as they absorb it.

In Example 93, another example of real-time hypothesising can be seen, this time trying to work out how a strange-sounding process might be carried out. Here, it has just been revealed that due to his profound deafness, Thomas Edison would "listen" to music by biting on a

piano while it was being played. James forms a theory in real-time about how this might have worked.

93) *I guess he'd pick somewhere where the player could play it and he could sit there biting the piano and listening through his head, because the vibrations would obviously make their way to his inner ear.*

As with quite a few instances when conclusions are formed based on new information, the hedging phrase “I guess” signals that this is merely a suggestion, not a description of information sourced. Further hedging work is performed by the modal verb “could”, which suggests that the act described is a reasonable possibility, rather than something that actually happened. The hedging is balanced by the booster “obviously”, which modifies the verifiable proposition that the process of hearing is a result of vibrations making their way to the inner ear. The boosting of the proven hypothesis strengthens the case for the unproven, spontaneous theory, since it has some base in definite truth. This hypothesis being formed in real time encourages the process of probing information, as the elaboration of the base fact was not prepared in advance. This creates positive feeling around scientific curiosity, and displays how once one has knowledge of a scientific concept (in this case how people hear things) they can extend it to working out how things manifest in the real world.

Another example of a host performing a real-time evaluation, this time regarding the quality of his research, can be seen in Example 94.

94) *I think that maybe now I read that, because I thought it said pancakes and then I read it and it said flapjacks. So there are two options here, one I've written down the wrong*

word, or more likely I've copy-pasted that word and the word flapjack means something different in Canada.

Here, Dan is evaluating what might have gone wrong in the process of researching for a fact and reporting it in the podcast. In real-time, he reflects on two reasons for the confusion. He hedges his process of evaluation with "I think" and "maybe", which shows that his reasoning is tentative. He tracks the process of evaluation by contrasting what he thinks "now" with what he "thought", marking the moment of change in thought with the transition markers "and then." He then presents his conclusions with a final hedge, "there are two options here". The decision to include this section of discourse in the episode rather than editing it out firstly allows the listener insight into processes of research, where mistakes are inevitable and critical thinking necessary to correct them. It secondly presents the host as fallible, which helps to build personality and present him as on the same level as the audience.

Example 95 shows an instance of a host making explicit reference to the mental process of working out how best to communicate information.

95) *They have a third eye, <u>which is</u> a little light sensing…*

A pineal one.

Yeah, a pineal eye.

<u>I'm trying to think of how to describe it really.</u>

Here, James identifies that a new concept which needs glossing has been mentioned, and begins to try using the code gloss "which is". When he trails off, Andy takes it as a signal that a different strategy of introducing the concept might be more useful and introduces the name

before the function. James then explicitly addresses the difficulty in explanation that caused him to trail off, narrating the mental process of evaluating which may be the best way to approach this new concept. This admission expresses the attention that he is paying to making sure that they are getting the information across effectively, which may make the listener feel attended to.

Another activity performed in real time, which attends to the dual infotainment goal of the podcast, is information sharing through quizzes or mini-games between the hosts. These have already been briefly discussed in Section 5.2.3, where they are conceptualised as NSTAAF-specific frame markers. In one instance, the suitability of this method of sharing information while being engaging is made explicit, when one host spontaneously suggest doing so this way, in Example 96.

96) So in Sweden in 2012, the top Wikipedia page that was searched, that was clicked on

was...

OK, <u>we should guess.</u>

Oh, OK.

This shows that effort is made when recording the podcast to give information in the most engaging way possible. The sense of obligation is presented with the modal “should”, expressive of duty.

An affordance provided by the conversational nature of the podcasting medium is that hosts can provide real-time evaluations of the content throughout. This may be more possible in

this medium than others, and also more emotional (Figueroa, 2022). For example, self-mentioning evaluations of methods can also take the form of the host hypothetically inserting themselves into the role of scientist, as in 97.

97) Have we ever tested it?

No, I don't really want to do that experiment.

This invites the reader to consider whether they could do what the scientist did, thus encouraging critical engagement.

6.2.2.2) Admission of Non-Expert Status

One engagement strategy used in NSTAAF appears to be the decision to present the hosts as being on a similar level, in terms of knowledge bases, as the audience. This helps to create solidarity (Hyland, 2004) and establish a relationship of mutual discovery. A specific way in which this is done is to admit that they do not have expert status on the information they are sharing. An example of this comes from an episode in which one of the facts was about antimatter, which all of the hosts admitted they had very little deep understanding of. In fact, this was turned into an internal running joke in the episode. Example 98 shows James admitting that he did not understand what he was reading.

98) *So an antimatter is just like the opposite of matter, so if you have an electron with a negative charge, then the antimatter version of that is a positron, which has a positive charge. I know, I see what's weird is, I just, for me, I still don't understand what that means.*

In this example, James appears to regurgitate some information that he has read, then admits that he has no understanding beyond that. He repeatedly draws specific attention to the fact that the problem is with his own understanding with the multiple self-mentions “I see”, “I just” and “for me”, which do not attempt to blame either the concept itself or the explanation he found for being too difficult. Rather, he takes ownership of the fact that the problem was with his own processing. This self-humbling is endearing to the listener, and also mitigates the possibility that they might feel inferior for not understanding the science, since the science communicator does not either.

An understandable feature of the antimatter fact section of the episode is that there appear to be more evidentiality markers in this section than any others in the data. There are multiple occasions of the hosts qualifying subsequent explanations of processes by saying that it is what they “read”, as shown in Examples 99 and 100.

99) *So wait, because <u>what I read was</u> the beginning of the universe, big explosion, and what should have happened is the universe created enough matter, which is why we're here…*

100) *<u>So I read that</u> with humans that we're trying to create antimatter, we've got a tiny amount. But if we created a lot, it would be equivalent of like an atomic bomb explosion*

In these examples, it is perhaps deemed necessary to indicate that this information is taken directly from another source and has not been scrutinised in any meaningful way by the hosts, due to their lack of deep understanding. Here, they are conceding to their non-expert statuses

and trusting that the information they have found is sufficient, and thus attributing all responsibility to that source.

Another way in which non-expert status is signalled is when the hosts refer to how they built their own knowledge bases, in instances where this was not through rigorous scientific research or enquiry. In Example 101, for instance, Dan admits that his knowledge of a process was built only from cultural references.

101) So when you siphon petrol, you have to suck a little bit out, don't you?
And then you spit it out of your mouth.
I only know this from movies.

By self-mentioning and admitting that his knowledge comes from merely existing in the world and consuming cultural content, rather than active processes of research, the host aligns himself with the listener. Perhaps crucially, this admission was unprompted, showing that Dan is sensitive to the listener's desire not to feel inferior to the hosts. It also perhaps performs some work in redefining knowledge-building, making explicit the idea that knowledge building need not be an intimidating process, rather can be passive and removed from rigorous laboratory domains.

On another occasion, 102, Andy humbles himself by off-handedly suggesting that his knowledge base may be lower than that of the general public on a particular matter.

102) Oh, just stuff on the UN, I didn't realise this, but I think maybe it's quite well known that the UN, the idea of the UN was conceived by Churchill and Roosevelt…

The admission that he didn't know something "quite well known" is carefully hedged with "maybe", which mitigates the possibility that the audience may feel inferior if they also did not know before the podcast. This self-referential admission of prior naivety is able to perform different functions depending on who the listener is. They may be in the same position as the host, of not having known something and being surprised by the fact that they did not know it. This strengthens the relationship through solidarity and shared experience. Alternatively, they may have known the information that the host has admitted prior ignorance, which likewise builds solidarity due to the concession that has been made to the listener's positive face (Goffman, 1955). Once again, the self-mentioning admission of missing knowledge, which humbles himself and takes him closer to the uninformed role of the listener, was not necessary in the discourse. Andy did not have to draw attention to his prior lack of knowledge, but chose to in order to place himself in a relatable role. This assists with the accessibility of the content being discussed, as the listener does not feel that they are being spoken to somebody wildly more intelligent than them, who will be able to understand things on a higher level than them.

Another method of admitting non-expert status is to hedge the quality of the explanation they are giving, by qualifying the quality or fullness of the research that they performed. Phrases such as "to my knowledge", and "as far as I can tell" are markers of this, which admit the possibility that an alternative explanation for something may be possible, but the non-expert, secondary researcher host has not found it. An example of this is 103.

103) Yeah, second question that I had was, are they the only animals with a tail for a leg?

As far as I know, you do have prehensile tails that animals use to swing around trees and stuff and grab things, but to my knowledge…

Here, two self-mentioning hedging phrases are used in quick succession. The self-mention takes responsibility for the research performed and thereby the explanation composed from it, while the hedge of completeness of research allows for the possibility that the truth of the proposition (that kangaroos are the only known animal to use their tails like a leg) may be incomplete or partly untrue. The result is both that the listener is alerted to the fact that there may be inaccuracies due to the second-hand nature of the information, and that the host is prevented from coming across as arrogant, or of claiming to have complete knowledge of something they are in fact a non-expert about. This is transparency surrounding the potential difficulties of secondary research, the hedging nature of which differs from the general tendency in science popularisation to display secondary research as absolute fact.

6.2.2.3) Providing an Appropriate Amount of Detail and Accuracy

NSTAAF implicitly self-describes as having an infotainment goal, in which information is balanced with entertainment. This balance means that sometimes, information may be incomplete or imprecise for the sake of attending to entertainment needs. This is reflective of the goals of the audience when listening to the podcast, which are different to experts in their field and may simply be to have their general curiosity satisfied, or to be entertained (Hyland, 2010).

Example 104 shows an instance where James clarifies that he has simplified information for the sake of ease of understanding, in line with the level of specificity required for an infotainment podcast.

104) *So we're going to say that counts as a trampoline are we?*

I think I am for the sake of this fact.

While the object under discussion may not exactly fit the dictionary definition of a trampoline, it is close enough to inform the listener's image creation. Additionally, describing the object as such allows for the reader to draw upon pre-stored images rather than building from scratch from less familiar images – in this case, of stretched walrus skins with holes drilled through. The conceptualisation of a trampoline for this fact also allows for more efficient communication throughout, as the label has been established and can act as a substitute for "the stretched walrus skin with holes drilled in it." The self-mention "I think" allows the host to take responsibility for simplifying the information in this way. "For the sake of this fact" appears to fulfil a dual metadiscourse function. Firstly, it hedges the accuracy of the information, admitting that it may not be useful outside of the confines of the frame of the fact. Secondly, it code-glosses by providing a frame of reference for how far the information ought to be transferred to other domains – not at all. The lack of transferability of the information is illustrative of a concern here for entertainment above information, as the knowledge is not expected to contribute to any tangible intellectual goal other than satisfying curiosity.

Example 105 below provides another example of a host specifying that he is defining something in an unverified, potentially inaccurate manner for the sake of ease of image creation.

105) *Okay, my fact this week is that the active ingredient in the first ever homeopathy treatment was the blood of Thomas Beckett.*

Wow.

So this basically when Thomas Beckett died, he was basically a saint straight away as soon as he died and everyone thought he was great and they had his blood as a relic but they only had a small amount of his blood so the way that they could give it to lots of different people was to put a tiny drop, an enormous vat of water and then take bits of that water and give it to people and it supposedly would be able to cure everything, which as far as I'm concerned is pretty much homeopathy.

As discussed in Section 4.1, in NSTAAF, the headline fact acts as a structuring device, in which it is a point of reference for the subsequent discussions to return to. In this example, the headline fact defines "the first ever homeopathy treatment". It is then code-glossed that in fact, the treatment described is not widely considered the "first ever homeopathy treatment" – rather Andy has inferred that it fits the definition and has chosen to describe it in terms of this familiar concept. As well as the code-glossing function, "as far as I'm concerned" both takes responsibility for the choice to describe the treatment in this way, ascribing himself an originator role (Tang and John, 1999), and hedges the accuracy of the conceptualisation. The decision is further hedged with "pretty much". In addition to informing image creation, the choice to describe the treatment as "homeopathy" increases engagement as it is a concept likely to be familiar in the lives of the lay-audience and therefore makes the fairly distant

history being described feel closer to them. This attends to the audience's anticipated desire for the information given to feel familiar and close.

Sometimes, a simplification is made which is not signalled in the podcast. Take Example 106.

106) They're very primitive sheep, so they've lived on the island for thousands and thousands of years and they have this amazing thing where they subsist on exclusively seaweed.

Here, the particularity of the sheep's diet is boosted with the adverb "exclusively". Brief investigation, however, reveals this to be untrue. A more hedged phrasing is found in a 2003 paper about the sheep, which says that they subsist "almost entirely on seaweed" (Hansen, Hector and Feldmann, 2003). The simplification was, however, deemed close enough for the sake of the podcast, which values entertainment above rigour.

Another way in which it is made clear that entertainment may take precedent over information is instances where it is admitted that a fact or an element of a fact may be dubious, but is interesting enough for inclusion in the podcast regardless. Take, for instance, Example 107.

107) They made frozen blocks of walrus meat, which they turned into - I find this impossible to believe, but I love it - One-way sledges, which you would eat as you went.

Firstly, it is important to note that by self-mentioning with “I find”, Dan is not saying that the information is definitely untrue. Rather he is saying that he personally doubts the credibility of the fact. He boosts this opinion with “impossible”, however, which (perhaps oxymoronically) has a strong hedging effect, where the listener is encouraged to likewise doubt the truth of the information. The subsequent attitude marking, however, of “I love it” justifies the inclusion of the information regardless of its truth status. As discussed in Section 6.2.3.1, justification of inclusion in dialogue could be considered to perform negative facework, reassuring the listener that their freedoms are not being unnecessarily infringed upon by the obligation to listen to talk for no reason.

Example 108 shows a further example of information being included in the discourse despite its truth status being in question.

108) So maybe this is not true, but... So when the Spanish came, actually, it was an extraordinary thing that happened, first of all.

Again, the potential dubious truth content is hedged with “maybe”, to invite the possibility that it is in fact true. The entire hedging phrase “maybe this is not true” however anticipates that the listener will find the subsequent information unbelievable and implies that the host’s opinion on initially researching was the same. The transition marker “but” signals that the potential untruth will be overridden and the information will be shared anyway. Once again, the attitude marker “extraordinary” justifies the space in the dialogue despite the dubious nature of the truth content, revealing entertainment to take precedent over academic robustness.

6.2.3) Strategies to Make the Listener Feel Attended to and Acknowledged

The following section concerns strategies identified as efforts to create content which acknowledges the interpersonal needs of the listener. This includes considerations such as politeness, ensuring that the listeners feel supported through the content, and making them feel part of a community.

6.2.3.1) Attending to Face Needs

Some aspects of facework have been briefly discussed in previous sections, for example Section 6.2.6 on Frame Markers. The examples below however more explicitly address interpersonal audience concerns, without overlapping with the previously discussed goals of information relevance and interest, or accessibility.

Some of the engagement strategies used in NSTAAF could also be interpreted as strategies to help to maintain the listener's negative face. This largely concerns strategies to avoid making the listener feel as though their freedoms are being imposed upon. Effort appears to be made throughout the podcast to avoid making the listener feel as though their time is being taken up unnecessarily. A frequent marker of this appears to be the adverb "quickly", as shown in Example 109.

109) Hey, so I was, I was looking into mountains.

Oh, yeah.

Can I bring it to mountains very quickly?

Yeah.

By saying that the talk will happen "quickly", Andy is reassuring the listener that their freedoms will not be imposed upon for too long by the taking up of their time. Fairly often, "quickly" appears with the adverb "just", as shown in Example 110.

110) *Can I tell you about these just really quickly, about those monks?*

Yeah, please.

Here, "just" further modifies the anticipated speed with which the information is going to be shared. In this particular example, Andy begins by asking "can I tell you…". The phrasing of this as a request to enter the discourse attends to the negative face of the other hosts, who are acting as pseudo-listeners in the discourse – thereby the negative face of the listener is being attended to by the engagement between the hosts.

Related to requesting space in the discourse, there are several instances of the hosts explicitly justifying why they are sharing something. A marker of this appears to be the adverb "just", this time in a frame marking role, as in 111.

111) *I was reading about just while we're in America and the sort of rich elite there, Russell*

Westbrook, who is a basketball player…

Here, "just" is used to situate the subsequent information in what has been said before, marking the frame of reference and reassuring the listener that they are not being spoken to

about something for no reason. It also helps to present the information as spontaneous, which creates a conversational, casual atmosphere at odds with the formality of academia, in which the listener feels relaxed and comfortable.

Another strategy to further justify the inclusion of something in the discourse is to use attitude markers. An example of this is 112.

81) *Can I tell you something about adhesion?*

Yeah.

I think you will like it.

Here again, Andy requests a space in the discourse with a question. He then anticipates the other hosts' attitude towards what he is going to say, predicting that they will "like" it. The prediction is hedged using the self-mention, "I think", so that they do not feel as though they are having this opinion imposed upon them. The result is that the space in the dialogue is justified by the reassurance that the host is attending to everybody's – the hosts, in pseudo-listener role – needs, by giving them information that they will enjoy and which therefore is worthy of imposing on their time. It has not been forced upon them, since the space in the dialogue was requested and in theory, could be denied.

6.2.3.2) Creating Cohesion

An engagement strategy to make the audience feel supported through the discourse is to ensure that there is cohesion between different sections of the episode or stretches of discourse. To elaborate from a point of view aside from the face concerns of justifying to the listener why the information deserves space in the discourse (see Section 6.2.2.3) phrases

such as “just on”, “just while we’re on” and “just because” also help to create a clear thread between different pieces of information, allowing them to organise it in their minds. The conceptual jump from one field of information to the other is mitigated, and the connection feels closer. To provide an example, 113 shows the use of the frame marker “just on” to introduce a related, but new line of conversation to the discourse.

113) *Just on the idea of, so single-cell organisms, when I think of that, I just think of the earliest of life.*

Somewhat ironically, an insightful example of the hosts’ awareness that they need to guide the reader by keeping their information linked together is 114, where Andy admits that his new line of conversation will cause the information to stray from its current trajectory, violating the maxim of relation (Grice, 1975) (see Section 2.1.3).

114) *Just on taxonomy, I know this is a complete tangent, but there was a fly in 1994, a fossil fly which was named I, just the letter I..;*

His self-mentioning acknowledgement that he will create a “tangent” admits that this is not the way that the podcast is typically structured, revealing a default strategy of keeping all the information shared bound together tightly.

Specific transition markers appear to have subtly different, specific functions in structuring the podcasts. “Also”, for example, tends to signal that there is going to be a shift of focus to a different, but related fact, as shown in Example 115 where there is a move to a new fact, still in the existing realm of numbers.

115) *Also, the number 100 is the sum of the first nine prime numbers.*

This marker helps to maintain and signal a cohesive, logical flow of information which the listener can follow easily.

The transition marker “so” appears to have a subtly different function, as illustrated by Example 116.

116) *...they have, they're not designed to protect against moisture from the outside. It's the moisture that your feet create when you're walking around the day. So they were for soldiers in the First World War.*

Here, “so” signals that the focus of the explanation is going to shift from a description of what the object is, to its function, thus linguistically signalling a shift in the communicative goal of the explanation.

Example 117 shows another illustration of the hosts’ awareness of the need to achieve cohesion in their structuring of episodes, in a case when the link may not have been clear.

117) *Well, here's a slightly weird link.*

The bananas in pyjamas, the TV show?

Yeah.

Australian big TV show.

Here, the attitude marking of “weird” towards the strength of the link between the ideas implicitly acknowledges the need to join ideas together logically for the sake of the reader, to guide them through the discussion successfully.

Much of the way the episodes are designed hangs on the necessity to create cohesive frames for the information. The episodes are split into four distinct sections, delineated by four distinct “headline facts”. The headline facts contain multiple elements that can be focussed on at different times, and act as a focal point that can constantly be returned to throughout the discourse. Once again, one of the best illustrations of this comes from an instance where the strategy proved to me somewhat problematic. See Example 118.

118) *Okay, my fact this week is that bananas emit antimatter. That's not… so I've had to get my head round antimatter, when I should have just researched bananas. I should have gone down that road, what am I doing?*

Here, James makes the design of the podcast episodes, where a headline fact provides multiple possible springboards for research, explicit, and jokes about how he chose the more difficult option for himself. This provides insight into the structure of the episodes, intended to guide the listener through the episode by allowing them firstly to anticipate the topics that they will be spoken to about, and later to mentally collate it under the cohesive device of the headline. There is perhaps a case for references back to the headline fact as endophoric markers, as they fulfil the criteria of internal textual reference to prior in the discourse, for the benefit of audience comprehension.

An aspect of structuring that it is specifically important to attend to in an infotainment podcast is to refocus the discourse towards information following a stretch that only entertains. A word which seems to frequently perform this function is “sorry”, as in Example 119.

119) *What do you call a fish with four eyes?*

A fish.

Actually, sorry, there's another amazing single-side organism

“Sorry” here signals a return to facts following, in this case, humorous metacommentary about a bad joke. This apologetic frame marking implicitly reveals the host’s awareness of the need to balance information and entertainment with both attended to. The shift back to informational content is subtly acknowledged and apologised for, without breaking the flow of the episode.

6.2.3.3) Making Spontaneous Corrections/Clarifications

An advantageous affordance of audio media when popularising science is the ability to perform spontaneous corrections and clarifications during their explanations. This increases engagement as it shows attention being paid to user needs, in the form of real-time adjustments being performed.

Take, for instance, Example 120. Here, Andy immediately corrects his explanation to use a more common term, more likely to be easily understood by a larger proportion of the

audience. This shows awareness of the need to make sufficient adjustment towards audience needs on a lexical level (Hinds, 1999).

120) No, he was riding on a locomotive - on a train, and he got very friendly with people who were engineers on this train…

This adjustment to a higher frequency word, if in a different mode to a podcast, may have needed to go through multiple editors before being approved or noted. The conversational nature of the podcast allows for this correction to be made in real-time, attending quickly to audience needs.

There is a slightly different example of rephrasing in Example 121.

121) And before the games, they will spray onto, like the tracks, for example, hundreds of paper-thin coats of ultra purified water. So it makes it completely smooth, so there are no bubbles, there are no impurities.

Here, Andy says that there are "no bubbles", then immediately adapts his description to "no impurities", which encodes the information of why the lack of bubbles is important. The rephrasing therefore immediately adds precision, which helps aid the listener's understanding of why the water-spraying process is necessary.

In a subtly different example, 122, the conviction of a statement is adjusted in real-time, with Andy deciding to boost the strength of the proposition.

122) So it's for it's actually just a protruding bit of bone, and it's mainly - it's solely used to hold bamboo for them to eat it.

Andy begins using the hedge “mainly”, but immediately adjusts to the booster “solely” as a reflection of the fact that the physiology discussed is accepted fact in the scientific community. This real-time adjustment adds precision to the fact, making the information more credible and therefore more worthy of engagement.

Another affordance of the audio-format, specifically one with multiple hosts, is that clarifications can be requested by interjections. Example 123 shows this, and contains an interjection.

123) *And they would start on Sunday at midnight basically.*

<u>Wait, so</u> this is the original, this is when it was turned into a sport?

Here, the request for information performs a code-glossing function, indicating that the explanation given was not sufficient without elaboration – in this case some context to situate it in time. The multi-host format allows for multiple voices to be responsible for attending to listener needs, and for one person to take responsibility for filling in gaps if they go unnoticed by others.

6.2.3.4) Attention to Audience Design

The multi-host format has many benefits in terms of the ability of NSTAAF to attend to audience needs. One affordance it has is to allow for hosts to indicate when a host has incorrectly and egocentrically assumed that their background knowledge is shared between

all members of the group, thereby all listeners, leading to ineffective communication (Fukumura, 2015). In instances where this is explicitly addressed, the attention paid to ensuring that the audience has been appropriately "designed" becomes clear. Full discussion of literature surrounding this issue can be found in Section 2.1.3.

Many aspects of audience design as facilitated by the multi-host format can be examined by looking at the following example, 124.

124) *Do you know the good Guam fact?*

No.

So Guam is this island in the Pacific owned by America.

This question is addressed to the other hosts, who must reply in either the affirmative or the negative. The definite article is interesting, as it implies that there is an attitudinally marked "good" single fact about Guam which is prevalent in the culture. This fact is so "good" in fact that people can perhaps be expected to know what it pertains to without any further elaboration. The multi-host format allows for the hosts to either confirm or deny this. As with other features previously discussed, this question will have different effects for different people. People who did in know "the good Guam fact" experience a boost to their positive face as they feel included in the in-jokes and references of a community. People who did not know that they will soon have it revealed to them, so do not feel isolated.

Another example of an assumed shared cultural reference point is found in 125.

125) There's a spider crab called Macrocheira kaempferi… It's like that massive Japanese spider crab that you see every now and then on the internet.

The demonstrative pronoun "that" implies that there is something specific and singular being referred to, implied to be prevalent in some way in the public consciousness. The audience is assumed to have a stored image of it. Demonstrative pronouns appear, therefore, to be used as markers for creation of assumed shared experience. The engagement marker "you see", creates an anticipated shared experience, attending to the positive face (Goffman, 1955) want to be included in a community.

In Example 126, the benefit of having multiple hosts is harnessed in order to perform a real-time "poll" of whether something needs further elaboration.

126) Sold by a guy called Roy Brooks. Do you guys know who he is? No, okay…

Perhaps unclear from the transcript, there is a brief pause in the audio of this section, where it can be reasonably assumed that the hosts non-verbally indicated that they did not know who Roy Brooks was. The hosts in their pseudo-listener role provided a representative sample of the audience, who were subsequently assumed to require more information.

In Example 127, Dan informs Andy that a cultural reference he used was perhaps not as universal as he had assumed.

127) And he was basically known as the Heston Blumenthal of his day. And he just- I'd say I wouldn't have known who Heston Blumenthal was…

“Basically” reveals the attempt to simplify the information by means of a cultural reference, assumed to be a pre-stored image, and a useful comparison for conceptualising who this figure was. Dan self-mentions with “I wouldn’t have known”, again acting as a pseudo-listener used as a sample for levels of background knowledge in the audience. The inappropriateness of the reference due to it being more niche than Andy assumed having been pointed out, a more accessible explanation can follow, allowing the listener to engage more meaningfully.

Example 128 shows another instance of the specificity of a reference chosen being problematic, and this being drawn attention to. This time however, the over-specificity affects the entertainment element of the podcast, rather than the accuracy of information.

128) I think, didn't Jeremy Corbyn once sit on the cow catcher because he couldn't find the seats on a virgin train?

That's a pretty niche joke.

There’s an American going, what the hell is this all about?

Explicit attention being drawn to the lack of universality of the joke attends to the listener need not to feel patronised and reassures them that they are not unintelligent if they did not understand. Additionally, in this case, it was also potentially necessary to specify that this was a joke, since if a listener did not understand the reference, it is possible that they could have taken it at face value. The acknowledgement of the incorrect pitch in this moment, therefore, both reinforces the listener’s positive face and ensures that they do not interpret a joke as genuine information.

6.2.3.5) Creating a Listener Community

The podcast appears to attempt to create a community of listeners to the podcast, which makes them more likely to engage since they feel a sense of community (Mou and Lin, 2015), and as though they are being directly addressed. This includes in-jokes, references to the history of the podcast, and self-mentions on the part of the hosts which make the podcast feel like a conversation between friends.

A strategy of making the listener feel included within a community is occasions when the hosts are self-referential between each other about the podcast. This occurs in the opening segment to each podcast, where the phrase "once again" refers implicitly to a back-catalogue of episodes which the listener can return to, shown in Example 129.

129) *... James Harkin, and once again we have gathered around the microphones with our four favourite facts from the last seven days…*

"Once again" appears to assume that the listener has returned having listened before, strengthening the community feel. Additionally, the closing segment also explicitly refers to the back catalogue, shown in Example (130).

130) *...nosuchthingasafish.com, we have all of our previous episodes up there*

Sometimes, the hosts will refer to a previous episode, as in 131.

131) *So we've talked about this kind of thing before, but there's this glacier which is 150 miles away from where Pizarro landed.*

Mentions of previous episodes create a community of hypothesised listeners. This has two potential outcomes, depending on the listener. Those who are long-time listeners will feel a sense of pride at remembering the subjects having been discussed previously. They will feel included in the community of podcast listeners and be incentivised to remain loyal. Those who had not listened to the episodes mentioned may wish to join the community and feel incentivised to begin becoming a regular listener.

Another aspect of community creation is the creation of the personalities of the hosts, which make listeners feel as though they are sharing an experience with friends. This is made explicit from the start, as the introduction to the podcast (almost identical across episodes) features self-mentions, as shown in Example (132).

132) *My name is Dan Schreiber, I am sitting here with James Harkin, Anna Ptazynski, and Andrew Hunter Murray…*

The explicit self-mention and introduction by name of all the hosts right at the beginning gives listeners friendly, familiar "characters" to guide them through the information. These "characters" are often described as having done things together outside of the podcast, as in 133.

133) *You and I were at the British Library, and they have this incredible treasures room where they have original writing from Dickens and Thomas Hardy and everyone.*

The fact that the listener is invited into the shared world of the podcast hosts beyond the confines of the podcast creates a friendly, rather casual host-listener environment. Shared personal anecdotes provides a warmth to the episodes, which incentivises the listener to continue listening, as they mind find out more personal asides which will make them feel important and special.

An advantage of creating likeable "characters" within the podcast is that they can be used to exemplify information. This is fairly frequently through reference to things that have happened in their own lives. Take, for instance, Example 134.

134) That's like my parents, when they moved to Hong Kong, they lived on Redneck Cellar Road. And no one could work out what Redneck Cellar was. They just had no idea, it turns out that it was actually Alexander Road. But the person who was Chinese, who was making the sign, obviously wrote from right to left.
No way.
So Redneck Cellar is very famous as an early example of that happening, exactly that.

In this example, Dan uses an anecdote from his own life as an interesting illustrative example (Hyland, 2001:221) of an issue with translation that was being discussed. The audience will be more engaged with the content having formed a relationship with him. Personal accounts enrich the information, both from the point of view of using lived experience to verify information, and of creating a more engaging narrative. The familiarity of being able to situate the podcast hosts in the abstract information being presented may make the information more accessible for the listener.

In the following Example 135, Anna again uses the known experience of James to introduce a fact about the process of making a type of brandy.

135) Guys, you were talking about holy pina colada, here's another Slovenian drink, salamander brandy. You tried that when you were in Slovenia?

Oh, come off it.

Well, I'm glad you didn't try it because it's not a very nice way of making it.

The slightly accusatory nature of the question of whether James had tried it is humorous in its sharpness, boosting engagement. The attitude marking of being "glad" that he didn't because the process of making it is "not very nice" prepares the listener for the description of an unpleasant process. Again, the information has been enriched by hanging it from a familiar character. Additionally, the insight into James' trip makes them feel more entrenched in the community, further heightening engagement.

An illustration of the importance of building a listener community can be seen in Example 136, where allowing the listener access to some "behind the scenes" type information seems to break some implicit structural rules of the podcast. Here, Anna reveals that she amended one of the numbers in her headline fact just before the recording began.

136) I've changed the number on my fact by the way, so don't freak out when I say it.

My fact this week is that about 70% -

What!?

*F*cking predictable… My fact this week is that about 70% of parents admit to having a favourite child.*

This seems to be a rare 'fourth wall break' in the podcast, which abandons the implicit fiction that the host bringing the headline fact is the only person to have heard it before, and that they are not shared before recording. This segment was likely kept in due to the other host's humorous and extreme reaction, which in itself may have increased the interest in the fact. The fact that the hosts all already know the information that is going to come can probably be considered something of an open secret, as the audience cannot be assumed foolish enough to think that all subsequent fact-sharing between hosts is spontaneous. The trade-off between entertainment and sustained fiction is, therefore, worth it. In this particular instance, being invited into the world beyond the podcast in some small way is exciting for the listener and increases their senses of community and inclusion.

6.2.3.6) Addressing the Audience Directly

On some occasions, engagement with the audience is explicit, in instances where they are being literally acknowledged and addressed. The first sentence of the podcast, which is almost word for word identical in every episode, contains two engagement marking elements, as shown in Example 137.

137) *Hello, and welcome to another episode of no such thing as a fish, a weekly podcast coming to you from the QI offices in Covent Garden.*

The audience is explicitly addressed and welcomed to the podcast, which implicitly creates a pseudo-space in which they feel comfortable. They are also addressed and attended to with "coming to you", which creates the impression that the transfer of information is personal and intentional. These elements create an engaging and inclusive environment from the beginning of each podcast.

The ending segment of each podcast is similarly highly rich with engagement marking, as shown in Example 138.

138) *Thank you so much for listening. If you'd like to get in contact with any of us about the things we've said over the course of this show, you can get us on our Twitter accounts.*
I'm on @Schreiberland, Andy @andrewhunterm, James @eggshaped and Ptazynski…
You can email podcast at qi.com.
Yep, or you can go to our group account, which is @QIpodcast or go to our website nosuchthingasafish.com where we have all of our previous episodes. We will be back again next week with another episode. We'll see you then.
Bye.

The explicit thanks for listening may make the listener feel appreciated, attending to their positive face. The multiple options given to get in touch and invitation to do so creates a feeling of community, and genuine connection between host and listener. "We'll see you soon" further enriches this sense of community, as it assumes that the listener feels welcome to return.

Some engagement marking between the hosts and their audience is in the form of directives that they ought to do something to enrich their understanding of what has been said, or their engagement with the content. These directives are often tangible actions that they should perform, as in 139 and 140.

139) You should put up a picture on your Twitter because it looks unbelievable. Well, if you go to my Twitter @eggshaped, I'll put that picture up.

140) I think my favourite thing that I read about Karl Marx is that, obviously, he's buried in high gate cemetery and I've been to it. You can, if you live in London, it's worth going.

It is satisfying as a listener to be directed towards something that can have real-life outcomes. The engagement here has the potential to have a bearing on their future activities beyond the time in which they are listening to the podcast, thus creating an interactive and highly engaging environment.

Another way in which the hosts explicitly acknowledge the audience is instances in which they acknowledge and attend to the restrictions of their audio-only mode. The following example, 141, illustrates this.

141) ... they frequently adopt poses, showing their muscles, like bodybuilders, going, hey ladies, two tickets to the gun show, where are you? Like just for people listening, Dan is doing the bodybuilder poses as well.

Andy's narration of what is happening in the room gives the listener an insight into the world behind the restriction of the format, and makes them feel acknowledged and attended to. Sometimes the restrictions of audio can be used in a humorous way to further increase engagement. Take Example 142.

142) Okay, my fact this week is that due to climate change, nine out of the 21 cities that have hosted the Winter Olympics will be too warm to do so by 2050.
I was glad to see that you put climate change in air quotes there, James.
I did not do that, for people at home. I wouldn't do that.

In this exchange, Anna teases James by suggesting that he used air quotes when referring to climate change, using the audio-only format of the podcast to suggest that he has a laughable, denialist view of climate change. James specifically addresses the "people at home" to clarify that the Anna was joking. This both verifies that the statement was a joke, and acknowledges the audience, making them feel addressed and attended to.

7) General Discussion

In this section, I will return to the research questions and answer them in turn.

1) How frequently does the science popularisation podcast use metadiscourse to encourage audience engagement, as compared to other modes of science communication?

The normalised frequency counts of metadiscourse items from Hyland's search terms initially seemed to indicate a comparatively low prevalence of metadiscourse items in NSTAAF. Close reading, however, of full, contextualised podcast transcripts revealed the use of metadiscourse resources unrepresented in the search term lists. These included attitude-marking exclamations, engagement-marking questions, and frame-markers specific to the context of the podcast. It is difficult to obtain numerical figures for the use of these resources, due to the revealed unsuitability of frequency counting for the task. Some of the metadiscourse resources spanned long stretches of discourse, or were highly similar to items on Hyland's search term list so were not represented in the counts, for example. The method of using an updated list of metadiscourse items to identify where engagement strategies may be located in the podcasts proved successful in Section 5, when undertaking qualitative analysis. This suggests that were a framework of metadiscourse which takes audio modes into account to be developed and applied to the corpora, perhaps the metadiscourse counts for NSTAAF would be higher, and perhaps closer to the other corpora.

2) Which metadiscourse items are used notably more frequently/differently in the science popularisation podcast as compared to other modes of science communication?

NSTAAF uses spoken-mode specific resources to perform metadiscourse work, which is unafforded by written modes. This includes attitude-marking through incredulous repetition ("It was ten metres high…" "Ten metres!?") and sarcastic tone. It also uses lexis unsuited to formal registers, such as informal attitude-marking exclamations ("Wow!") and unspecific evidentiality markers such as "a thing by…" These features are appropriate for the dual entertainment and information goals of the podcast, where academic rigour and precision is sometimes compromised for the sake of being entertaining.

3) What linguistic strategies of audience engagement can be identified in the science popularisation podcast by identifying metadiscourse items?

4) How do non-metadiscourse features contribute to these audience engagement strategies?

These two research questions will be addressed together, since it became clear from the concordance line analysis (see Section 6) that metadiscourse was best treated as an identification tool for where engagement strategies may occur. Once these strategies were located, rich contributions to engagement were found in the interplay between metadiscourse and non-metadiscourse. It seems counterproductive, therefore, to subsequently treat the two types of language separately.

There are three broad ways in which NSTAAF appears to encourage engagement.

Firstly, it uses linguistic strategies to create relevant and interesting content. Relevance is communicated by telling the listener why they ought to care about what they are being told. They are also invited into explanatory narratives to make the information seem conceptually closer and less abstract. Their folk knowledge is corrected or expanded on, contributing to their intellectual growth. Interest is heightened by emphasising the newsworthiness of the facts, and by using humour to exemplify the information, thus uniting informational and entertaining goals. Throughout, science is celebrated, albeit not always in prototypical, exclusively positive ways. Sometimes science is celebrated for its nuance, its strangeness and its ability to encourage critical conversations.

Secondly, the podcast uses strategies to make the content seem accessible for lay-audiences. Hosts humble themselves by admitting their statuses as non-experts, which helps to avoid alienating the audience. They turn explanations into games and quizzes, creating pseudo-interaction in what is prototypically a one-way channel of communication. They evaluate content throughout, in ways which are not bewilderingly intellectual, implicitly encouraging the audience to do the same. They adapt the level of the information they are sharing, both to attend to the assumed knowledge-bases of the audience, and to achieve the desired balance between entertaining and informing, as is in line with the hypothesised goals of the listener.

Thirdly, the podcast attends to the emotional and intellectual needs of listeners. Attention to their face needs ensures that their politeness desires are upheld. Self-reference and host personality construction help to create a perceived community of listeners, attending to needs for community inclusion. Instances where audiences are directly addressed reassure them that they are being acknowledged. This acknowledgement is strengthened by linguistic choices or

adaptations that reveal that the design of the audience is being taken into consideration. This is shown in real time in instances when corrections and clarifications of information are made spontaneously. Audiences are also guided through discussions with linguistic strategies of cohesion.

The pertinent implication of these investigations is that the science popularisation podcast appears to be a well-suited form to engage audiences, allowing them to feel motivated and able to consume scientific content meaningfully. The podcast harnesses strategies to recontextualise scientific information towards the assumed motivations of laypeople - which are to learn the science that is interesting to them, in modes that are more relevant to their lives than the clinical outputs of academies. Science popularisation podcasts are, then, a vital tool towards goals of open science, where ordinary people are permitted access to knowledge which can change, enrich and improve their lives.

8) Further Work

There is much scope for further work following this project. Firstly, the unsuitability of Hyland's framework to accurately capture metadiscourse prevalence in NSTAAF highlights the potential need for the development of a metadiscourse framework for audio media. Such a framework would be able to identify non-lexical metadiscourse features, for example the use of sarcastic tone to attitude mark.

Secondly, experimental methods could be used to investigate whether the metadiscourse items genuinely have the assumed effect of increasing how engaged people feel in the content. For example, two sets of scripts could be produced, one which includes the metadiscourse features and one which does not, and participants could be asked to rate them according to measures such as how guided, included and interested they feel.

Thirdly, a comparative study could be performed with a non-science popularisation podcast, to investigate whether the engagement strategies are especially prevalent in science popularisation, or if metadiscourse use is consistent across podcasts of different genres.

Finally, the results of this study could be communicated to science popularisers, to draw attention to the strategies of engagement identified. Specific attention to the strategies could help to facilitate them communicating information to laypeople in an engaging and effective way. Additionally, to distribute these results beyond the world of academia is fitting, given the focus of this study.

9) Conclusion

Science popularisation podcasts are a form suited to heightening audience engagement with scientific content. My investigations into a science popularisation podcast have found both traditional and novel uses of metadiscourse to guide and interact with audiences, which increases their motivation to continue listening. I have also found evidence of attention to audience design, which ensures that information is recontextualised appropriately for the non-academic goals of laypeople. Science popularisation podcasts are then, a channel through which knowledge can be meaningfully shared and used.

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Appendices

Appendix 1: Hyland's Metadisocurse Framework Categories

TABLE 3.1 An Interpersonal model of metadiscourse

Category	Function	Examples
Interactive	**Help to guide the reader through the text**	**Resources**
Transitions	express relations between main clauses	in addition; but; thus; and
Frame markers	refer to discourse acts, sequences or stages	finally; to conclude; my purpose is
Endophoric markers	refer to information in other parts of the text	noted above; see Fig; in section 2
Evidentials	refer to information from other texts	according to X; Z states
Code glosses	elaborate propositional meanings	namely; e.g.; such as; in other words
Interactional	**Involve the reader in the text**	**Resources**
Hedges	withhold commitment and open dialogue	might; perhaps; possible; about
Boosters	emphasize certainty or close dialogue	in fact; definitely; it is clear that
Attitude markers	express writer's attitude to proposition	unfortunately; I agree; surprisingly
Self-mentions	explicit reference to author(s)	I; we; my; me; our
Engagement markers	explicitly build relationship with reader	consider; note; you can see that

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Appendix 2: Link to Excel Sheet of Search Term Raw Frequencies and Frequencies Per Mil Words

Search Terms Raw Frequencies and Per Mil.xlsx