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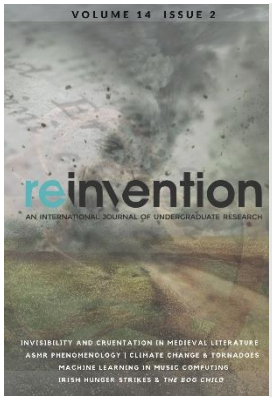

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Editorial

Reinvention: Patterns in Uncertainty

Auni Siukosaari, University of Warwick

I would like to extend a warm welcome to all of our readers to this new issue of *Reinvention: An International Journal of Undergraduate Research*, Volume 14, Issue 2 (14.2). As the world continues to recover from the Covid-19 pandemic, uncertainty persists as a theme in all of our lives, and familiar as well as new patterns are beginning to emerge.

This issue (14.2) provides an extremely rich and diverse set of undergraduate papers that push the boundaries of their respective fields. From the examination and analysis of literature that reveals to us important aspects of history and power structures, to the use of machine learning in music classification, to the examination of the phenomenology of ASMR, all the way to the study of one of the most pressing issues of our time – climate change and its impacts – this issue offers you a variety of insightful and thought-provoking research.

What these papers all have in common is their appreciation of patterns and finding connections in uncertain, under-studied or under-explored areas. While the fields of study vary greatly, their contributions all highlight useful and complex patterns that reveal valuable aspects of our lives that we might not have necessarily realised. This idea is captured in the cover of this issue, created by Shreya Sridharan, which represents a variety of patterns

intersecting one another. As our world continues to get more interconnected than ever, the ability to find, appreciate and learn from complex patterns is increasingly valuable.

To begin this issue, Curtis Thompson's paper, 'Lyric-Based Classification of Music Genres Using Hand-Crafted Features' dives into the intersection of machine learning and music classification. His paper is extremely relevant in an age where we are surrounded by music-streaming services that benefit their users by classifying music by genre and, notably, his prediction accuracies improve on those of previous studies.

Cameron Cross's 'Cloak and Cruentation: Power, (In)Visibility and the Supernatural in the *Nibelungenlied*', on the other hand, examines the Medieval epic poem the 'Nibelungenlied' and the narrative function of the two supernatural elements in it, the cloak and cruentation. Through focusing on this piece of German literature, he highlights how the dichotomy of the visible/invisible reveals deeper power structures.

Rory Bines-Morris's 'Reappearing in Different Forms: Ancient and Contemporary Irish Hunger in *Bog Child*' focuses on Siobhan Dowd's novel *Bog Child* and examines the repetition of history, particularly the extended history of self-sacrifice and hunger in Ireland, as well as the gendered patterns that persist. His paper offers an insightful analysis of historical cultural trauma and offers compassionate ends to its repetition.

Samuel Inskip's 'Effects of Anthropogenic Climate Change on the Occurrence of Supercellular Tornadoes in the USA' investigates the ever-pressing relationship between climate change and natural disasters. With a focus on tornadoes in the USA, his research supports efforts for better tornado preparedness and predictions in affected areas as climate change progresses.

Finally, Anna Lindfors and Heather E. Branigan's 'From Cathartic "Brain Tingles" to Scratching Chalkboard Sensations: An Exploratory Study Investigating the Phenomenological Aspects of ASMR' explores the relatively under-studied field of ASMR. The authors present a model for future research that accounts for the complexity and variability of individual experiences across different dimensions (Physical, Psychological and Social), which offers alternative ways of capturing the diverse experiences and connections people have to ASMR.

Patterns, both old and new, are everywhere to be found, and this issue hopes to shed light on a few incredibly important ones. The quality of the papers in this issue has been extraordinary, and I want to thank and congratulate all the authors who contributed. I hope these papers,

their findings and themes, resonate with our readers and provide a greater understanding and appreciation of undergraduate research across the globe. As always, we look forward to new submissions and collaborative projects for our next issue as we continue to work with undergraduate students to uplift their valuable contributions to academic literature.

My time as Editor at *Reinvention* is coming to an end, and I am honoured to be introducing Shreya Sridharan as the next Editor following this publication. My experience at *Reinvention* has been incredibly rewarding and has continued to deepen my appreciation for the promotion of international and interdisciplinary voices in academic spaces. I want to thank the Journal Managers at Warwick for their continued support, all the incredible authors I have worked with and learnt from along the way, and the stellar editorial team I was privileged to be a part of. I have no doubt Shreya and the team are going to do an incredible job with the journal going forwards.

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Lyric-Based Classification of Music Genres Using Hand-Crafted Features

Curtis Thompson, University of Warwick

Abstract

The classification of music genres has been studied using various audio, linguistic and metadata features. Classification using linguistic features typically results in lower accuracy than classifiers built with audio features for the task of predicting the music genre of lyrics. In this study, we hand-craft features unused in previous lyrical classifiers such as rhyme density, readability and the occurrence of profanity. These examples are among a total of 217 features crafted in this study. We use these features to train six different traditional machine-learning algorithms for lyrical classification across nine popular music genres and compare their performance. The experiments are conducted on a dataset of over 20,000 lyrics. A final accuracy of 0.56136 was achieved when predicting the music genre of the lyrics across the nine genres, improving upon accuracies obtained in previous studies. The hip hop and religious genres were predicted with a high accuracy (0.89245 and 0.69027 respectively), whereas the model did not perform as well on pop and R&B (0.43006 and 0.29950). The features that contribute most towards these predictions are also identified.

Keywords: Music-genre classification, natural-language processing, computational linguistics, machine learning, music information retrieval, sound and music computing

Introduction

Classifying music is imperative for online music streaming services such as Spotify, YouTube Music and iTunes, as it allows them to provide a rich user experience – for example, Spotify provides automated playlists for over 5000 genres of music (Rodgers, 2020). Music genres are a popular method for categorisation in computer applications – genres are typically defined by characteristics such as tempo, instruments, vocalisations, rhythmic structure, lyrical style (KOOP, 2019). Lyrical style can be broken down into further features, such as the use of 16-bar verses in hip hop (Edwards, 2009) or Jamaican slang in reggae.

Being able to automatically classify music into different genres is beneficial to these streaming services as it reduces the time and effort required by record label or streaming service employees to correctly categorise music. This is one reason why the classification of music audio and lyrics into genres has been well-researched (Fell and Sporleder, 2014; Tzanetakis and Cook, 2002; Zhang *et al.*, 2016). Despite this research, classification using lyrics has not been able to predict the music genre of songs as accurately as that of audio classifiers (Silla Jr. *et al.*, 2008).

In this paper, we implemented **features** and techniques previously not used for the classification of lyrics into music genres – such as Malmi Rhyme Factor, **Flesch reading ease** and **principal components analysis** – to improve upon the existing literature in this field.

This study aims to improve upon the results obtained in existing literature when using only **hand-crafted features** – intuitive features calculated via an equation or simple algorithm, as opposed to inferred features from a deep-learning model – as these features are easy to interpret when attempting to understand machine-learning models.

Related work

The classification of music genres has been widely studied by academics within the fields of music and computer science. Relevant literature can be found within the domains of natural-language processing, sound and music computing, and music information retrieval, as well as more broadly within machine learning and data analytics.

Classifying music genres using samples of audio files is a well-explored area of research. Convolutional neural networks (Zhang *et al.*, 2016) and hand-crafted features (Tzanetakis and Cook, 2002) have both shown to yield success, as well as when these methods are combined in an ensemble (Bahuleyan, 2018).

Music-genre classification using song lyrics is less researched. Fell and Sporleder (2014) implemented an n-gram model, where classifications are based upon the appearance of different phrases of word length *n*. This was combined with a model based upon five different aspects: vocabulary, style, semantics, orientation and song structure. The results of these models varied depending on the genres of the original text, with the models being more successful with rap lyrics and less successful with folk lyrics.

The work of Mayer *et al.* (2008) explores genre classification using a set of features such as TF-IDF (term frequency – inverse domain frequency), couplet or quartet rhyming counts, parts-of-speech counts and simpler textual features such as the number of unique words. Across ten different genres, an accuracy of 0.3347 was achieved using a **support vector machine** (SVM) model – a model that attempts to find the optimal hyperplane equations that split the data into different classes.

Other features that could be explored when using lyrics to classify music genres include a **rhyme density function** (Malmi *et al.*, 2016) – a function that quantifies the frequency of rhymes in lyrics – and profanity detection (Lewis, 2014).

Dataset

No publicly accessible dataset that spans multiple genres exists from the related works. Therefore a new dataset needed to be constructed to complete this task.

This dataset spans the eight most popular predominantly English genres of music: hip hop, R&B, rock, pop, country, dance, religious and jazz (Nielsen Music, 2019), as well as reggae.

Reggae, although not on the Nielsen Music list, was used as a substitute for the world genre as it is one of the most prominent genres within world music where the majority of the lyrics are in English. Also, the Latin genre was excluded due to its overabundance of non-English songs.

The dataset was created from 21,416 song lyrics attributed to 488 different artists to ensure that no genre was overpopulated by a single artist, as that may have skewed the dataset away from the genre and towards a specific artist. Samples per genre were balanced post-collection by removing artists until each genre had approximately 2000 samples. The song distribution across each genre is shown in Table 1. The dataset was then split into a training set and evaluation set using an 80/20 stratified split.

Genre	Artists	Songs	Songs in Training Set
Country	52	2492	1993
Dance	49	2289	1831

Hip Hop	61	2182	1745
Jazz	56	2168	1734
Pop	50	2391	1912
R&B	56	2019	1615
Reggae	58	2060	1648
Religious	54	2825	2260
Rock	52	2990	2392
Total	**488**	**21,416**	**17,130**

Table 1: Genre distribution of the dataset and training set.

These lyrics were collected by scraping the lyric website Genius and storing them into individual .txt files, filtering out files that do not contain any text. As Genius has no standard for tagging lyrics with genres, each set of lyrics was tagged with a genre based upon individual record label data found online. The resulting dataset used in this paper is approximately 34MB.

Preprocessing

Several preprocessing steps were performed in Python to clean the lyrics before features could be extracted. Firstly, text within square brackets was removed as this is commonly used to indicate comments on Genius. At this point, features that do not rely on pronunciation are calculated.

Punctuation was then removed, and the lyrics converted to lowercase. Methods to convert the text into a list of tokens (words) and into IPA (International Phonetic Alphabet) were also written, as these would be needed for some features. The CMU Pronouncing Dictionary was used to obtain American-English IPA translations. The remaining features were then calculated.

Lyric features

A total of 47 different features were constructed for the genre classification of lyrics, alongside a further 170 binary features to indicate whether certain words were present in the text. These features were grouped into four abstract sets: textual statistics, syllabic and rhyming features, vocabulary, and structural features.

Textual statistics

Textual statistical features are those that can be obtained by counting simple occurrences or patterns within the text. In this paper, these features are: total words, unique words, total characters, unique characters, total punctuation, unique punctuation, total numbers, total letters and total lines. From these features, we also calculated average words per line and average characters per word. In total, 11 textual statistics were used.

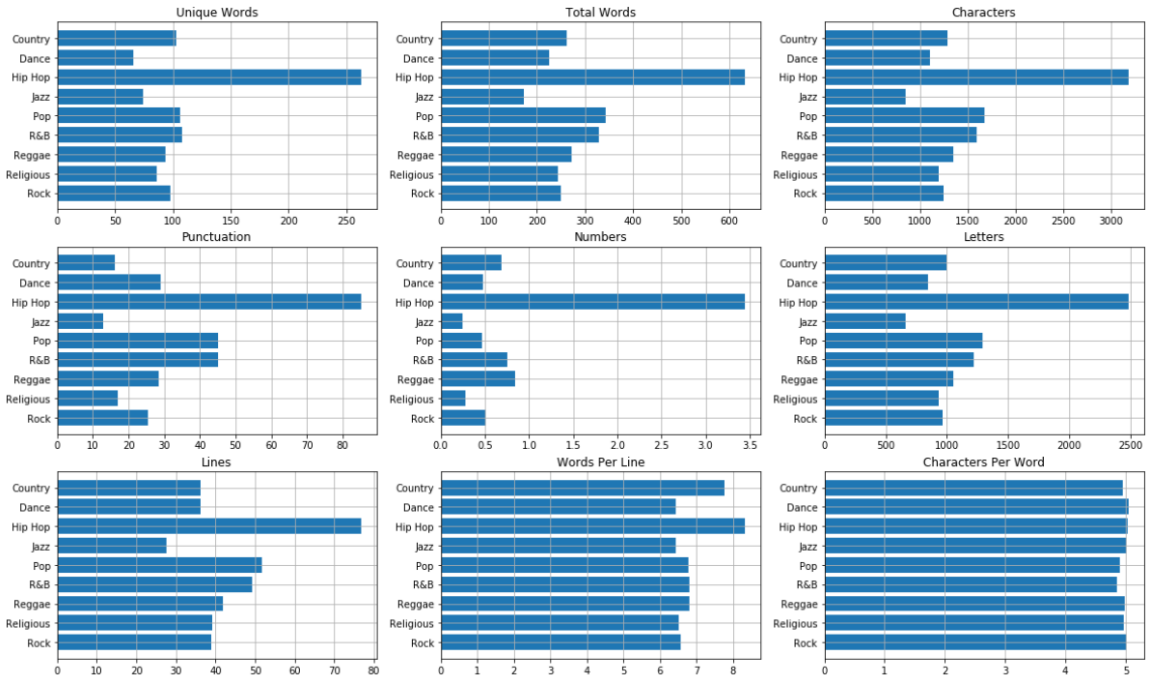

Figure 1: Mean textual statistic metrics across the nine genres.

Many of the features in Figure 1 correlate with the length of the lyrics. Hip hop has the highest mean in eight of the nine shown features, which is to be expected as hip hop lyrics are typically rapped, and thus have more words and lines. Jazz lyrics are the shortest when

measured by features such as total words and total characters; however, dance lyrics are the shortest when measured by unique words. This is likely due to the high repetitiveness of dance lyrics, causing fewer unique words.

While these textual statistics may not be useful to differentiate between some genres, it is easy to differentiate between genres such as hip hop, dance and jazz due to the lengths of the lyrics.

Syllabic and rhyming features

Syllabic and rhyming features are those that directly relate to the IPA representation of words or syllables in the text. These are total syllables, average syllables per word, average syllables per line, and Flesch reading ease (Flesch, 1948). Flesch reading ease, as a measure of **readability**, quantifies how difficult a text is to understand in English.

Different genres can be defined by different musical rhythms, and the use of syllabic features could allow us to detect these different rhythms. Readability, measured through Flesch reading ease, also allows us to combine syllabic and vocabulary metrics – where, for example, dance lyrics might be more readable due to the repetitive use of simplistic words.

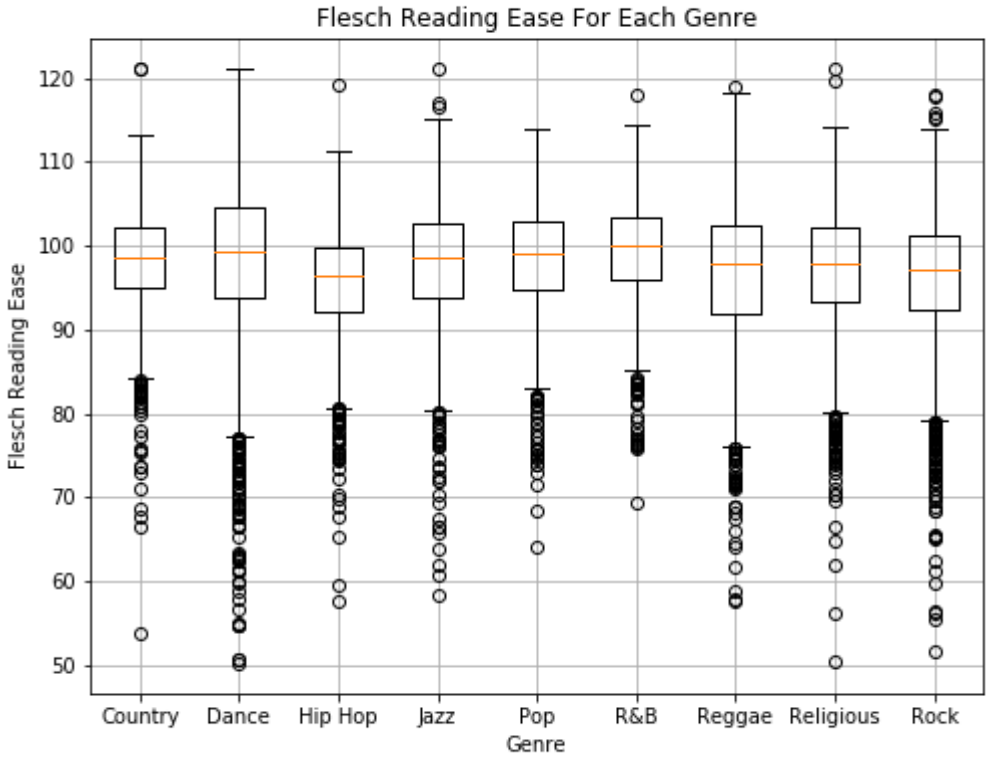

Figure 2: Flesch reading ease box plots for each genre, measuring the readability of lyrics.

The range for Flesch reading ease, when excluding outliers, varies depending on the genre. R&B lyrics have the highest mean and the smallest range, highlighting that they are usually more readable than the lyrics of other genres. In contrast, approximately 75 per cent of hip hop lyrics are less readable than the average R&B lyrics. Reggae and rock lyrics are also likely to have a lower readability.

Rhyming features, which are dependent on the IPA conversion, are also included here. Rhyming within this paper refers to assonance, the repeated occurrence of similar vowel phonemes. Other types of rhyming – such as perfect rhymes, consonance and alliteration – were considered; however, assonance is prevalent in many genres of music such as hip hop and pop.

Rhyming features used in this paper include those that count the number of rhyming couplets or blocks. The different rhyming blocks detected were AA, AABB, ABAB, ABBA and AAAA

rhyme patterns. The number of occurrences for each of these rhyme patterns, as well as the total number of quatrain rhyming blocks, were used as features.

Malmi Rhyme Factor (Malmi *et al.*, 2016) was used as a separate feature. While the previously constructed features can detect end-rhymes, Malmi Rhyme Factor can detect rhyming in different positions of lines and calculates an overall value for the density of rhyming. Malmi *et al.* notes that this feature has particular use with hip hop lyrics and used it to rank songs based upon their density of rhyme. This feature has not been used in existing work of music-genre classification for lyrics.

Vocabulary

We assume that different genres make use of different words. Features based upon this assumption can be constructed by using TF-IDF to extract words that are more frequent in certain genres, and then counting the occurrence of these words in the lyrics (Mayer *et al.*, 2008).

TF-IDF was calculated for each preprocessed text in the training set, restricted to words between 3 and 12 characters in length. Words were also excluded if they appeared in fewer than 50 songs, or more than 50 per cent of songs. For each genre, the average TF-IDF values were calculated, creating an ordered list of words that are common to lyrics of that genre. The 50 highest-valued words for each genre were then taken to create bag-of-words features. It is important to note that all words were converted to lowercase and had punctuation removed such that, for example, ‘Jesus’ and ‘jesus’ are considered as the same word. These were binary features that indicated whether each word was present in a text. Due to several words being frequent in multiple genres, only 170 binary features were created.

Despite the overlap of words for genres, some genres did have unique words in their lists. The highest-ranked words in reggae included Jamaican or Rastafarian slang such as ‘jah’, ‘babylon’, and ‘natty’. Highly ranked words in religious songs included religious terms; the top three words were ‘god’, ‘lord’ and ‘jesus’. Hip hop saw many profane words rank highly, with five of the top six words being profane.

Profanity features were also constructed. These were the number of profane words, number of unique profane words, and the frequency of profane words in the lyrics. Profanity was detected

using the Lewis profanity list (2014). Jewalikar and Fragapane (2015) found that the rate of profanity varies depending on the genre of music. Hip hop songs were the most profane, with one in every 47 words being a profanity, while genres such as folk and country were the least profane (one profanity in every 2925 and 4438 words, respectively). Powell-Morse (2014) found a similarly high rate of profanity in rap music, on average 13.76 instances of profanity per rap song. These findings suggest that profanity may be a useful characteristic with which to differentiate between genres.

Structural features

The structural features in this paper are: average line-syllable similarity, mean line-syllable length, deviation line-syllable length and similar verse count. Line-syllable length is calculated as the number of syllables that occur in a line, and the line-syllable similarity between any two lines can be calculated with Equation 1.

$$s(a,b) = 1 - \frac{abs(length(a) - length(b))}{max(length(a), length(b))}$$

Equation 1: Line-syllable similarity.

By using Equation 1, the average line-syllable similarity can be calculated as the mean similarity between all adjacent lines in the lyrics. A box plot of values for each genre is shown in Figure 3. For all genres, the mean value for lyrics falls between 0.7 and 0.8; however, the metric's range is noticeably smaller for genres such as hip hop, pop and R&B.

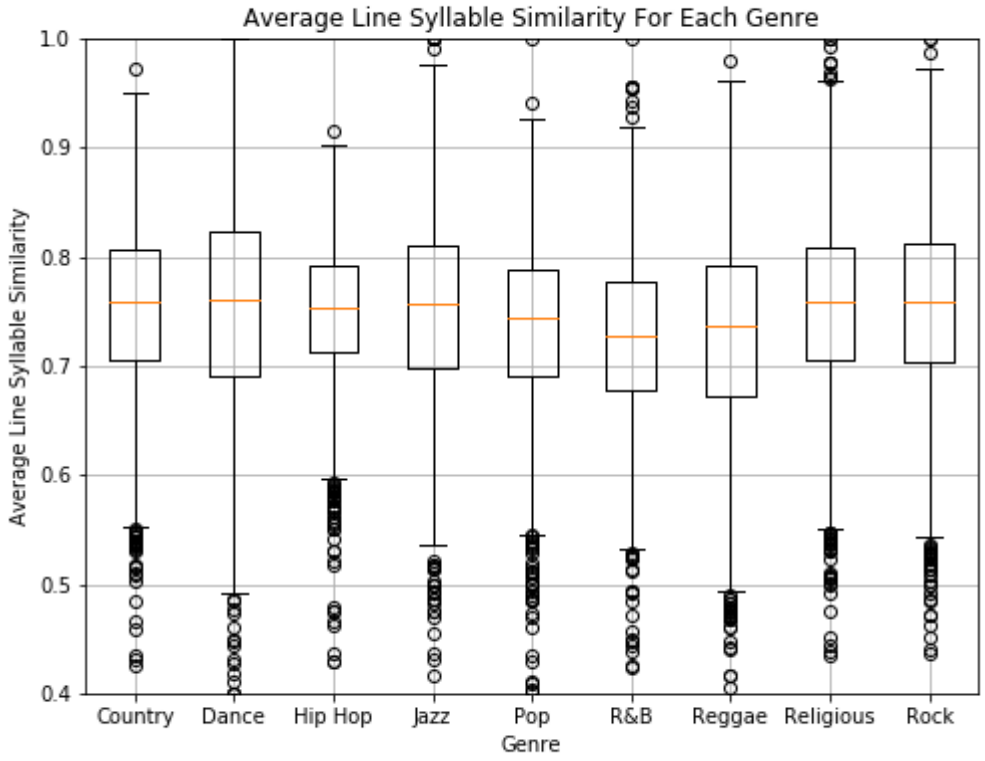

Figure 3: Average line-syllable similarity for each genre.

Lyric classification

As we have generated a high number of features, we will use dimension reduction to improve computational efficiency. To reduce the dimensionality of the dataset, we performed principal components analysis (PCA) on the features calculated on the training set. PCA maps data with a high number of features into a lower dimensionality such that the variance of the lower dimensional representation of the data is maximised. The features were reduced to 30 dimensions.

We used the PCA features to train a range of machine-learning models: k-nearest neighbours (kNN), support vector machines (SVM), random forest classifiers, multi-layer perceptrons (MLP), Naïve Bayes and XGBoost classifiers. We performed five-fold stratified **cross-validation** (CV) alongside grid search to select the best hyperparameters for each model. The best performances of each model are shown in Table 2.

Model	Best Performing Hyperparameters	CV Accuracy
SVM	C=1, gamma='scale'	0.53555
XGBoost	learning_rate=0.3, max_depth=3, reg_lambda=0.5, subsample=0.75	0.51932
Random Forest	n_estimators=200, max_depth=None, max_features=3	0.51220
MLP	hidden_neurons=50, alpha=0.0001	0.50175
kNN	n_neighbors=67	0.49031
Naïve Bayes	N/A	0.48739

Table 2: Cross-validation accuracy of models with their best performing hyperparameters.

For each model, the best performing hyperparameters were used to build a model that could predict genres in the evaluation set. Accuracies, between 0 and 1 inclusive, on the evaluation set are shown in Table 3.

Model	Evaluation Accuracy
SVM	0.56136
MLP	0.54830
Random Forest	0.54760
XGBoost	0.53360
kNN	0.52193
Naïve Bayes	0.49463

Table 3: Accuracy of models on the evaluation set.

Discussion

The best performing model was the SVM, which had an accuracy of 0.56136. The accuracy of every model on the evaluation set was higher than the accuracy achieved by Mayer *et al.* The work of Mayer *et al.* would be expected to achieve a lower accuracy as it was performed on ten genres, compared to nine in our study, but the accuracy difference of 0.22666 between the studies is a major difference, suggesting improvement through this study. It would be beneficial to the task of lyric classification if a standard dataset were created to allow an easy comparison of models in the future, similar to that used for the recognition of handwritten digits (LeCun *et al.*, 1998).

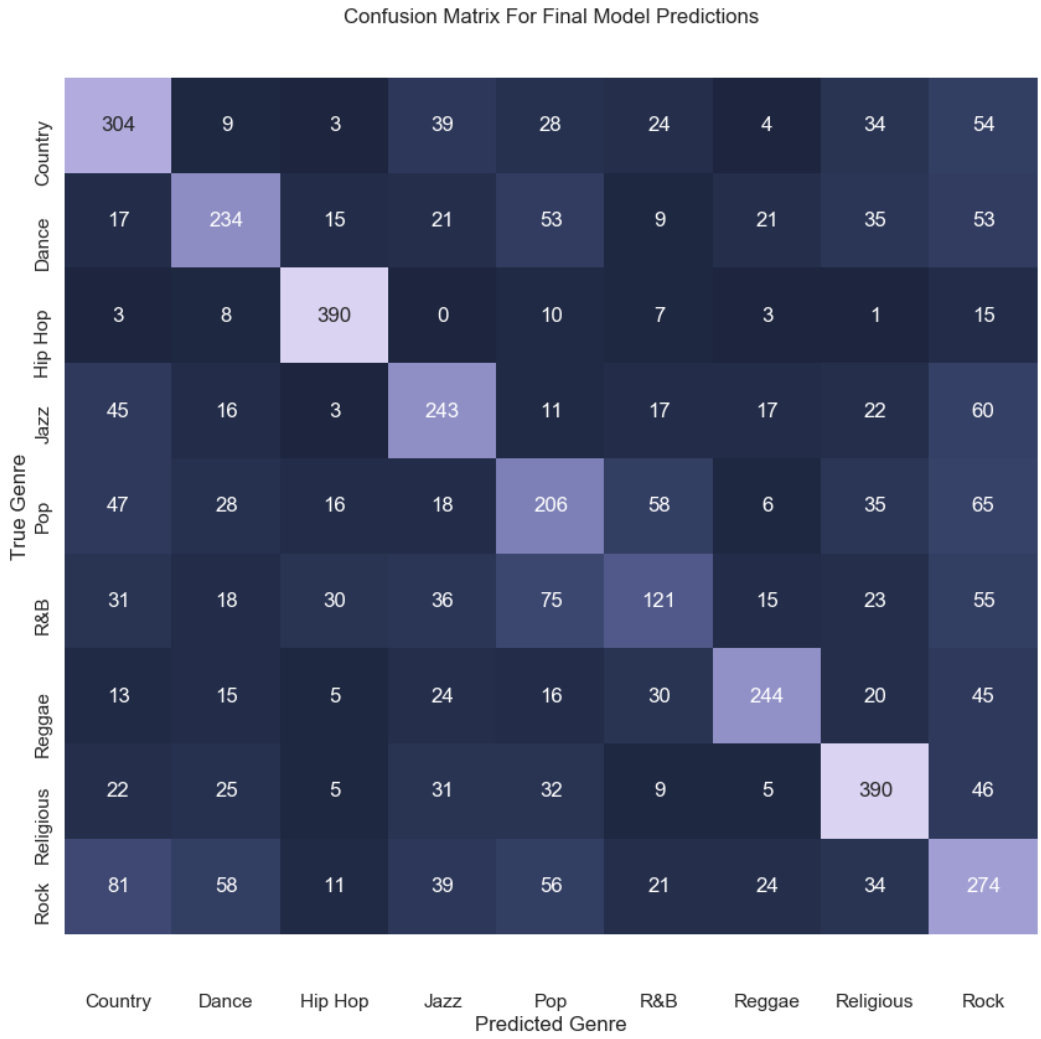

Figure 4: True and predicted counts for each genre.

The confusion matrix for the SVM is shown in Figure 4. From the confusion matrix it is evident that the model performs best on hip hop lyrics, with an accuracy of 0.89245 for that genre. The model performs least well on R&B, pop and rock lyrics with accuracies of 0.29950, 0.43006 and 0.45819 for the respective genres. These three genres are hard to differentiate for the model, with 130 R&B lyrics being classified as either pop or rock, more than the number of R&B lyrics that were correctly classified. Rock is a common incorrect prediction for lyrics of most genres.

Due to the ratio of songs per artist, and the training and evaluation datasets containing the same artists, we recognise that the models may be overfitting to certain styles of the artists as opposed to whole genres. The large number of musical artists that we used in this study reduces the overfitting; however, it could further be reduced in future studies by introducing artists in the evaluation stage that were not seen by the models in the training stage. By including this step, the diversity of the dataset for each genre would increase, therefore giving an advantage to models that better generalise when comparing the different models.

The feature importance for two models created in this paper can be seen in Figure 5 – however, since the models were fit using the PCA components, the importances are in terms of these components. The most important components across these two models based upon average importance are components 0, 4, 2, 8 and 3 respectively.

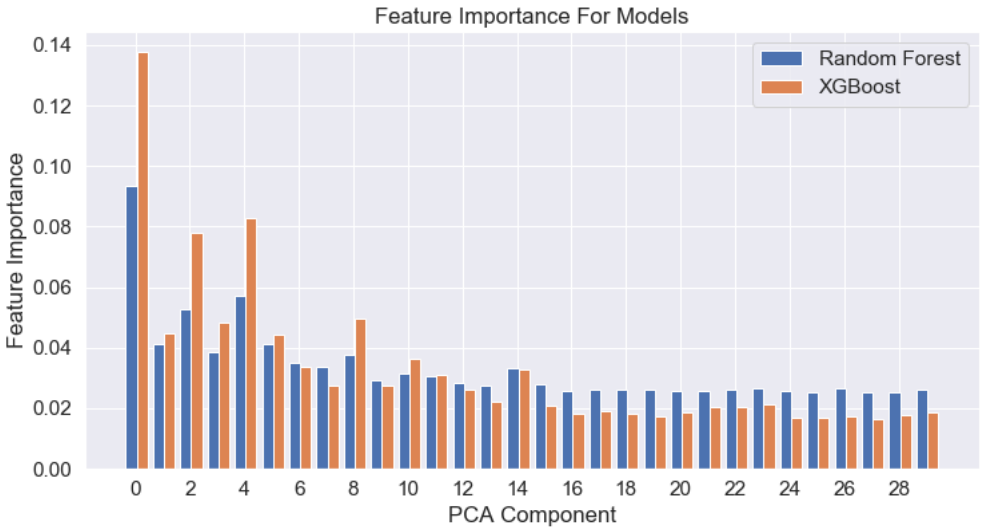

Figure 5: Feature importance for random forest and XGBoost models.

By transforming a diagonal matrix through the PCA function, it is possible to see the influence each original feature has on the PCA components. The highest influencing features on component 0 are total words, characters and letters – all features that define the length of the lyrics. Therefore, these features could be seen as the most important when differentiating between genres.

Components 2 and 4 are both influenced greatly by features relating to the vocabulary of religious and reggae lyrics, respectively. Component 8 is also influenced greatly by vocabulary features; however, it is not specific to one genre. Therefore, vocabulary features could also be viewed as important when differentiating between genres.

Due to the implementation of the SVM model in the scikit-learn Python package, the feature importance for the highest performing model could not be obtained. However, the high feature importance correlation for other models suggests that the feature importance for the SVM will be similar. In future research, it may be beneficial to use methods to understand the workings of the SVM, such as Local Interpretable Model-agnostic Explanations (LIME) (Ribeiro *et al.*, 2016).

Another avenue for future work is the use of deep-learning approaches for multi-class classification. Deep-learning models have been shown to outperform classical machine-learning models in a variety of different prediction tasks (Nguyen *et al.*, 2018; Paterakis *et al.*, 2017). Natural-language processing (NLP) transformers, such as RoBERTa developed by Facebook, may be particularly suited to tasks such as music-genre classification from lyrics due to the textual nature of the problem.

Conclusion

A total of 21,416 song lyrics were collected across nine different genres of music: hip hop, R&B, rock, pop, country, dance, religious, jazz and reggae. These lyrics were split into a training set and evaluation set using an 80/20 split for the purpose of building models for the classification of lyrics by music genre.

A total of 217 features were engineered across four abstract categories: textual statistics, syllabic and rhyming features, vocabulary, and structural features. Principal components analysis was then performed on the dataset and used to build several different models. The

best performing model was a SVM, with an accuracy of 0.56136 across the nine genres. This accuracy was highest when predicting on hip hop lyrics, with an accuracy of 0.89245, and lowest on R&B lyrics, with an accuracy of 0.29950. The overall accuracy of the SVM model was greater than the accuracies of similar models in existing literature.

Due to the implementation of SVMs in the popular scikit-learn Python package, the importance of features cannot be obtained trivially. Instead, the feature importance for random forest and XGBoost models was used to find the most important features. It was concluded that features correlating with the length of the lyrics, as well as features related to vocabulary, were the most important features in this task. Further studies may wish to expand upon the analysis of the importance of individual features.

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Glossary

Cross-validation: Training a model over multiple iterations, where each iteration uses a different portion of the dataset for training and testing.

Feature: A measurable property of the data.

Flesch Reading Ease: A quantified measure of readability.

Hand-crafted features: Intuitive features calculated via an equation or simple algorithm, as opposed to inferred features from a deep-learning model.

Principal Components Analysis (PCA): A method to change the dimensionality of data by calculating the principal components of the data.

Readability: How difficult a text is to understand in English.

Rhyme density function: A function that quantifies the frequency of rhymes in lyrics.

Support Vector Machine (SVM): A machine-learning model that separates data into different classes using hyperplanes.

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Cloak and Cruentation: Power, (In)Visibility and the Supernatural in the *Nibelungenlied*

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Abstract

The Medieval epic poem the 'Nibelungenlied' makes use of two supernatural elements. There is a cloak that renders a character invisible, and the phenomenon of cruentation is trial by ordeal, which supposedly reveals who the murderer of a victim is. Although critics have stated the importance of these two elements to the narrative, the questions of how and why these elements are crucial remain under-analysed. This paper seeks to fill this gap in current research by assessing each supernatural phenomenon's narrative function. I argue that their supernatural qualities are not the only aspects that link them, and that it is their power to alter what is (in)visible that makes them a catalyst for changing socio-cultural power dynamics in the text, ultimately leading to the tragic ending of the poem.

Keywords: Nibelungenlied; invisibility cloak in the Nibelungenlied; cruentation in Medieval literature; Bahrprobe in German Medieval literature; cruentation in Nibelungenlied

Introduction

As one of the most well-known texts in Medieval German literature, the *Nibelungenlied* (*NL*) (Edwards, 2010; Schulze, 2011)[1] is an epic poem written by an anonymous poet, most likely around *c.*1200 – the high point of Middle High German (MHG) literature – in the region of Passau, a town in modern-day lower Bavaria. Scholars have suggested that the poem is loosely based on the Old Norse ***Poetic Edda***, and we know that Richard Wagner's ***Der Ring der Nibelungen*** took inspiration from the *NL*, but only very broadly (Haymes, 2009: p. 218 ff.).

The *NL* has undergone plentiful analyses of power structures between the characters in the text. Less researched, however, are the two main supernatural elements in the text: cruentation (a phenomenon where the wounds of a murdered corpse bleed if the murderer approaches it) and the cloak of invisibility. Within the relatively little research that has been

produced on the cloak, academics have noted its importance to the narrative (cf. Bekker, 1971: 106; Selmayr, 2015: 69), with Sieburg stating: 'ohne die Tarnkappe ließe sich das *Nibelungenlied* nicht erzählen' ['the *Nibelungenlied* could not be told without the invisibility cloak'] (Sieburg, 2017: 193).[2] Nevertheless, there is a need to know what *precisely* makes the invisibility cloak so vital, as previous studies have somewhat assumed its power at face value.

Furthermore, there is even less research on cruentation in the Middle Ages, as the *Nibelungenlied* and Hartmann von Aue's *Iwein* (also written in the early thirteenth century) are the earliest representations of cruentation in German literature. As a result, most of the focus is on the phenomenon in Early Modern literature (cf. Dawson, 2018) and the literary representations of Early Modern legal proceedings and medicine (Ceglia, 2020: 24). I seek to address this gap in Medieval research by asking: how do both supernatural elements move from mere symbolism to becoming crucial to the entire narrative of the *NL*? I shall also build on previous analysis to argue that not only are the cloak and cruentation vital to the narrative but that they are also linked by what they can manipulate to be (in)visible, thus changing socio-political hierarchies in the *NL* and, in turn, changing how the characters perceive each other.

For both elements, I shall explain how and when they are used in the text and the consequences they hold for the characters. I shall also argue that the unique nature and consequences of both supernatural elements mean that they are cornerstones of the *NL* narrative. To achieve this, I shall highlight the germane and surrounding narrative moments and chapters (called 'Adventures') where the invisibility cloak and cruentation appear, demonstrating how consequential they are within the poem, and also help to fill the gaps for a general audience. To that end, I shall also be focusing on some of the main characters of the poem, namely Siegfried (the main hero of the *NL* and owner of the cloak of invisibility), Gunther (king of the Burgundians), Kriemhild (Siegfried's wife and Gunther's sister), Hagen (Gunther's vassal) and Brünhild (the queen of Isenstein and Gunther's wife, who has supernatural strength). In both cases, it will become apparent that both supernatural elements inherently rely on the dichotomy of the visible/invisible – hence (in)visible – to change power structures within the text: the cloak is required to make Siegfried unseen and unknown, and cruentation is required to make God's judgement visible.

The qualities of the invisibility cloak

From its introduction, the invisibility cloak is deeply associated with (in)visibility and power. The cloak's holder, Siegfried, is also the owner of a large treasure hoard, for which he had to fight off giants, a dwarf named Alberich and a dragon (92–101). Even before the cloak's invisible qualities are mentioned, the fact that Siegfried had to defeat the dwarf Alberich 'mit sorgen' ['with hardship'] (336: 1–3) to win the cloak highlights that it is a prize that demonstrates the victor's existing physical power in the form of strength. This symbolism also implies that 'wer die Tarnkappe besitzt, ist zugleich Herrscher über den Hort' ['whoever owns the invisibility cloak is also master of the hoard'] (Selmayr, 2015: 68), thus giving the owner of the cloak even more power than before.

Further, Siegfried gains two main supernatural advantages when wearing the cloak: the strength of 12 men and the ability to turn invisible. Unlike the factual description of the strength Siegfried gains when wearing the cloak (337: 1–3), the narrator elaborates on the benefits of invisibility to the audience: '*Ouch was diu selbe tarnhût also getân,*/ *daz dar inne worhte ein ieslicher man,*/ *swaz er selbe wolde, daz in doch niemen sach*' ['Moreover, the cloak of invisibility was of such a nature that anyone wearing it could do whatever he wanted without anyone seeing him'] (338: 1–3). This explicitly confirms the importance of (in)visibility in the narrative and shows the audience that it affords the wearer supernatural power as a result of manipulating what is (in)visible.

The invisibility cloak's function within the narrative

The narrator's explanation also states the cloak's primary supernatural function, which is to create a power imbalance in the form of knowledge. In the 7th Adventure*,* Siegfried uses this utility to great effect by helping King Gunther win over the Queen of Iceland, Brünhild, and secure her hand in marriage after striking a deal with the Burgundian king. If Siegfried helps Gunther secure Brünhild's hand in marriage, the king will, in turn, give his permission for Siegfried to marry Kriemhild (332–34). Siegfried takes Gunther and his entourage to Isenstein, introducing himself not as a knight but as Gunther's vassal. While seeking Brünhild's hand in marriage, Gunther finds himself challenged by Brünhild to a contest of strength, which owing to her supernatural strength, she is convinced she will win. If he *alone* is successful throwing stones and javelins better than her, she will marry him. If not, she will kill them all (423–27).

Siegfried dons the cloak to aid Gunther in this contest without Brünhild's knowledge and, as a result, they win.

Indeed, with the narrator emphasising the fact that 'wan diu Tarnkappe, si wæren tote dâ bestân' ['were it not for the cloak of invisibility, they would have died on the spot'] (457: 4), the invisibility cloak takes on a pivotal role in this passage in two main ways. Firstly, it allows Siegfried to successfully fool Brünhild into thinking it is just Gunther competing (465: 2). Brünhild is not aware of Siegfried's presence during the combat (which directly contradicts the rules she set out in strophes 423–27) and believes Siegfried and Hagen's lie that he missed the competition entirely because he went back to the ship to guard it (472–73). Consequently, there is a power imbalance due to differing levels of knowledge in this scene caused by the ability to become invisible. I agree with Albrecht Classen here, who states that 'in reality, Brünhild has not lost either to Gunther or Siegfried, because both receive illegitimate outside help: Gunther from Siegfried, and Siegfried from his [invisibility cloak]' (Classen, 1992: 102). The fact that Brünhild is tricked into *thinking* she lost the competition is ultimately the unique and exclusive result of the strength and invisibility afforded to Siegfried by the cloak. Without this knowledge imbalance, Gunther would never have been able to marry Brünhild.

Secondly, the use of the cloak's additional strength-giving qualities is also used here. It is the only reason that Siegfried can match Brünhild's strength, with which she can throw a spear that three men can barely lift (441: 1–3), with Hagen saying of her: '[»]der ir dâ gert ze minnen, diu ist des tîvels wîp«' ['["]She whom you desire to woo there is the very Devil's wife!"'] (438: 4). Indeed, this evidence further solidifies the idea that this contest could not be won without Siegfried and the invisibility cloak. The unique nature of the contest requires both advanced strength and the advantage of anonymity that only the invisibility cloak can provide.

As a result of Siegfried and Gunther winning this contest, all promises are kept. Brünhild takes Gunther's hand in marriage, Siegfried is offered Kriemhild, and they have a double wedding to celebrate (10th Adventure). However, Siegfried lying to Brünhild about his status (that he is a vassal rather than a king) poses problems. As Brünhild becomes more aware of the Burgundian **courtly society** in which Gunther, Siegfried and Kriemhild operate (Newman, 1981: 72), she becomes increasingly preoccupied with Siegfried's marriage to Kriemhild. As far as Brünhild is concerned, Siegfried is Gunther's vassal and thus should not be marrying into royalty (*NL* 620; Campbell, 1997: 563 ff.). In other words, Brünhild takes umbrage at Siegfried and Kriemhild's

marriage due to Siegfried's deception, a deception ultimately caused by the competition in which he used the invisibility cloak.

Brünhild's anger at this perceived mixing of social status leads to a problem for Gunther: she will not consummate the marriage. She verbally refuses him when he initially attempts consummation, which leads to Gunther becoming angry. When he tries to force her by tearing her clothes apart, she does the following: '*Di fuoze unt ouch di hende si im zesamne bant. / si truoc in zeinem nagel unt hienc in an di want*' ['She bound together his feet and hands; she carried him over to a nail and hung him up on the wall'] (637: 1–2). As has been noticed by commentators such as Renz, this use of physical strength in reaction to Gunther's forceful sexual advances is problematised by the poet because Brünhild uses force to defy Burgundian social codes (Renz, 2006: 23). Indeed, considering that the 'later Middle Ages [...] witnessed violent forms of misogyny' (Classen, 1992: 92), this defiance thus causes Gunther to respond in kind. Feeling humiliated and emasculated by the previous night's experience, Gunther wants to get the upper hand again. For this, he needs to display dominance to Brünhild, and Siegfried offers to help him do so.

What follows is yet another situation that would be impossible to achieve without the invisibility cloak. Siegfried offers to don the cloak and force Brünhild into submission when the lights are extinguished. On the condition that Siegfried does not make love to her (651–55), Gunther agrees, and 'an sîner vrouwen minne stuont aller sîn gedanc' ['[a]ll his thoughts were bent on the love of his lady'] (657: 4). As Lienert notes: 'Minne hier meint nur Sexualität, und Sexualität ist wesentlicher Bestand der Gewalt über Frauen' ['courtly love here means exclusively sexuality, and sexuality is an essential element of violence against women'] (Lienert, 2003: 10). Brünhild tries to tie up whom she assumes to be Gunther once more (671), almost succeeds (674), but ultimately Siegfried is victorious. The battle ends, and Siegfried (still wearing the invisibility cloak) takes Brünhild's ring and belt (679: 2–3). As far as the narrator is concerned, the outcome is clear: 'dô wart si Guntheres wîp ' ['then she became Gunther's wife'] (677: 4).

As far as Siegfried is concerned, he is thus successful on two counts. Firstly, he overcomes Brünhild with the cloak's strength-giving powers, neutralising the perceived threat of her strength and 'disobedience'. Secondly, he achieves anonymity with the invisibility the cloak provides, thereby also tricking Brünhild again into thinking his actions were, in fact, Gunther's. In both instances of battling Brünhild, Siegfried's use of the invisibility cloak is an

absolute necessity; he requires it to be stronger than her and not to be seen so that the marriage consummation is seemingly legitimised.

Nevertheless, Siegfried suffers the consequences of his actions. When he takes Brünhild's ring and belt, he decides to give them to Kriemhild (679: 3–680: 3), and they return to their kingdom in Xanten (714: 2). Ten years after the assault on Brünhild, both couples have had children and are thriving in their respective kingdoms. One day, Brünhild and Gunther invite Siegfried and Kriemhild back to their kingdom. When they arrive, the queens have an almighty argument (14th Adventure), which is about whether Siegfried is a vassal or a king. Kriemhild attempts to settle the argument by stating that Siegfried deflowered Brünhild (840–42), and she produces the ring and belt taken from Brünhild to back up her claim. This causes significant problems for Siegfried, not only because this act would be seen as adultery, but also because '[i]n a **patrilineal** system it is crucial to know the identity of the father', especially when concerning kingship and Brünhild's son's claim to the Burgundian throne (Nelson, 1992: 126). For this, it is decided by Hagen that Siegfried must die (870), and he sets about convincing Gunther to betray Siegfried (916). Hagen asks Kriemhild where Siegfried's vulnerable spot is, feigning interest in protecting him (897). The vulnerable spot refers to the fact that Siegfried bathed in a dragon's blood after slaying it to make himself supernaturally invulnerable to standard weapons. While he was bathing, a linden leaf fell onto his back between his shoulder blades, thus creating a vulnerable spot (899–902). They invite Siegfried out hunting, and Hagen stabs him in the back, killing him (981–1002). Thus, for his actions undertaken with the anonymity of the invisibility cloak, Siegfried pays with his life.

Both uses of the cloak have a significant effect on the narrative, to the extent that Siegfried dies due to his actions. Further, he lies to Brünhild in one instance, and his later actions can be construed as rape – quite possibly by Medieval standards and certainly by contemporary standards (Edwards, 2018: 12–14; Nelson, 1992: 124). The invisibility cloak's use becomes as morally questionable as it does crucial and consequential to the narrative. In fact, it is by recognising the consequences of that violence (ultimately, Siegfried's death) that we can historically contextualise and understand the violence against women in the *NL* (Sterling-Hellenbrand, 2018: 72–73), and, furthermore, the invisibility cloak's critical role in that violence. It is clear, therefore, that the invisibility cloak is vital to the overarching *NL* narrative. To be sure, two of the most crucial points in the narrative – Gunther's wooing of Brünhild and the consequent consummation of the marriage – cannot happen without it, due

to the inherent need for the anonymity required to trick Brünhild in both narrative conundrums.

Cruentation and its qualities

Having established the importance of what is (in)visible in the *NL*, let us now analyse one of the defining sections of the *NL*: the 17th Adventure. This is the part in which Siegfried is found murdered and is buried. Marking the second half of the text, it is in this scene where Kriemhild accuses Gunther and Hagen of killing Siegfried and begins to plot her revenge accordingly. Although there has been much research done on this Adventure, one of the most substantial research gaps is that of the lack of attention paid to cruentation (*ius cruentationis*; *Bahrprobe*): the phenomenon of a murdered corpse's wounds bleeding afresh when the murderer approaches it (Dawson, 2018: 152). As with other trials by ordeal, cruentation was a ritual to elicit God's judgement (*iudicium Dei; Gottesurteil*) on a person accused of a crime in the Medieval and Early Modern periods (Bartlett, 2008: 28). Even though they were banned by the Fourth **Lateran Council** (1215), the practice of and belief in trials of ordeal remained very much present in Medieval society (Birkhan, 2010: 15).

In this section, I shall argue that cruentation's inherent links with invisibility, the supernatural and power structures within the *NL* mean that the narrative is dependent on cruentation to the extent that it acts as a catalyst to narrative progression. The qualities of cruentation from textual evidence will be analysed to demonstrate how it functions in the *NL*. To that end, I shall demonstrate its stated importance and its links to the supernatural, (in)visibility and power in the text. Secondly, I shall apply this analysis to demonstrate how cruentation is crucial to the narrative. I shall argue that it gives Kriemhild the power of societal validation to blame Hagen and Gunther for the death of Siegfried.

From its introduction, cruentation is portrayed as an essential phenomenon within the 17th Adventure. The first explicit mention of it is in strophe 1044: 1–3, in which the poet explains to the audience what cruentation is: 'Daz ist ein michel wunder, vil dicke ez noch geschiht:| swâ man den mortmeilen bî dem tôten siht,| sô bluotent im di wunden, als ouch dâ geschach' ['This is a great marvel – it still happens many a time today. Whenever a marked murderer is seen alongside a dead man, then the corpse's wounds will bleed – as also happened here']. In addition to Schulze's analysis of this strophe as being a plain description of what cruentation is (Schulze, 2013: 224), there is a further significance to the narrator's explanation. The poet

of the *NL* relied on the cultural context of the audience to be effective in creating a visual representation of the narrative in their minds (Wenzel, 1992: 324f.). The best way to achieve this visual representation is, therefore, to explain what this phenomenon is. The explanation not only makes sure everyone has the same base knowledge of the phenomenon, but it also indicates that the audience should pay attention to it. Strophe 1044, thus, is there to indicate that the audience should consider cruentation carefully when assessing the 17th Adventure.

In addition to its established importance, the idea that cruentation was God's verdict is very much present in this text. Nevertheless, any reading of cruentation as God's judgement hinges upon the idea that Christian religious practice is taken seriously in any given text. This means that a brief assessment of the NL's religiosity must happen if we are to factor in the aspect of God's judgement.

Although the NL (especially manuscript B) is a less religious text (Kuhn, 1965: 280), this does not mean that Christian religious practice is not present in it. Indeed, the temporal structure of the entire 17th Adventure is encoded in Christian practices. For example, Siegfried's body is discovered at Mass time (1005:1). Then, a day passes, and everyone wakes in the morning once again for Mass, where the singing of many clergymen can be heard (1040: 2). After the cruentation scene, Siegfried's funeral is held where everybody must donate something towards the salvation of Siegfried's soul. Interestingly, the poet clarifies that the financial gain typically expected from the donations are unimportant in this case. In strophe 1060, it becomes apparent that even the people who could not afford it were told to take money from Siegfried's personal wealth and give it back to him as a token for safe passage into the afterlife. The result is that the salvation of Siegfried's soul is prioritised over the financial process of donation. Thus, religious practice is heavily inculcated into the 17th Adventure.

This is strong evidence to suggest that the act of cruentation is tied to the Christian religious idea of the miraculous, which Jacob Grimm identified as a source of the supernatural, which typically causes just and good results to occur (Grimm, 1875: 861). Indeed, I am inclined to agree with Sieburg, who notes that the word 'marvel' ('wunder') in strophe 1044: 1 should be considered 'tatsächtlich im christlichen Sinne' ['very much in the Christian sense'] (Sieburg, 2017: 187). Furthermore, this also proves the fact that cruentation is 'not pagan, but Christian "magic" deeply rooted in a religious pattern of thought' (Willson, 1960: 41). This means that the idea of cruentation as a supernatural intervention representing God's judgement can and should be taken seriously within the *NL*.

Moreover, the other crucial element to cruentation is that it is a visible phenomenon. This is present not only explicitly in 1044 with the conjugations of 'sehen' ['to see'] (lines 2 and 4), but also implicitly in Kriemhild's invitation asking anyone who wished to approach Siegfried's corpse to do so: '»swelher sî unschuldige, der lâze daz gesehen.| der sol zuo der bâre vor den liuten gên.| *dâ bî mac man di wârheit harte schiere verstên*«' ['"Let he who is innocent have it be beheld! Let him approach the bier before all the people! *The truth will soon be shown then*"'] (1043: 2–4, my emphasis). The fact that this strophe directly precedes the explanation of cruentation indicates that everyone present in the room was ready for the trial by ordeal to happen after Kriemhild's invitation. That means, therefore, that everyone was watching the body. The nature of cruentation thus becomes a way to deliver God's verdict, which relies on manipulating what is visible to have any weight.

Likewise, the idea that cruentation is an exclusively visible event, combined with the relatively short amount of time the poet spends describing the physical act itself (1045: 1–2), also indicates a somewhat unique phenomenon. Temporally, it happens relatively suddenly and is the result of God rendering His judgement *visible*. This evidence is very much in line with the idea that '[l]ike ghostly apparitions and bizarre coincidences, cruentation reveals God's hand in uncovering sin […]' (Dawson, 2018: 152). Rather than hiding what is visible (as with the cloak of invisibility), cruentation is designed to render the truth visible – both literally and metaphorically – with God's aid (Ehrismann, 1987: 152). Therefore, cruentation is a phenomenon by which an omnipotent, omnipresent and invisible supernatural being (God) uses His power to render His judgement visible.

Cruentation's function within the narrative

To be sure, the qualities of cruentation are of vital narrative importance as they act as a catalyst to the second half of the narrative structure. By tracing Kriemhild's suspicions, and accusations, it is possible to see that cruentation validates her inner thoughts and beliefs. This validation, in turn, gives her the social and legal power to blame who she thinks is responsible for Siegfried's murder – Gunther and Hagen.

A good example of why the cruentation is vital to this affirmation is explained earlier in the text; Kriemhild may have strong suspicions about who killed Siegfried, but she cannot publicly accuse anybody. After giving Hagen vital information regarding Siegfried's only vulnerable area – between his shoulder blades – in the 15th Adventure (902–06), Kriemhild then has a

prophetic dream during which Siegfried is hunted down by two wild boar and killed. As a result, she tries to warn Siegfried not to go hunting (921–22). By the time Siegfried is found, Kriemhild already suspects that the information she gave Hagen was used against Siegfried: ‘Ê daz si reht erfunde, daz iz wære ir man, | an di Hagenen vrâge denken si began, | wi er in solde vristen. dô wart ir êrste leit’ [‘Even before she found out for certain that it was her husband, she began to think of Hagen’s question about how he should protect him’] (1008: 1–3). Importantly, the word ‘think’ (‘denken’) suggests a rare interiority of thought. While Kriemhild usually speaks her thoughts, this one she kept to herself. This interior suspicion turns to a proclamation in the relatively private sphere of the hallway outside her chambers. It is just her servants who hear her say: ‘»ez ist Sîfrit, der mîn vil lieber man.| ez hât gerâten Brünhilt, daz ez hât Hagen getân«’ [‘“It is [Siegfried], my dearest husband. [Brünhild] has conspired to have Hagen do this deed”’] (1010: 3–4). However, when asked by Siegfried’s father, Siegmund, in a more public sphere, Kriemhild pretends not to have any clue who did it, but makes her intentions towards the murderer(s) very clear: ‘»Hey, sold ich den bekennen […]| ich geriete im alsô leide, daz di friunde sîn| von den mînen schulden muosen weinende sîn«’ [‘“Oh, if I were to know who did it, […] I would cause him such harm as would make his friends weep because of me”’] (1024: 1, 3–4). This inconsistency in verbally exclaimed beliefs and interior thoughts leads me to agree here with Robles, who states that in the *NL:* ‘[d]a die Frauen machtlos sind, ist auch ihr Wissen ohne Macht’ [‘because women are powerless, their knowledge is equally so’] (Robles, 2005: 366). Despite Kriemhild’s social status as queen, she cannot openly accuse anyone without some societal backing in the courtly society in which she lives. In other words, she lacks enough firm proof to accuse anybody openly and justifiably.

Cruentation provides precisely this proof, and this perceived evidence gives Kriemhild the power of societal validation. For example, Kriemhild’s invitation to all who think themselves innocent to approach the funeral bier in 1043 affirms that this is a trial that should be taken seriously and will begin to provide closure to Siegfried’s death. As the cruentation happens, one possible interpretation of God’s judgement is revealed, as described by the narrator in 1044: 4: ‘dâ von man di schulde dâ ze Hagene gesach’ [‘Thus Hagen’s guilt was beheld there’]. This description is also reiterated and explicitly states that cruentation took place: ‘Di wunden vluzzen sêre, alsam si tâten ê’ [‘The wounds flowed as freely as they did before’] (1045: 1). This evidence confirms and explains Hatto’s footnote on strophe 1024 in his prose translation: ‘Kriemhild needs firm legal proof, which, in medieval eyes, she will soon obtain beside the

bier' (Hatto, 1965: 134). In a similar way to which God shifts His judgement from invisible to visible (and therefore *publicly* visible), Kriemhild can now carry forwards her accusations in an equally public manner.

With this substantiation, Kriemhild dramatically changes her approach and outwardly accuses Hagen and Gunther of killing Siegfried, contrary to 1044: 4, in which the poet explicitly states that the guilt lay with Hagen. This public accusation also proves that, while cruentation serves as legal proof, it is equally up to interpretation; people listening to or reading this tale could well be inclined to agree with Kriemhild's *or* the author's interpretations (Bildhauer, 2006: 43). Even when Gunther attempts to deceive her into thinking that it was ambushers, and not Hagen, who killed Siegfried, Kriemhild refuses to believe him from the outset: '»Mir sint di schâchære […] vil wol bekant.| nu lâz ez got errechen noch sîner vriunde hant.| Gunther und Hagene, jâ habt ir iz getân.«' '[The ambushers […] are very well known to me. Now may God have [Siegfried's] allies' hands avenge it yet! Gunther and Hagen, it was you who did this!'] (1046: 1–3). Furthermore, Kriemhild's mention of God in line 2 has a dual meaning here. The first interpretation is more literal, with Kriemhild expressing her wish to take revenge. However, the combination of Kriemhild's evident preoccupation with Christianity (Raffel, 2008: 337f) and the usage of 'now' ('nu') in 1045: 2 also implies a logical following-on from previous events. Now that God has revealed Hagen and Gunther's act to Kriemhild, the natural progression would be for Him to let her take revenge on those who killed her husband. Thus, as a direct result of cruentation providing substantiation within the narrative, Kriemhild is given the power to turn her interior suspicions into exterior accusations that are now considered valid in the considerably more public, courtly society in which she operates (Gephart, 2010: 25f.).

With this accusation now validated and public as a direct result of cruentation, Kriemhild then sets about planning her revenge in the form of a blood feud on Hagen, Gunther and all the Burgundians for Siegfried's murder (cf. Bildhauer, 2006: 75–76). After Siegfried's burial and her return to Worms, Kriemhild requests the hoard of the Nibelungs be brought to her (1116). She then uses it to amass military power (1127) and, to Hagen's dismay, begins to assemble a considerable force behind her (1128). In response to Kriemhild amassing so much power, Hagen puts the treasure in the river to stop Kriemhild from using it. He remembers the location of the hoard so that one day he may use it again. However, the poet emphasises in the last line of 1140: 'sine kunden ins selben noch niemen ander gegeben' ['In time they could

neither give it to themselves nor to anyone else']. This prophetic line foretells the narrative's ending, which is the eventual – and near-genocidal – downfall of Gunther, Hagen and almost all of the Burgundians (Schulze, 2013: 94).

After amassing this force, Kriemhild eventually takes another husband – King Etzel – and moves with him to Gran, which is now Esztergom in present-day Hungary (22nd Adventure). Seven years pass, and she invites Gunther, Hagen and all the Burgundians to her castle in Gran under the guise of offering them an olive branch (23rd Adventure). Almost all the Burgundians arrive and, shortly afterwards, the guise of diplomacy is dropped on both sides (29th Adventure), and a war begins. The battles are a bloodbath that result in the deaths of all the main characters, excluding Etzel and some of his entourage. Almost all of the Burgundians are slain, too (39th Adventure). Therefore, we see that the phenomenon that catalysed Kriemhild's revenge is the societal and legal validation cruentation gave her. It is cruentation that ultimately serves as a narrative catalyst, leading to the downfall of the Burgundians at the end of the poem.

Conclusion

To conclude, then, both the invisibility cloak and cruentation provide significant narrative development in the *NL*. The fact that both the invisibility cloak and cruentation appear at crucial narrative points is no coincidence. That both supernatural elements inherently rely on the (in)visible dichotomy to function; the invisibility cloak hides and cruentation brings to light.

The invisibility cloak only appears when no other tool or plan would solve the 'problems' Siegfried and Gunther face. Siegfried and Gunther use the extra strength given to the wearer to overcome Brünhild and the invisibility element to provide the veil of anonymity required to fool Brünhild into thinking it was just Gunther present during both the competition and the assault.

As we have seen, Siegfried's uses of the cloak have consequences. Siegfried lies to Brünhild, setting up her discomfort with his marriage to Kriemhild. That discomfort then leads to her refusing to consummate her marriage to Gunther, leading to the second use of the cloak. Taking the ring and belt from Brünhild and then giving them to Kriemhild means that Siegfried is ultimately accused of sleeping with Brünhild himself, for which he pays dearly. The

invisibility cloak is used to hide people, which shrouds the narrative in mystery for the characters and ultimately leads to Siegfried's death as a direct result.

On the other hand, cruentation is about rendering potential evidence visible for the characters to interpret. From the introduction of the phenomenon to the narrative implications, it is also clear that the qualities of cruentation make it so unique to the narrative. It is a supernatural power created by God to convey His judgement onto a murderer, which is effective insofar as it is visible. It was believed that God made visible his judgement to give societal and legal validation to what would have ordinarily remained an unsubstantiated claim, thus giving the accuser power. By tracing the development of Kriemhild's thoughts, suspicions and accusations, it is possible to see that cruentation is the catalyst to a crucial narrative progression: Kriemhild's revenge, or in other words, the beginning of the downfall of the Burgundians.

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Endnotes

[1]Any primary text citations of the NL will be further presented as strophe and line numbers (strophe; line(s)) from the B manuscript (St Gall, Stiftsbibliothek, cod. 857). I shall use a Middle High German (MHG) edition paired with an English translation, as cited before this endnote in the main text body. Any italicised quotations are in Middle High German, any non-italicised German quotations are in modern German. For primary text usage I shall present citations like this: (strophe(s): verse(s)). If there is no colon, strophes are assumed.

[2]Any English translations of secondary sources in this article are my own.

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Glossary

Courtly society: A specific set of values, beliefs and codes that nobles, royalty and knights had to follow as part of their lives. This includes not marrying someone of lower status, for example.

***Der Ring der Nibelungen*:** Wagner's epic opera composed from 1848-74, which is loosely based on the NL. The entire opera takes place over four evenings.

Lateran Council: An ecclesiastical council made up of senior Catholic Church members who took decisions on doctrine(s), administration, discipline and how best to apply all of their decisions to everyday life. The first Lateran Council was held in 1123, and the final one (the Fifth Lateran Council) from 1512-17.

Patrilineal: The notion that power or riches are passed down to exclusively male heirs. In this case, the continuation of Gunther's dynasty required a male heir.

***Poetic Edda*:** Old Icelandic poetry written in the Early Middle Ages (*c.* tenth century, although precise dating is still the subject of scholarly debate). Important for this article is that they certainly predate the NL.

Vassal: A servant of the feudal nobility who pledged allegiance to their lord in return for land and protection.

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Reappearing in Different Forms: Ancient and Contemporary Irish Hunger in *Bog Child*

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Abstract

Siobhan Dowd's novel *Bog Child* explores a legacy of self-sacrifice in Ireland. From a contemporary context, it explores the second hunger strike of Long Kesh prison in the 1980s and a fictionalised famine in the first century as a more ancient example. Using Kathleen Jamie's notion of 'surfacing' and Oona Frawley's 'memory cruxes' as launching points to explore *Bog Child*, this paper works to illuminate how these temporally distant events are intricately connected through an extended history of self-sacrifice and hunger in Ireland. In the process, it also explores how, in that extended history, gendered notions have crept in, how they are reinforced and how they can be challenged. *Bog Child* is at its core a novel about the repetition of history, and particularly of historical cultural trauma, but one that ultimately works to offer a compassionate end to this repetition, as the paper will conclude.

Keywords: Bog Child, The Troubles in Northern Ireland, hunger strikes in Long Kesh Prison, hunger strikes and Brehon Laws, Irish famines and British Imperialism

In her collection of essays, *Surfacing* (2020), Kathleen Jamie explores, through the lens of personal memory and her first-hand accounts of archaeological digs, the ways in which the past 'surfaces' into the present and becomes part of it, an irruption in the typically linear configuration of time. Following her experiences at an archaeological dig in Alaska, where artefacts of the Yup'ik people's ancestors were being uncovered as the descendants watched and lived alongside the dig, Jamie muses: 'The past can spill out of the earth, become the present' (2020: 31). These artefacts then are not only a temporal irruption, but a literal and physical eruption from the earth. This kind of irruption/eruption, or 'surfacing', to use Jamie's terminology, is at the heart of Siobhan Dowd's novel, *Bog Child*.[1]

Dowd's novel follows a young man, Fergus, after he discovers a body from around 80 CE preserved in a bog in Northern Ireland. Over the course of the novel, Fergus has a series of

ephemeral dreams in which he is given insight into the life of the eponymous 'bog child', named Mel. Through these dreams, we learn that Mel was accused of being a witch and the cause and/or perpetrator of a famine, and that she was subsequently executed in the belief that this would bring the famine to an end. Concurrent to his discovery of Mel's body and his ethereal visions of Mel's life, Fergus's brother, Joe, is participating in a **hunger strike** in Long Kesh prison. Members of the Irish Republican Army (IRA) imprisoned in Long Kesh underwent two hunger strikes to secure the rights to be treated as prisoners of war and not as common criminals, as they were at the time of the novel's main setting. The first of these hunger strikes failed. The second, on the other hand, was successful: led and engineered by Bobby Sands, ten strikers died and concessions in favour of the strikers demands were subsequently made by the British government. Joe participates in, but survives, the latter.

The revelation of how Mel came to be in the bog draws parallels between her and Joe through starvation in the former's experience of famine and the latter's commitment to the hunger strike. Moreover, the two become linked by their willing self-sacrifice, as Mel allows herself to be scapegoated and consequently executed, and Joe starves himself in the name of an independent Ireland. Through the juxtaposition of the hunger strike in which Joe participates, and the famine for which Mel is scapegoated, Dowd uses Mel's 'surfacing' to highlight the uncanny relevancy between the past and the present. As Jamie says elsewhere in her essays: 'time is a spiral […] events remote to one another can wheel back into proximity' (Jamie, 2020: 161). It is a more poetic reiteration of the aphorism 'history repeats itself', and is expressed differently again by Dowd in *Bog Child* through the resurrected voice of Mel prophesising Ireland's future: '*old grudges leapfrogging over generations, reappearing in different forms*' (Dowd, 2015: 312; emphasis original). Throughout the novel, as Fergus becomes a conduit through which the past and present of Ireland are explored, the legacy of hunger – be it famine or strike – on Ireland's cultural memory emerges as a site of crippling violence and grief. This paper seeks to explore the nuanced ways in which Dowd's novel explores this legacy, which simultaneously reinforces and challenges long-standing notions of hunger striking in Ireland. Moreover, this paper means to elucidate how the fictional, although still plausible, famine of Mel's narrative connects directly to the hunger strike in Long Kesh prison, nearly two millennia later.

Oona Frawley has developed some useful terminology for this paper. What I have in the introduction referred to as an irruption/eruption or, borrowing from Kathleen Jamie, the

process of surfacing, is symptomatic of what Frawley refers to as 'memory cruxes' (Frawley, 2014: 1). For Frawley, 'memory cruxes' are events that stimulate 'the transposition of the process of remembrance from the level of the individual to the cultural' (2014: 1). Memory cruxes, then, are central to the way in which *Bog Child* is able to thematically contrast and pivot between 80 CE and the 1980s with little distortion. Memory cruxes 'represent an ongoing attempt to debate the past and enter into a dialogue with it' (2014: 1), and *Bog Child* uses these temporally distant yet comparable moments to develop such a dialogue. More importantly, Frawley sees memory cruxes as intricately and particularly connected with historical sites of trauma, identifying, for example, the Great Irish Famine (1845–52) as especially impactful on Irish culture and politics (2014: 3–4). Further, as memory cruxes '[refuse] to allow us "closure"' (2014: 5) they 'induce a cycle of repetition and recurrence of trauma' (2014: 7). There is, then, nothing random about time's repetitiousness nor the way in which apparently disparate events spiral into proximity (Jamie, 2020: 161) because there is, according to Frawley, a cultural structure, a cultural trauma, that 'haunts us' (Frawley, 2014: 5). We can therefore understand Fergus's ephemeral dreams to be a haunting by Mel, but on the broader cultural level of a memory crux, evidence of Ireland's haunting by the legacy of famine, its literal surfacing through Mel and its figurative resurfacing through the hunger strikers in Long Kesh prison.

If 'hunger' is an Irish memory crux, it is no surprise that the history of hunger strikes in Ireland occupies 'an integral part of Irish history and mythology' (Sweeney, 1993: 421). Therefore, in order to understand the significance of the invocation of such history and mythology in *Bog Child*, it is important to clearly outline the historically charged and culturally important context that a hunger strike holds in Ireland. Firstly, hunger striking is rooted in the Gaelic societal codes of Brehon laws (Aretxaga, 1997: 82; Sweeney, 1993: 421), and it is important to understand that Brehon laws were not a legal system in the way that 'laws' are understood now, but part of a 'strong tradition of oral legal codes' (Sweeney, 1993: 241). George Sweeney explains that one of these laws suggested an indebted party could claim from their debtor such assets as was a suitable alternative payment, until the debtor was otherwise able to fulfil their obliged debt (1993: 421–22). We see this within one of Fergus's dreams in *Bog Child*, in which Mel's family's goats are forcefully claimed in payment for a debt owed to the community chief, Boss Shaughn, which pushes Mel's family to the brink of starvation (Dowd, 2015: 161). However, 'for many people […] this method was neither a realistic option nor a practical solution' (Sweeney, 1993: 422), and as an alternative, 'the

aggrieved would 'fast against' his debtor [...] a tactic usually employed by the powerless against the powerful' (1993). Sweeney highlights the use of fasting to resolve a kind of economic contract; however, Begoña Aretxaga contextualises it within a broader 'juridical mechanism for arbitration of certain disputes' (Aretxaga, 1997: 82) wherein Brehon laws 'allowed those who were unjustly wronged to fast at the door of the wrongdoer until justice was done' (1997). Brehon laws, then, can be seen not only as the process by which debt was repatriated, but also by which justice more generally itself was upheld in Gaelic society. Success for the aggrieved was often assured by the fact that if someone was to die by 'fasting against' a debtor or wrongdoer, not only was the family of the aggrieved to be compensated, but the threat of magical retribution lingered over the transaction (Sweeney, 1993: 422).

Magical retribution aside, it is important to be able to recognise the parallels in the fasting precedented by Brehon laws and the hunger strikes of the 1980s. While remembering that the two acts are indisputably distinct (Aretxaga, 1997: 82), 'the link of continuity between ancient Gaelic tradition and contemporary political practices is powerful in republican imagination' (1997). Through such continuity, not only could one infer that the hunger strikers were 'fasting against' the British government, but the ideological significance of the protest is elevated by invoking ancient Irish law to defy modern British law. As such, the hunger strikes also reveal the broader potentials of fasting, demonstrating its ability to expand beyond a process to claim material compensation, as in Sweeney's description, to ideological compensation, meaning justice, as in Aretxaga's description. Such continuity is vividly present in Annie MacSwiney's hunger strike in 1922, during which she 'camped outside the gates of Mountjoy [Prison] and began a hunger strike' protesting the imprisonment of her sister, Mary MacSwiney, who was holding a hunger strike of her own in the prison, protesting British domination of Ireland (Sweeney, 1993: 429). Annie MacSwiney's hunger strike is more directly derived from Brehon laws as she 'fasts at the door of the wrongdoer' (Aretxaga, 1997: 82), but Mary MacSwiney's protest from within the prison is illustrative of republican 'political identity as direct descendants of their preconquest ancestors' (1997) through a looser application of Gaelic tradition and invocation of Brehon laws. The latter then is more akin to the hunger strike by republicans in Long Kesh in the 1980s and in *Bog Child*.

In that 'loose' invocation of the Brehon laws, there is a streamlined continuity between the MacSwiney sisters' hunger strike and that of the hunger strikers in Long Kesh. To understand this, we need to explore what inspired hunger strikes and opposition to British rule in the first

place. The history of Ireland's invasion and occupation by forces hailing from Britain is long and storied, beginning at least as early as Norman invaders arriving from Britain in the 1100s (Radden-Keefe, 2019: 11). For the British, Ireland was 'their first colonial frontier'[2] (Patel and Moore, 2018: 51) and '[many] of the techniques of social control developed at home were practiced and refined [...] in Ireland' (2018: 190). Ireland was to Britain a testing ground for imperial rule. This is firstly illustrated by the industrialisation of Ireland into a colonial agricultural centre in the 1500s (2018: 190), followed by the Scottish and English protestants who emigrated to Ireland and 'established plantation systems' in the 1600s (Radden-Keefe, 2019: 11). Secondly, the enforcement of these industrial agricultural structures was ensured by 'military mobilization to protect colonial property' (Patel and Moore, 2018: 191). Militarised action, used as a response to Irish rebellion against British colonisation, became cyclical: the 'savagery' of violent rebellion, the unwillingness to become 'civilised', meaning opposition to modern farming methods of that era and British colonial rule more generally, inspired further justification for colonisation of Ireland by the British, which in turn fostered more 'savage' rebellion (2018: 191).

The resilience of such a conceptualisation of the Irish as 'savage natives' is clear in the military's attitudes expressed to Fergus by a British soldier: 'as far as my unit's concerned you're the **taigs**. A crew of mad, bad Irish bog-men, straight out of the stone age' (Dowd, 2015: 127). Although this is said tongue-in-cheek to Fergus by a clearly disillusioned British soldier – he is Welsh and thereby from a comparable British imperial testing ground to Ireland – it highlights the resilience of prejudiced ideologies, bordering on stasis. This stasis is emphasised by the comparison of contemporary locals to 'bog-men' and the exhumation of a centuries-old body from the bog nearby. The quality of Mel's preservation in the bog also serves to create a feeling of stasis: '[it] was as if the child was on the cusp of a second coming' (Dowd, 2015: 99). Early on in the novel, we are alerted to the local land's capability to preserve the past. Foreshadowing Mel's discovery, we are told that the peat in which Mel is found is 'made from things that lived here in millennia gone by and pressed by time into a magic frieze' (Dowd, 2015: 5). As much as Fergus becomes a haunted conduit through which the past surfaces, the land – Ireland itself – is revealed to be a gateway to the past, a repository that has absorbed history into it and preserved it in pristine condition.

By the mid-nineteenth century, Ireland was a profitable frontier for the British Empire. '[At] the height of the [1845–48] potato famine, Ireland was exporting around three hundred

thousand tons of grain a year to feed the mother country [England]' (Sweeney, 1993: 145). Some have estimated that the exports of corn during the famine would have been enough to feed 2 million people (Kinealy *et al.*, 2019: 19). That such disproportionate distribution of resources would have exacerbated the death toll the famine wreaked on Ireland's population demonstrates the extent of the institutional and economic violence that the British inflicted on Ireland.[3] This had a long-standing impact on Ireland to the extent that as late as

> the turn of the [twentieth] century, the wake of the cataclysmic social and economic upheaval of the famine was still evident. Irish society was still nurturing the resentment of a crippling exploitation and the gradual peeling away of its cultural heritage
>
> (Sweeney, 1993: 423)

which, in brief, would ultimately lead to the **Easter Rising** of 1916,[4] and then the partitioning of Ireland in 1921 following the Irish War of Independence (1919–21), which is what would lead to 'the troubles' of the 1970s and 1980s.

As such, there is a poignant irony in the Irish utilising a hunger strike to protest British rule of Ireland when Britain has sought to control and exploit Ireland through agricultural frontiers that led to famine. By invoking the historical violence of British rule, hunger strikes become continuations of violent British rule over Ireland. Not only does it invoke the violence inflicted, but also the resistance to it: 'the hunger strike, linked as it is to religio-political martyrdom […] [was] a weapon of last resort, of those nurturing a sense of oppression and frustrated in their attempts to resist' (Sweeney, 1993: 421). While '[the] political prison seeks to [delegitimise] its inmates' struggle by casting them as individual common criminals' (Whalen, 2019: 96–97), the hunger strikes cast inmates within 'the pantheon of Irish heroes' (Sweeney, 1993: 421). This pantheon 'provided role models in the 1970s and 1980s for republicans who sought an end to British rule in Northern Ireland' (1993: 435). However, attempts to delegitimise the opposition to British rule extended beyond merely misclassifying prisoners, but through a wider delegitimisation of the movement altogether: hunger striking 'was to become linked to militant republicanism along with Arthur Griffith's Sinn Fein party, a movement opposed to the use of physical force prior to 1916' (1993: 425). More troublingly, Sinn Fein would consequently be 'deliberately and wrongfully blamed by the British for what was officially called 'the Sinn Fein rebellion'' (1993: 425), which was a violent opposition to

British rule in Ireland, and is now more commonly referred to as the Easter Rising. John Pickering, a hunger striker, explains how such delegitimisation was re-employed during the 1980s:

> there was this battle going on for hearts and minds and it centres around terminology. They [the British] started using words like Bandit Country for South Armagh, and Godfathers for the IRA leaders. The criminalization of the republican struggle was part of that.
>
> (cited in Howard, 2006: 91)

This is the core reason the hunger strikes occurred in the 1980s. The British government aimed to strip imprisoned members of the IRA of their political autonomy by creating a narrative of common criminality rather than legitimate, militant opposition to an oppressive regime. Those imprisoned used hunger strikes to win back that political autonomy.

However, criticism of the mythologisation and cultural formulation of the figure of the hunger striker has arisen. Fundamentally, 'the hunger striker remains gendered male in the archetype' (Whalen, 2019: 113), which is problematic when the hunger strikes of the early twentieth century 'became the gold standard of republican protest' (McConville, 2015: 338), but exclusively in a male paradigm. Not only is the archetype of the hunger striker a male 'character', but the act of undertaking one is perceived to be a male act of heroism: 'the very *men* who do represent the will of Ireland and are endeavouring to vindicate *her* liberties' (Gannon, 1920: 449; emphasis mine). When one considers that 'Irish and British suffragists turned to the hunger strike as a form of political protest well before republican men' (Whalen, 2019: 97), it is unsurprising that there are suggestions that 'women hunger strikers […] largely have not received the attention their stories deserve' (2019: 95). However, although Irish suffragist Hanna Sheehy-Skeffington claims a '[hunger] strike was then a new weapon – [Irish suffragists] were the first to try it out in Ireland' (cited in Whalen, 2019: 97–98), this ultimately ignores the Gaelic legacy of the Brehon laws. However, this does not mean that suffragists were not pioneers of hunger striking as a mode of political protest (2019: 98), invoked by cultural right, as did Annie and Mary MacSwiney in 1922, and Dolours and Marian Price – perhaps the most well-known female hunger strikers of the IRA – in 1973, 'in an effort to secure repatriation to Armagh Gaol' (Whalen, 2019: 99) from a prison in mainland Britain. Rather, what this is more indicative of is that the discourse surrounding the Brehon laws is

also framed within a male context, reinforced by the fact that Sweeney's description of the Brehon laws uses male pronouns to describe the process (Sweeney, 1993: 421–22).

However, 'we must [recognise] the efforts of contemporary republicans (and republican prisoners in particular) to ensure that their female comrades were not forgotten by the general public, beginning in earnest in the 1980s' (Whalen, 2019: 113). For example, Jackie McMullan's account of the work his mother did to raise awareness of the hunger strikes: 'These women were extraordinary. They organised protests the length and breadth of the country, then took it abroad – America, France, Austria – generating publicity, drawing people's attention to the issues' (cited in Howard, 2006: 83). While there is no use in undermining this work, especially when Aretxaga reminds us of how vital it was and how crucial it is to combat the typical figuration of women in guerrilla warfare as 'victims of a violent conflict over which they have little control' (1997: 9), it seems that this was perhaps not exactly in the spirit of what Lachlan Whalen refers to, however well-intentioned it may be by McMullan. As deserving of attention as McMullan's mother's work may be, the story, coming from a male hunger striker (McMullan), in an article that fails to mention female hunger strikers, reinforces gendered and inaccurately represented divisions of labour: 'mobilizing was informally defined as women's work' (Kauffman, 2018: 36). This division of labour is a continuation of the way in which imperial (read: capitalist) structures worked to devalue the labour of women. '[We] continue to think of 'real work' solely as wage work and forget that [unpaid labour] makes it all possible' (Patel and Moore, 2018: 116). Of course, male hunger strikers were not financially compensated either, but were culturally compensated by the regular recognition of their sacrifice. Reflecting on this, we need to recognise that free – meaning here also uncredited – labour is disproportionately thrust upon women, and that even while the dictates of capitalism devalue free labour, it is far from invaluable but is to an extent the very foundation of Western society, as observed by Patel and Moore, above (2018: 116).

Mel does not escape such configuration, responsible as she is for numerous domestic tasks around the home. However, following the murder of Boss Shaughn by Mel's brother, after the family's goats are taken, Mel allows herself to be scapegoated for the famine that follows, interpreted as magical retribution lingering over a botched transaction governed by Brehon law. As such, *Bog Child* engages with a cultural history of self-sacrifice in Ireland, both in its more immediate and contemporary relevancy in the form of hunger strikes, as well as its place

in an ancient heritage wherein it implicates Mel within that 'pantheon of Irish heroes' (Sweeney, 1993: 421) and martyrs. In this sense, *Bog Child* is a curious text for the way in which it recodes the traditionally male space of the mythological hunger striker as female, but maintains and reiterates the archetype of the contemporary hunger striker as male through the character of Joe. However, as archaeologists in the novel compose a reality of Mel's life, based on the cryptic clues that surround her death, their failure to realise a faithful comprehension of the events indicates a societal amnesia. That is to say, the failure to recognise Mel as a martyr, a figure of self-sacrifice, could be read as a commentary on the omission of female self-sacrifice within canonical Irish history. This also aligns with Frawley's 'memory crux' as she notes that trauma oscillates between the extremes of erasure (forgetting, silence) and omnipotence – the inability to forget (Frawley, 2014: 6).

Yet, the representations of women in the novel are not so straightforwardly progressive towards a consciousness of the important role women played in the legacy of hunger striking. This becomes particularly prevalent in the part of the novel set in the 1980s. For example, in the wake of the death of a hunger striker, it is noted that 'women across the North had taken to the streets with dustbin lids, crashing them down on the tarmac, cymbals of protest' (Dowd, 2015: 206). Although brief reference is made to the hunger strikes of suffragists (2015: 299), this is largely the only direct action women take in any form of protest within the novel. This, unfortunately, continues the misrepresentation of women in the hunger-strike movement – and throughout the troubles more generally – as merely reacting to male action as opposed to being autonomous protesters themselves, with their own agency. Furthermore, the use of dustbin lids within *Bog Child* confines women to passive protest, confined within preconfigured domestic spaces. Although this scene is historically accurate, it omits the more radical purpose for which dustbin lids were employed: to actively aid paramilitary agents by 'sending up a great gnashing din […] alerting the rebels that a [British] raid was underway' nearby (Radden-Keefe, 2019: 42). Such action illustrates an autonomous reclamation of domesticity in order to actively participate in paramilitary operations. Women were not passive bystanders in the troubles, but active participants, even when confined within domestic spheres. Moreover, Aretxaga provides a further example of how women were able to reappropriate domesticity in service of the republican cause. Following a curfew in Belfast, 1970, violently enforced by the British military, 3000 women marched through Belfast carrying placards that read 'British army worse than the Black and Tans, women and child beaters' (*Irish News*, cited in Aretxaga, 1997: 58) – the Black and Tans being a British mercenary force,

notorious for extreme and unprovoked brutality, sent to fight against the Irish in the Irish War for Independence. Aretxaga notes that the invocation of the brutal Black and Tan forces 'posed a powerful and odious force (Black and Tans) against a powerless people (women), thereby underscoring the shamefulness of the army's actions and delegitimizing its authority' (1997: 58). So, although credit is due women for their comparable efforts of hunger striking, so too should we recognise that not only did Irish women combat and challenge their regular portrayal 'as victims of a violent conflict over which they had little control' (1997: 9) by directly intervening and participating in it, but they were also savvy enough to understand how to use that portrayal effectively to undermine British occupation in a similar way that male hunger strikers are credited with employing the optics and legacy of the famine that Britain inflicted on Ireland through their hunger strike.

It is regrettable to see, then, women be further stripped of their autonomy in *Bog Child*. In the novel, the decision to take Joe off his hunger strike by putting him on a drip after he goes into a coma – although instigated by the matriarch – is ultimately made by the family patriarch (Dowd, 2015: 293–94). In actuality, it was the decision of a hunger striker's mother to put a striker on a drip, leading to others doing the same for their loved ones, that would ultimately lead to the end of the second hunger strike in Long Kesh (Howard, 2006: 77). Although he ultimately makes the decision to intervene, Fergus's father is initially vehemently against it: 'You'd interfere with everything Joe's done, everything he's done for his country, everything he's tried to achieve by this amazing, courageous sacrifice' (Dowd, 2015: 284). Thus, in his reluctance to save Joe, there is a recognition of the political implications of doing so. If '[the] aim of the hunger strike was to crank up the moral pressure on the British government by a series of drawn-out, highly [publicised] deaths' (Howard, 2006: 78), a hunger striker surviving without a concession from the government was in some ways a failure of the purpose and aims of the hunger strike.

However, there is a far more insidious implication here that unites male and female hunger strikers. The forced feeding of female hunger strikers in the 1970s and early twentieth century highlights 'the [intersection] of [the] patriarchy and medical discipline […] that [pathologise] and 'treat' the protesting female body' (Whalen, 2019: 97). The forced feeding of women and the saving of men by drip – insofar as a drip is, in this context, essentially a form of force feeding coded as medical action – represents the intersection of state control and the medical discipline.[5] If '[a hunger striker's] object is to bring the pressure of public opinion to bear upon

an unjust aggressor to […] advance a cause for which he might face the certainty of death in the field' (Gannon, 1920: 450), but the state does not allow them to make the ultimate sacrifice, it is possible that the full force of public opinion is ultimately mitigated, whether the hunger striker is male or female. While admittedly, in the latter case, the act of force feeding via drip is instigated by the next of kin, this ultimately provides state actors plausible deniability of state interference.

There is also another way in which to read this, and one that is far less cynical, and through which the family matriarch regains autonomy lost in *Bog Child*'s historical inaccuracy. In *Bog Child*, Dowd challenges the default righteousness of sacrifice that is the legacy of hunger strikes (Sweeney, 1993: 435–36). Instead she raises, through Mel's voice, a vision of Ireland's violent history as the product of '*old grudges leapfrogging over generations, reappearing in different forms*' (Dowd, 2015: 312; emphasis original). In realising the futility of Mel's self-sacrifice – that the troubles are an extension of the conflict which Mel tried to end – Fergus comes to understand that, even if Joe were to die, '*the British will still own the North. The bombs will still go off*' (Dowd, 2015: 294; emphasis original). This conclusion was already reached by one character in the novel: Fergus's mother. Through the voice of Fergus's mother, Dowd challenges the status of strikers as secular saints (Sweeney, 1993: 425): 'Sacrifice is what Jesus did. He saved us all. Who did Bobby Sands save?' (Dowd, 2015: 32). On the one hand, this resignation to the futility of self-sacrifice in the face of imperial oppression might be seen as a white-washing of the institutional violence of the British; but on the other, it seems also to be a critique of that affliction of the Irish: self-sacrifice. Such resignation does not delegitimise the struggle of the protesters, but rather laments the living cost of such a protest, and Fergus's mother consistently voices a compassionate opposition to the hunger strike, the success of which is counterintuitively measured in lost lives.

Bog Child ultimately invites the reader to question who in Ireland is driving the conflict and paying the price. To return to the disillusioned British soldier who Fergus befriends, Owain: as a Welshman, he had a choice between '[the] army or the mines' (Dowd, 2015: 129). Owain finds himself trapped between two protests of the 1980s. Had he not joined the army and ended up in the mines, he would have found himself participating in a strike of his own later that decade. The novel emphasises the economic violence employed by Margaret Thatcher's neoliberal agenda and, in so doing, clearly situates the conflicts and violence within British

neo-imperialist rule which mirrors older British imperial rule over Ireland. However, *Bog Child* asserts that it should not be the oppressed who pay the price, however idealistic this may be.

Through the narrative of Joe and his participation in the hunger strike in Long Kesh prison, *Bog Child* raises questions of an ethical nature around such a method of protest. What is critically different about *Bog Child*'s oppositions to such a strategy is that they are divorceable from a religious ethos. While hunger strikes have been conflated with suicide – and thus argued to be a moral sin against God – republican members of the clergy, such as P. J. Gannon, have argued contrary to this. Dowd's discourse, however, lies not in the ethics of religion, but in the unquestionable sanctity of life. This cleaving of the question of the hunger strike's morality from its context of 'religio-political martyrdom' (Sweeney, 1993: 421) leaves room for a more compassionate view. While it perhaps underestimates the insidiousness of imperialism, it ultimately inspires search for an alternative mode of protest that does not leave a divided nation, so full already of grief and violence, with more left to reconcile.

Further, in its paralleling of ancient and contemporary self-sacrifice, *Bog Child* illustrates the toxic effect memory cruxes have on cultural memory, especially when those memory cruxes are rooted in trauma. Not only do memory cruxes reinforce the cyclical recurrence of the trauma and its violence – in this instance, variances of hunger – but they also lead to the erasure of history. The latter effect is visible in the typically male archetype of the hunger striker and erasure of female autonomy in the history of the troubles. Although it is perhaps all too idealistic, *Bog Child* does offer a salve for the ills of memory cruxes: breaking the cycle. Mel's irruption/eruption and subsequent haunting of Fergus inspires him to realise that the cyclicality of violence creates stasis, immobility, a 'magic frieze' (Dowd, 2015: 5). Instead then, the decision to save Joe brings with it the promise of possibility, the chance for the cyclicality to end. Instead of the same thing reappearing in a different form, something new will emerge, a future, rather than being anchored to the past, forced to spiral outwards endlessly from the same trauma.

Notes

[1] Although I do not reference it – or develop any comparative analysis to it – because I did not find the parallels to be explicit or significant enough to distract from my main discourse, it is well worth noting that Seamus Heaney's collection of poetry *North* (2001) also takes as its main metaphor the bog bodies unearthed in north-east Europe.

[2] That Ireland was once a colony of Britain should not be in dispute. However, as Begoña Aretxaga has observed, 'the status of Ireland as postcolonial nation is anomalous [...] compounded by the fact that Ireland is not only the oldest British colony but also an undeniably European country' (1997: 15). Moreover, Northern Ireland is 'both the unaltered "other" of Britain and the suppressed internal "other" of Ireland' (1997: 15). Special care should be paid when considering the (post-)colonial status of Ireland, with necessary nuancing to its unique situation.

[3] The harvesting of, and overreliance on, potatoes by the native Irish population itself was instigated by 'Oliver Cromwell's orders [to] the Commonwealth Army to destroy Irish agriculture' (Patel and Moore, 2018: 239). As potatoes grow underground and remain hidden, they were a perfect agricultural subterfuge against Cromwell's forces. Truly, then, the Great Famine is all the more traumatic for its cause originating simultaneously in the failure of Irish resilience to the British and Britain's continued violent exploitation of Ireland.

[4] It is interesting to note that Patrick Pearse, an instigator of the Easter Rising Rebellion, considered 'bloodshed a "*cleansing*" thing' (Pearse, cited in Radden-Keefe, 2019: 11; emphasis mine), language which mirrors that of pre-eminent post-colonial thinker, Frantz Fanon, who famously said '[at] the level of individuals, violence is a *cleansing* force' (1963: 94; emphasis mine).

[5] While I aim here to draw a parallel between male and female hunger strikers, it is important to understand the gendered differentiation maintained even in this commonality, namely that the act of forced feeding is, by its nature, inherently more violent than a drip, meaning state reaction to protesting bodies remains undeniably gendered, and especially more violently so towards female bodies.

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Glossary

Easter Rising: also known as the Easter Rebellion, was an armed insurrection in Ireland during Easter Week in April 1916 against British rule, and was defeated by a British military response. However, it signalled the start of the Irish republican revolution and the move towards the independence of the Republic of Ireland.

Gaelic: Referent to the prehistoric culture and society of Ireland. In broader terms, especially linguistic contexts, it can be referent to both Ireland and Scotland, but in this paper its use refers only to Irish Gaelic society.

Hunger strike: A means of protest by which an individual starves themselves, to death if necessary, in order to draw attention to their cause and extract concessions from their opposition.

Republican: Not to be confused with the American Republican Party, Irish republicanism is the political movement championing a united Ireland, under a single republic. Republicanism is opposed by the Unionist movement which advocates for Northern Ireland's place within the

United Kingdom. Neither are necessarily militant political movements, but both have militant factions.

Taig: A derogatory term for a Catholic and/or Irish Nationalist (Republican).

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Effects of Anthropogenic Climate Change on the Occurrence of Supercellular Tornadoes in the USA

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Abstract

The United States of America (USA) experiences the most tornadoes of any nation in the world, with these extreme weather events causing many deaths and billions of dollars of damage each year. With the recent warming of the climate due to human activity, it is likely that the occurrence of USA tornadoes will be affected. However, exactly how the spatial and temporal distribution of tornadoes in the USA will be affected by climate change is still an area of active research. The trends in the literature show that as the climate has warmed, there has been an observed clustering of USA tornadoes onto fewer, more active tornado days, as well as an eastward movement of the average centre of USA tornado activity. This review shows that these observed changes could be explained by shifts in environmental parameters related to tornado formation due to anthropogenic climate change. This research will allow for better tornado preparedness and prediction in tornado-affected areas as the climate warms. Future research may focus on more precisely modelling the impacts of global warming on USA tornado occurrence by using higher-resolution climate models.

Keywords: USA tornado climatology; temporal clustering of USA tornadoes; spatial redistribution of USA tornadoes; Tornado Alley; supercell formation

Introduction

A **tornado** is a violently rotating column of air, originating from a thunderstorm, that makes contact with the ground (Guo *et al.*, 2016), with supercellular tornadoes being the most powerful and destructive type. This type of tornado originates from a special type of thunderstorm, known as a **supercell**, that is characterised by a strong, rotating column of air in the middle of the storm, called a **mesocyclone** (Glickman, 2000).

The USA is particularly vulnerable to extremely strong and destructive tornadoes due to its geographical location being ideal for the formation of powerfully rotating supercells. The flat

central plains of the USA allow for warm, moist air from the Gulf of Mexico to be overlain by cooler, dryer continental air from higher elevations to the west, causing temperatures to decrease rapidly with height (Schultz *et al.*, 2014). This strong vertical temperature gradient results in a high **convective available potential energy (CAPE)**, which is a measure of how likely air is to rise and form a thunderstorm, with higher CAPE values generally resulting in stronger storms (Brooks *et al.*, 2014). Additionally, at the mid-latitudes where the USA is located, there is a large change in wind speed with altitude called '**wind shear**', which is essential for generating the rotating mesocyclone that characterises supercells. This combination of high CAPE and high wind shear in the Great Plains of the central USA makes the area well suited to generating powerful tornadoes. Strong tornadoes also occur in the south-eastern USA, outside of the Great Plains, where they tend to form from high wind shear, low-CAPE supercells; these remain poorly understood in the literature (Wade and Parker, 2021).

The USA experiences the most tornadoes of any nation in the world (Guo *et al.*, 2016), with tornadoes resulting in an average of 110 deaths and billions of dollars of damage each year (Tippett and Cohen, 2016). Moreover, **anthropogenic** climate change has been found to be affecting key factors in tornado and supercell formation, such as wind shear and CAPE (Diffenbaugh *et al.*, 2013). Due to the destructive nature of tornadoes, it is imperative that we understand if and how tornado formation in the USA will be affected by climate change in order to mitigate the risk posed to lives and infrastructure by these extreme weather events.

Therefore, the aim of this literature review is to understand how anthropogenic climate change may be affecting the formation patterns of tornadoes within the contiguous USA. It seeks to consolidate the findings of recent research about the changes in the temporal and spatial distribution of tornado formation in the USA since the 1950s and uncover the overarching trends in recent USA tornado climatology. It will also analyse recent research to uncover possible mechanisms for how anthropogenic climate change could be causing the observed changes in the tornado record.

Changes in the frequency of USA tornadoes

In the USA, the National Weather Service's Storm Prediction Centre maintains a database that contains information about the location and time of every recorded tornado in the USA that has occurred since 1954 (Schaefer and Edwards, 1999). This database has been used to analyse

the annual count of **tornado days** in the USA, which are defined as any day when at least one tornado has formed in the entire USA. This is essentially a measure of the number of days per year when there are suitable conditions for tornado formation to occur. It has been found that, since 1954, there has been a significant downwards trend in the annual number of tornado days in the USA (Brooks *et al.*, 2014; Elsner *et al.*, 2015; Moore, 2017a; Moore, 2017b). In particular, Brooks *et al.* (2014) found that the average annual number of tornado days has decreased by 33 per cent, from 150 in the 1950s to 100 in the 2010s.

This trend implies that the number of days in the USA with conditions suitable for **tornadogenesis** (i.e. tornado formation) has decreased over the past half-century, possibly in response to anthropogenic global warming. This potential link is supported by the fact that the decreasing trend in tornado days began in the early 1980s (Elsner *et al.*, 2015), which corresponds with a period of increasing average temperatures in the USA from 1984 onwards (Agee *et al.*, 2016) (Figure 1).

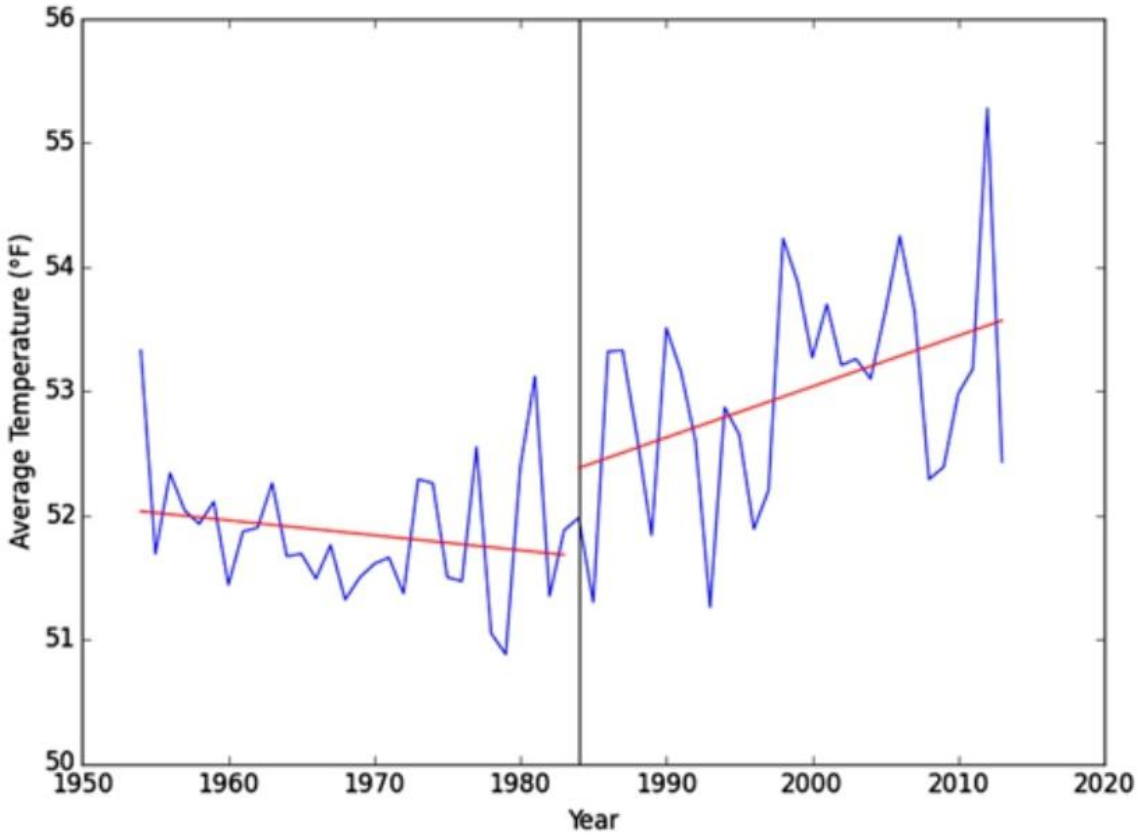

Figure 1: Average annual temperatures in the continental USA from 1954 to 2013 split into a 'cold' period (1954–1983) and a 'warm' period (1984–2013) (Agee *et al.*, 2016). © American Meteorological Society. Used with permission.

Furthermore, it can be seen that the average number of tornadoes per tornado day has noticeably increased since 1974 (Brooks *et al.*, 2014; Elsner *et al.*, 2015; Moore, 2017a; Moore, 2017b). Moore (2017a) found that this overall increase was primarily due to a statistically significant increase in the number of tornado days with 30+ tornadoes, with a corresponding decrease in tornado days with 1–10 tornadoes per day in the USA from 1974 to 2014. These concurrent trends have caused the mean number of tornadoes per tornado day to have increased from 3.75 from 1975 to 1980 to 5.46 from 2010 to 2014 (Moore, 2017a).

These findings indicate that, since the 1970s, tornadoes in the USA have been tending to cluster together on fewer tornado days, with each tornado day producing more tornadoes on average. This implies that as the climate in the USA has been warming due to anthropogenic climate change, the total number of days with favourable weather conditions for tornadoes has decreased. However, days when suitable conditions do occur have tended to produce larger and more severe **tornado outbreaks**.

Changes in the spatial distribution of tornadoes in the USA

Traditionally, the centre of tornado formation in the USA has been centred on the Great Plains in the central USA in an area known as **Tornado Alley** (Schultz *et al.*, 2014), which contains parts of South Dakota, Nebraska, Oklahoma, Kansas and Texas (Doswell *et al.*, 2012).

To investigate how a warming climate may be affecting this distribution of tornadoes, Agee *et al.* (2016) split the modern tornado record into a 'cold' period (1954–1983) and a 'warm' period (1984–2013) based on the average temperature trends of the USA during these periods (Figure 1). By dividing the eastern USA into 2.5°x2.5° grid boxes and comparing the tornado count in each grid box across both periods, the authors found that the area of maximum tornado activity in the USA has shifted eastwards from the traditional tornado centre of Oklahoma during the 'cold' period to Mississippi, Alabama, Louisiana and Tennessee in the south-eastern USA during the 'warm' period (Figure 2).

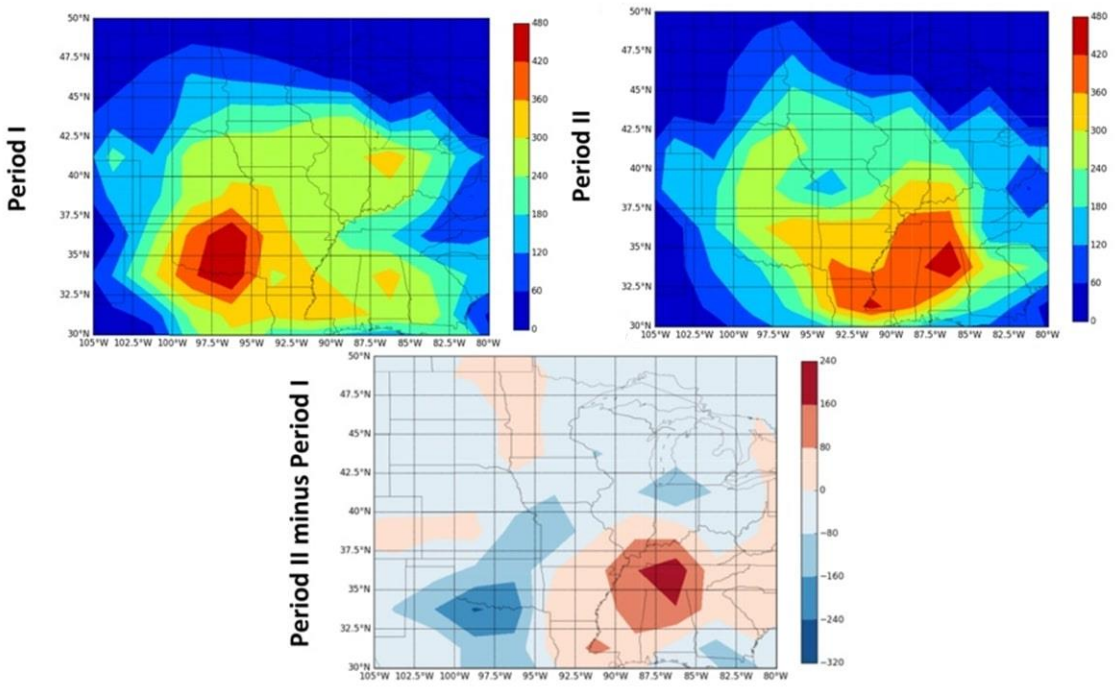

Figure 2: Map of tornado counts for the eastern USA for Period I (1954–1983), Period II (1984–2013) and Period II minus Period I (modified from Agee *et al.*, 2016). © American Meteorological Society. Used with permission.

Similar results have been obtained by Gensini and Brooks (2018) by calculating the annual maximum significant tornado parameter (STP) in 1°x1° boxes across the eastern USA and calculating how much it has changed for each box from 1979 to 2017. The STP is a predictor of how likely a tornado is to form in an area based on various environmental conditions such as wind shear, CAPE and **storm-relative helicity (SRH**; i.e. the strength of a supercell's mesocyclone). A statistically significant decrease in STP was found in Tornado Alley, with a corresponding increase in STP to the east around Mississippi, Louisiana, Alabama, Tennessee, Arkansas, Kentucky, Missouri, Illinois and Indiana.

These findings imply that, since 1979, the area where tornado-favourable conditions occur in the USA has shifted to the east, away from Tornado Alley, supporting the observed eastward shift in tornado reports found by Agee *et al.* (2016) and Moore (2017a). Moreover, the period 1979–2017 corresponds with the period of warming temperatures in the USA identified by Agee *et al.* (2016) from 1984 to 2013, which implies that anthropogenic global warming may be a factor in this shift in tornado activity.

Moore (2017a) has proposed that this eastward movement may be due to the significant increase in days with 50+ tornadoes in the USA since 1974, which are more likely to occur to the east of Tornado Alley. These larger tornado outbreaks occurring to the east of Tornado Alley may be related to the increase in annual maximum STP in the east, identified by Gensini and Brooks (2018), that would make tornado outbreaks more likely to occur in this region.

Challenges in obtaining accurate tornado records for analysis

It has been suggested by some researchers that some or all of these trends in tornado climatology could be explained by changes in tornado reporting practices, rather than changes in environmental conditions (Kunkel *et al.*, 2013; Brooks *et al.*, 2014).

These ideas may have some credence, as moderately detailed and accurate tornado records in the USA have only been available since the 1950s. Moreover, the introduction of **Doppler radar** in the 1990s, which can detect tornadoes remotely, caused a large artificial increase in tornado counts as a large number of weak tornadoes began to be detected that previously went unnoticed (Potvin *et al.*, 2018). Even with this improved technology, Potvin and colleagues estimate that only 45 per cent of tornadoes in the USA from 1975 to 2016 have been reported due to the large number of tornadoes occurring in rural areas.

Because of this short period of accurate tornado data, the incompleteness of the data and the large change in tornado reporting methods with the introduction of Doppler radar, it is difficult to determine whether the aforementioned trends in tornado climatology have been caused by climate change or changes in tornado reporting.

To try and minimise the impact of these changes in reporting, most literature on USA tornado climatology has only considered tornadoes that are ranked stronger than (E)F1 on the **(enhanced) Fujita scale** in their analysis. This scale is a measure of tornado power based on the measured wind speed and damage done by the tornado, with (E)F0 tornadoes being the weakest and (E)F5 tornadoes being the strongest (Marshall *et al.*, 2004). Since the 1950s, (E)F0 tornado reports have increased by 14–16 reports per year, while tornadoes rated stronger than (E)F1 have seen no significant increase over the same period (Tippett 2014) (Figure 3).

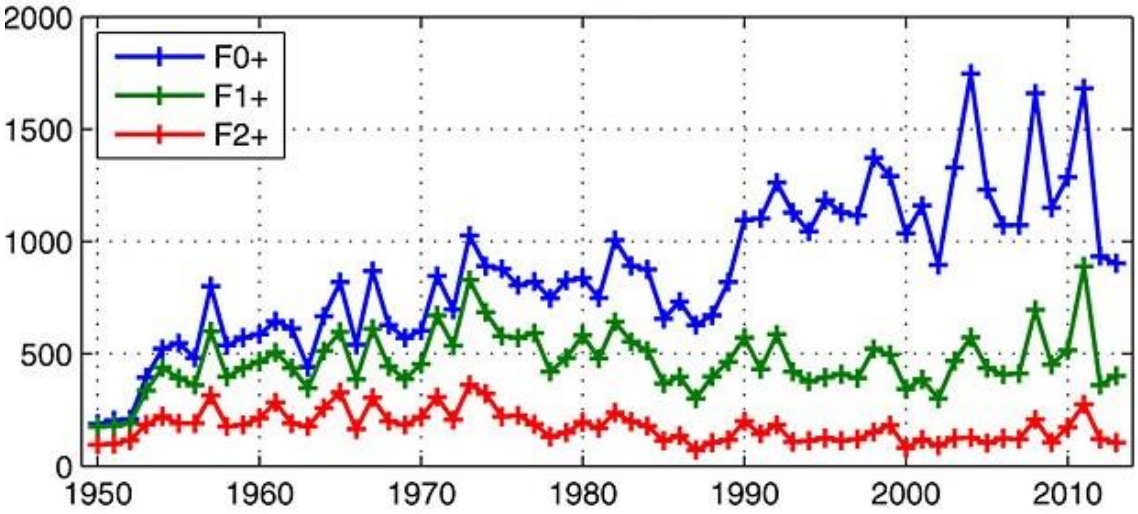

Figure 3: Annual USA tornado count for all tornadoes (blue), F1+ tornadoes (green) and F2+ tornadoes. Modified from Tippett (2014).

However, as the majority of tornadoes are rated as (E)F0s, excluding them from the data is not an ideal solution, as it biases the models towards trends in the formation of stronger tornadoes, which may not be representative of overall USA tornado climatology.

To try and overcome these limitations in reported tornado data, Tippett *et al.* (2012; 2014) developed a model called the **tornado environment index (TEI)** that predicts the number of tornadoes in a given timeframe based on average monthly rainfall from thunderstorms and average monthly SRH, which have both been more accurately recorded than annual tornado counts. Applying the TEI to USA climate data from 1979 to 2013, Tippett (2014) found that it accurately modelled changes in tornado activity from year to year, including the observed increase in USA tornado variability (Brooks *et al.*, 2014; Elsner *et al.*, 2015; Guo *et al.*, 2016; Tippett and Cohen, 2016), as seen in Figure 4.

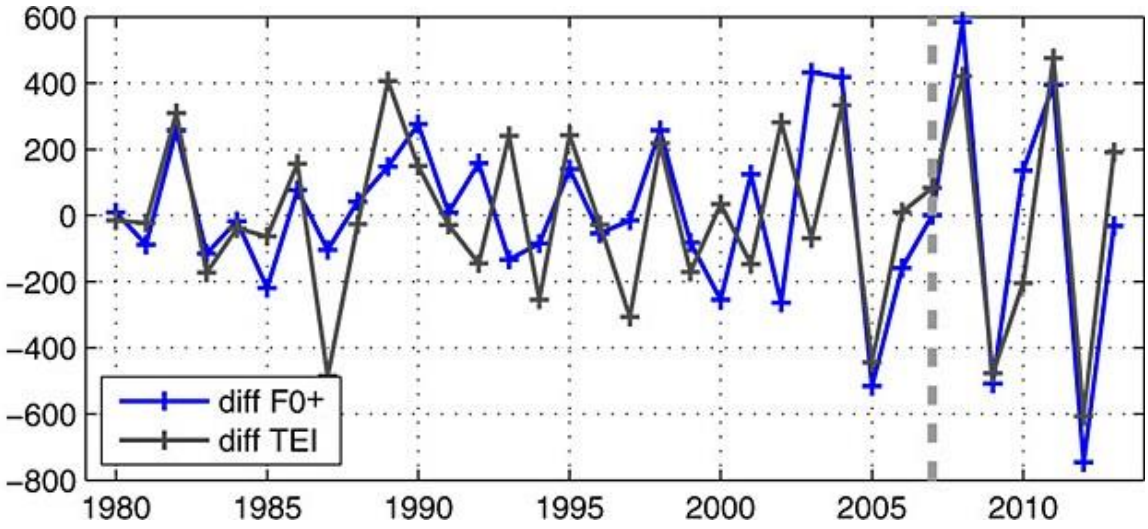

Figure 4: Year-to-year differences in the reported number of tornadoes in the USA (blue) and the predicted difference using the TEI (black). Modified from Tippett (2014).

As the TEI is based on accurately measured environmental parameters – rather than the problematic tornado record – this supports the idea that the observed changes in tornado reports are due to changes in the climate rather than changes in recording practices.

Mechanisms for how a warming climate is affecting USA tornado frequency

Due to our current incomplete understanding of how exactly tornadoes form during supercell events, it is very difficult to model how anthropogenic climate change will affect tornado formation directly. However, a good indication of how USA tornado climatology will change can be found by modelling how factors such as wind shear and CAPE –known to affect tornadogenesis – will change in a warming climate.

The current consensus in the literature is that a warming climate will cause an increase in days in the USA with favourable combinations of CAPE and wind shear for producing severe storms, and possibly tornadoes (Diffenbaugh *et al.*, 2013; Gensini and Mote, 2015; Seeley and Romps, 2015; Tippett *et al.*, 2015). This would suggest that the annual number of tornado days in the USA should be increasing with a warming climate instead of the observed decrease. However, CAPE and wind shear are not the only variables affecting storm formation, as **convective inhibition (CIN)** – which is how difficult it is for air to rise and form a storm – has also been predicted to increase with a warming climate (Tippett *et al.*, 2016). Higher CIN values mean

that it is harder for convection to initiate, so fewer storms form in a higher CIN environment, which could be counteracting the predicted increase in thunderstorm activity.

This idea is supported by the findings of Trapp and Hoogewind (2016), who simulated three historical tornado outbreaks in a climate model with climate conditions from the 1990s, and with predicted climate conditions in the 2090s in a business-as-usual global warming model. It was discovered that, compared to the 1990s simulation, many supercells in the 2090s simulation failed to initiate due to the increased CIN in a warmer climate. However, when supercells did manage to overcome the increased CIN, they were found to have stronger vertical **updrafts** and stronger rotation due to the increased CAPE in the 2090s, which is conducive to the formation of larger tornado outbreaks. This implies that in a warmer climate, the number of supercells that form will decrease overall due to increased CIN; however, when they do form, they will be more powerful and more likely to produce multiple tornadoes due to the increased CAPE.

This predicted trend in storm frequencies is notably similar to the observed trend in USA tornado frequencies, where the total number of tornado days has decreased, while the number of tornadoes per tornado day has increased (Brooks *et al.*, 2014; Elsner *et al.*, 2015; Moore, 2017a; Moore, 2017b). As a result, it is likely that increasing values of CAPE and CIN in a warming climate are the climatological mechanism behind the observed changes in USA tornado frequency.

Mechanisms for the observed change in USA spatial tornado distribution

Multiple studies have used climate models to map how the distribution of CAPE and wind shear will change across the USA due to anthropogenic climate change (Diffenbaugh *et al.*, 2013; Gensini and Mote, 2015; Seeley and Romps, 2015). It was found by Gensini and Mote (2015) that in the 1990s, the area with the highest frequency of days with favourable CAPE and wind shear for supercell formation in the USA during storm season (spring) was eastern Oklahoma, western Arkansas and south-western Missouri, which corresponds well with the area of maximum tornado activity in the period 1954–1983 identified by Agee *et al.* (2016). In the 2080s, this area of favourable conditions is predicted to expand eastwards to cover all of Arkansas and Louisiana, as well as parts of Texas, Mississippi and Missouri.

The eastward expansion of this region of favourable supercell conditions in a warming climate is predicted to cause a 27 per cent increase in future severe weather events, such as tornadoes, in the Mississippi, Ohio and Tennessee River valleys (Gensini and Mote, 2015), which lie to the east of Tornado Alley. This correlates well with the observed eastwards shift of the centre of USA tornado formation (Agee *et al.*, 2016; Moore, 2017a), and suggests that an expansion of areas with favourable CAPE and wind shear conditions in the USA due to anthropogenic climate change is likely the mechanism behind the observed eastwards shift in USA tornado activity.

Conclusion

In conclusion, anthropogenic climate change is most likely affecting the occurrence of USA tornadoes in two main ways. Firstly, it is causing USA tornadoes to cluster together into less frequent but more active tornado days. A possible mechanism for this is that a warming climate increases CAPE, which increases supercell severity, as well as CIN, which decreases supercell frequency. This would cause supercells to form less often, but to be more severe – and thus produce larger tornado outbreaks – when they do occur.

Secondly, climate change is causing the mean centre of tornado activity in the USA to move eastwards, away from Tornado Alley. This is likely due to global warming causing an eastwards expansion of the area where favourable CAPE and wind shear conditions for supercell formation occur in the USA. As a result, more severe supercells, and therefore tornadoes, are forming to the east of Tornado Alley, causing the mean centre of tornado activity to move east.

As the proposed climatological mechanisms behind these trends in tornado climatology are predicted to become more pronounced with future climate change, it is likely that the observed changes in USA tornado climatology will continue for the foreseeable future as average global temperatures increase.

The trends identified in this report are a good starting point in our understanding of the relationship between USA tornadoes and anthropogenic climate change. However, due to the aforementioned limitations of the tornado database, our limited understanding of tornadogenesis, and the limited resolution of climate models, it is impossible to definitively say whether these observed changes in USA tornado climatology are being caused by anthropogenic climate change, or are due to a longer-term natural climate variability. To

obtain a definitive answer, more research needs to be done in this area using higher-resolution climate modelling and a better understanding of tornadogenesis.

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Glossary

Anthropogenic: Something caused by human activity.

Convective available potential energy (CAPE): The amount of work done by the buoyant force on a parcel of air rising through the atmosphere. Positive CAPE will cause the air parcel to rise, and vice versa.

Convective inhibition (CIN): The amount of energy required by an air parcel to overcome its negative buoyancy and rise away from the ground.

Doppler radar: A type of radar that uses the Doppler Effect to measure the velocity of objects. It is commonly used to measure wind speeds and precipitation in thunderstorms.

Enhanced Fujita Scale: An updated version of the **Fujita scale**, introduced in the USA in 2007.

Fujita scale: A scale for rating the strength of a tornado based on measured wind speed and observed damage done by the tornado. The weakest tornadoes are F0s; the strongest are F5s.

Mesocyclone: A strong, rotating updraft in a supercell.

Significant tornado parameter (STP): A predictor of how likely a tornado is to form in a given area based on environmental conditions including wind shear, CAPE and SRH.

Storm-relative helicity (SRH): A measure of the potential for the formation of a rotating updraft (i.e. a mesocyclone) in a thunderstorm.

Supercell: A type of thunderstorm characterised by a strong, rotating column of air in the middle of the storm known as a mesocyclone.

Tornado: A violently rotating column of air, originating from a thunderstorm, that makes contact with the ground.

Tornado Alley: An area in the Great Plains of the USA that experiences the most frequent tornadoes in the USA.

Tornado day: Any day when at least one tornado forms somewhere in a given geographical area (e.g., the contiguous USA).

Tornado environment index (TEI): A function of SRH and monthly rainfall from thunderstorms that predicts the number of tornadoes that will form in a given timeframe.

Tornadogenesis: The process by which a tornado is formed.

Tornado outbreak: The occurrence of multiple tornadoes spawned from the same weather system. Generally, at least six to ten tornadoes must form for it to be classified as an outbreak.

Updraft: A current of rising air within a thunderstorm.

Wind shear: Change in wind speed over a given distance in the atmosphere.

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From Cathartic 'Brain Tingles' to Scratching Chalkboard Sensations: An Exploratory Study Investigating the Phenomenological Aspects of ASMR

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Abstract

ASMR is a sensory-perceptual experience in which specific audio-visual or haptic stimuli reliably trigger electro-static-like 'brain tingles' extending peripherally from the back of the scalp. While generally an under-studied phenomenon, research is beginning to identify potential therapeutic benefits of immersing in ASMR-content, supported by anecdotal accounts from active online communities. The present mixed-methods online study aimed to explore the phenomenological aspects of ASMR and its potential therapeutic effects. A total of 224 participants watched ASMR-videos and completed scales measuring ASMR response and affect. Participants then completed four open-ended questions about their ASMR experience and use. In line with our hypotheses, quantitative results suggested that participants who experienced ASMR demonstrated significantly higher positive affect and significantly lower negative affect compared to those who did not (or were unsure about whether they did) experience ASMR. The pleasurability and intensity of ASMR also positively correlated with measures of positive affect, and negatively with measures of negative affect. Thematic analysis identified great phenomenological variability in perceived pleasurability and intensity of ASMR experience among individuals as a super-theme present across themes (Psychological, Physical and Social dimensions). Based on these findings, a multi-dimensional model for characterising ASMR is proposed, providing clear opportunities for future research.

Keywords: ASMR, autonomous sensory meridian response, misophonia, human sensory-perceptual experience, theoretical development grounded in data, multi-dimensional model, social connectedness in ASMR

Introduction

Imagine seeing a sharp knife cutting into a colourful piece of soap. Once the knife goes through, little pieces of soap fall onto a white surface, which produces an intriguing and oddly satisfying sound. You might start to feel tingles originating from the back of your scalp, down your spine to other areas of your body. The phenomenon you have just imagined is defined in the literature as **Autonomous Sensory Meridian Response (ASMR)**. The tongue-twisting term of ASMR can be described as a sensory-perceptual phenomenon in which specific audio-visual or haptic stimuli reliably trigger electro-static-like tingles that originate at the back of the scalp and extend to peripheral areas of the body (Barratt and Davis, 2015; Barratt *et al.*, 2017). The physical aspect of these 'tingles' is considered involuntary, although there seems to be psychological autonomy over the intensity and duration of the response (e.g. choosing to immerse in ASMR-content and experience), which often promotes changes in **affect**[i] (Poerio *et al.*, 2018). Following anecdotal ASMR-manifestations by self-claimed 'ASMRtists' (content creators; e.g. Creative Calm ASMR) and active user-communities, growing research interest is directed towards the origins and implications of this under-studied and even mysterious phenomenon. The focus of the present mixed-methods study is to bring insight into the phenomenological aspects and applications of ASMR.

Commonly reported reasons for use indicate that ASMR-content is used to relax (86–98 per cent), sleep (41–82 per cent), cope with stress (70 per cent) and reduce anxiety (11 per cent) (Barratt and Davis, 2015: 5; Lochte *et al.*, 2018: 302). ASMR often contains 'person-centric triggers' in socially intimate content or 'non-person-centric triggers' that are more abstract in nature and object-focused (e.g. crisp sounds, repetitive and slow task completions) (Barratt *et al.*, 2017; Fredborg *et al.*, 2018). One of the few studies so far investigating ASMR suggests that both the use and experience of ASMR vary greatly among individuals (McErlean and Banissy, 2018), although some studies suggest that the effect of ASMR is stronger when receiving personal attention and care (Lochte *et al.*, 2018; Smith *et al.*, 2019). Brain-imaging ASMR studies, such as Lochte *et al.* (2018), have associated activity in the brain during ASMR with brain areas related to social cognition that become active during caring behaviour (e.g. being soothed by a parent). This resembles grooming behaviour in animals (Colonnello *et al.*, 2016) and has been tied to the socially intimate nature of ASMR-content (Barratt *et al.*, 2017; Poerio *et al.*, 2018), suggesting that ASMR could simulate naturally occurring caring behaviour and

thus promote neuroprotective aspects of positive social interactions (Colonnello *et al.*, 2016; Lochte *et al.*, 2018; Poerio *et al.*, 2018).

First studies into potential therapeutic implications of ASMR suggest that immersing[ii] in ASMR-content can have relaxing and calming effects (Fredborg *et al.*, 2018; Poerio *et al.*, 2018). For instance, immersing in ASMR-content has been shown to provide short-term relief from anxiety (Ditchburn and Bedwell, 2018), stress, depression and chronic pain for up to three hours after viewing content (Barratt and Davis, 2015). Notably, ASMR has been reported to provide relief of symptoms and promote subjective wellbeing even when other therapeutic approaches (such as medical interventions) have been ineffective (Barratt and Davis, 2015). In addition to psychological affect (e.g. feeling calm), effects of ASMR have been observed through physiological affect: ASMR-tingles have led to higher skin conductance and decreased heart rate (Poerio *et al.*, 2018).

At the other end of these pleasure-producing triggers is misophonia – a contrasting sensory-perceptual experience in which common ASMR-triggers such as mouth sounds (e.g. chewing) can produce severe disgust and irritation (Bernstein *et al.*, 2013; Schröder *et al.*, 2013). However, some reports suggest that 49 per cent of those who experience misophonia also experience ASMR (Rouw and Erfanian, 2018). Some suggest that the prevalence of misophonia is even higher in those who experience ASMR (ASMR-experiencers) (McErlean and Banissy, 2018), which has led some to hypothesise that these contrasting sensory experiences could reflect opposite ends of a spectrum (Barratt and Davis, 2015: 13). Additionally, given the heterogeneous nature of the phenomenon, suggestions of defining ASMR on dimensional terms to represent the broad range of individual responses to ASMR-stimuli have begun to emerge in the literature (e.g. Hostler *et al.*, 2019; McErlean and Banissy, 2018; Roberts *et al.*, 2019). Taken together, these empirical findings support the existence and distinction of ASMR as a unique sensory experience that should be further investigated to understand and define its expansive phenomenology.

The present study

As ASMR is an under-studied phenomenon, there are several unanswered questions relating to the subject. Given the heterogeneous nature of the phenomenon, variability in anecdotal ASMR experiences (McErlean and Banissy, 2018) and the aforementioned hypothetical suggestions for a spectrum-based view of ASMR (Barratt and Davis, 2015), the existing

dichotomous distinction between ASMR-experiencers and non-ASMR-experiencers (those who do not experience ASMR) seems inadequate. To explore the range of individual experiences associated with ASMR, then, a mixed-methods design was deemed as appropriate to gain more in-depth insights into this expansive phenomenon.

The current online study investigates the potential therapeutic implications utilising quantitative and qualitative measures in a sequential explanatory method (Creswell, 2011). Multiple factors are taken into consideration to build and strengthen a systematic foundation for ASMR research. We investigate potential therapeutic implications of immersing in ASMR-videos using measures of affect and ASMR experience. Based on prior findings, we expect to find higher positive affect and lower negative affect among those who experience ASMR compared to those who do not or are unsure of their experience (Hypothesis 1). We also expect to find a relationship between ratings of ASMR (pleasurability/intensity) and affect (Hypothesis 2). Furthermore, we conduct a **thematic analysis** (Braun and Clarke, 2006) to gain understanding of the phenomenological aspects of ASMR experience and use. Our qualitative analysis is guided by the research question: *How do participants describe the experience of immersing in ASMR?* Thus, the current study is novel in its use of mixed methods to provide insights into the phenomenology of ASMR.

Methods

Participants

In total, 231 volunteers participated, of which 9 were excluded due to incomplete consent forms, leaving a sample of 222 (68 males; 1 prefer not to say). The sample consisted of undergraduate students of the University of Aberdeen (UoA) and volunteers from online communities (M_{age}= 24,95, SD= 8,63). Participants for this online study were recruited through opportunity sampling via social media channels (e.g. Reddit, Facebook, Instagram) and the participant recruitment programme of UoA (SONA) between December 2019 and February 2020. Participants recruited via SONA were compensated 1 SONA credit for their time, whereas participants recruited via social media channels volunteered their time. Due to the exploratory nature of the study and sampling method used, a priori power analysis to calculate an ideal sample size would have been speculative at best and therefore was not conducted.

Procedure and materials

Ethical approval was obtained from the University of Aberdeen School of Psychology ethics committee, and the study was conducted in accordance with the BPS Code of Human Research Ethics (British Psychological Society, 2014). The online survey was administered using Snap Surveys Webhost. Internal consistency in the present study was measured with Cronbach's alpha for each questionnaire. After providing informed consent, participants completed the following questionnaires in the order presented:

The multi-affect indicator (Warr *et al.*, 2014)

An edited form of the Multi-Affect Indicator (MAI) was administered before (baseline) and after ASMR-videos. Similar to Poerio *et al.* (2018), we added a measure of social connectedness, given that social connectedness has been proposed to be linked to ASMR in previous literature (e.g. Lochte *et al.*, 2018). Thus, the MAI was used to measure affect and social connectedness. The MAI includes 12 items assessing pleasure and arousal – two dimensions of core affect. Participants were asked to rate their level of affect ('Please *indicate how you feel now compared to before you watched the videos*', e.g. connected with others, excited, dejected; See Appendix A for the full scale) on a Likert scale from 1 (*much less*) to 7 (*much more*). The MAI subscale scores were based on four categories of items, with three items describing each particular affect within each category. The four categories were: Calm: Low activation of pleasant affect (calm, relaxed, at ease; α=.94); Excited: High activation of pleasant affect (enthusiastic, joyful, excited; α=.79); Stress: High activation of unpleasant affect (anxious, nervous, tense; α=.91); Sadness: Low activation of unpleasant affect (depressed, dejected, hopeless; α=.88).

The ASMR checklist (Fredborg *et al.*, 2017):

A modified version of the ASMR checklist was included in the study in two parts (before and after immersing in ASMR-videos) to measure participants' perceived pleasure, intensity and duration of ASMR, ASMR-triggers and use of ASMR. The original version includes 16 ASMR-triggers, but only the ones present in video clips used in the current study were included (i.e. whispering, soft-spoken voice, tapping sounds, scratching sounds, squeezing sounds, soap cutting; see below for description). In the ASMR checklist, intensity and duration of each stimulus were rated on a seven-point Likert scale ranging from '*0 No tingles*' to '*6 Most intense ASMR*'. An option '*Unsure*' was offered for individuals who could not identify the

onset or duration of the tingles, which was important since the sample was expected to entail both experienced ASMR-users as well as ASMR-novices. In addition, overall pleasurability of ASMR experience was rated on a five-point Likert scale ranging from '*1 Quite uncomfortable*' to '*5 Quite pleasurable*'. ASMR-groups in the study were formed based on responses (Yes, No, Unsure) in the ASMR checklist. Following the questions of ASMR-triggers, participants were asked about their use of ASMR-content (e.g. for sleep or to aid relaxing). Participants were also asked to indicate whether they experienced misophonia to distinguish between those sensory phenomena similar to previous literature (Del Campo and Kehle, 2016) (See Appendix A). Internal consistency for the edited version of the ASMR checklist administered in the current study was adequate for the entire scale (α=.74), for intensity ratings (α=.84) and for duration (α=.89).

Video clips

Participants were asked to watch two short ASMR-videos to provide examples of ASMR-eliciting content and common ASMR-triggers. Videos were chosen based on their representability of different ASMR-triggers (Barratt *et al.*, 2017) and popularity (based on number of views) on YouTube (see Appendix B). The original videos sourced from YouTube were edited into two short video clips: non-person-centric (1:40 min) and person-centric (3:00 min) using iMovie v.10.1.13 (Apple, 2019) to provide examples of ASMR-eliciting stimuli. The timeline requirements were enforced in the duration of the videos to prevent participant dropout and loss of data. Video 1 contained 'person-centric' triggers (i.e. personal attention) through a woman speaking softly and whispering. A video with a female 'ASMRtist' was chosen to represent the majority of ASMR-content being produced by females (Iossifidis, 2017). Video 2 contained various non-person-centric triggers such as scratching, tapping, squeezing and soap cutting. Participants were instructed to wear headphones to fully experience the audio content of the videos. They were also instructed to focus on the intensity and onset of tingles while watching the videos.

Open-ended questions

To explore how participants describe the experience of using ASMR, participants were asked four open-ended questions:

1. Have you seen any of the videos before? If yes, please indicate which one(s) below.

2. Describe the experience of watching an ASMR video.
3. If you use ASMR, why? (e.g. sleep, relax, meditation, etc.)
4. Why do you think you experienced or did not experience ASMR?

Design and analysis

This online study employed an exploratory design utilising both quantitative and qualitative measures. The mixed-methods design of the present study was conducted in a sequential explanatory method, meaning that the qualitative measures were employed to support quantitative findings (Creswell, 2011). Between-subjects and correlational analyses were conducted to analyse the quantitative data, and a thematic analysis was performed to explore the qualitative dataset. We chose a bivariate **correlation** to investigate and represent the heterogeneous and complex nature of ASMR. This method was chosen based on previous findings (e.g. Poerio *et al.* 2018).

Thematic analysis

A thematic analysis (TA) was conducted to explore the qualitative research question. TA was chosen as it is not attached to any pre-existing theoretical framework. Therefore, it is a flexible tool that can be used from several different methodological standpoints, which makes it useful for mixed-method designs (Creswell, 2011). The TA was conducted via the realist method as reported experiences of participants were considered to represent their reality (i.e. true experience). Moreover, we drew on insights from grounded theory, which allowed a systematic yet flexible manner for constructing theory grounded in the data through substantive analysis of the dataset (Strauss and Corbin, 1994). This method is often utilised when little is known about the phenomenon (Chun Tie *et al.*, 2019), which makes it appropriate for the current study.

Qualitative data from four open-ended questions were analysed according to Braun and Clarke's guidelines (2006). The steps were as follows: (1) We[iii] familiarised ourselves with the data by reading and re-reading the data multiple times throughout several weeks and noting down initial ideas and preliminary codes. (2) Initial codes were created manually based on identified ideas. Each code was assigned a colour, which were used to systematically highlight

and collate data relevant to each code across the entire dataset. (3) All data relevant was collated under each code under potential themes and sub-themes. (4) Potential themes were revisited and contrasted to collated code extracts (Level 1), and thematic maps of the analysis were created (Level 2) (see Appendix C). (5) Themes were defined and discussed in research group meetings, after which themes were refined. After following these steps, themes were revisited to ensure coherence with other themes and in relation to the whole dataset. (6) Extracts were selected from the dataset to provide illustration of the themes identified during the analysis. During the selection, we related back to the analysis conducted in relation to the research question and study aim to ensure that the extracts chosen were representative. Existing literature was revisited after TA to connect identified constructs with current knowledge.

Results

Multiple data analyses were conducted to explore the phenomenological aspects of ASMR and its potential therapeutic implications. The order of the results presented in this section follows the order of the hypotheses and research question of the present study. Means and Standard Deviations of scales are presented in Table 1.

	ASMR Yes (n= 106)	ASMR No (n= 36, n_calm= 37)	ASMR Unsure (n= 79)
Calm	11.67 (2.43)	8.41 (4.26)	10.68 (3.09)
Excited	9.73 (1.41)	8.55 (3.05)	9.57 (1.89)
Stress	7.43 (2.62)	9.87 (3.75)	8.04 (2.95)
Sadness	7.74 (2.42)	8.41 (2.65)	8.00 (2.19)
Connectedness	4.21 (.86)	4.06 (1.31)	4.09 (.79)

Table 1: Mean Multi-Affect Indicator (MAI) scores (Standard Deviations in parentheses).

Notes: *n* refers to sample size. Participants were allocated into self-assigned ASMR-groups (Yes, No, Unsure) based on their responses in the ASMR checklist.

Therapeutic implications of ASMR

To investigate our hypotheses concerning the therapeutic implications of ASMR, we conducted a correlation between ASMR dimensions (Pleasure and Intensity) and affect (MAI), as well as one-way ANOVAs to compare the differences in affect between ASMR-groups.

ASMR pleasurability and intensity

We explored the relationship between ASMR-pleasure (ASMR-(P)) and ASMR-intensity (ASMR-(I)) (or, together, (ASMR-P/I)) ratings and affect measures. As Table 2 shows, multiple significant correlations were found. These findings suggest that higher reported ASMR-(P/I) correlates with higher positive affect (Calm and Excited) and lower negative affect (Stress and Sadness) and lower ASMR-(P/I) ratings with higher negative affect (Stress and Sadness) and lower positive affect (Calm and Excited). Social connectedness was positively correlated with ASMR-I as well as positive affect, and negatively correlated with negative affect. There was no significant correlation with ASMR-P and social connectedness. The strengths of the correlations are presented based on criteria outlined by Evans (1996): very weak (.00–.19); weak (.20–.39); moderate (.40–.59).

	Calm	Sadness	Stress	Excited	Connectedness	ASMR-P	ASMR-I
Calm	1	-.44***	-.77***	.65**	.357**	.59***	.33***
N	222	221	221	221	222	218	221
Sadness		1	64***	-.31***	-.338**	-.23***	-.21**
N		221	221	221	221	217	221
Stress			1	-.46***	-.249**	-.50***	-.25***
N			221	221	221	217	221
Excited				1	.621**	.37***	.25***

N				221	221	217	221
Connectedness					1	.112	.189**
					221	217	221
ASMR-P						1	.32***
N						218	217
ASMR-I							1
N							221

Table 2: Correlations between Multi-Affect Indicator sub-scales and ASMR-pleasure dimension of ASMR checklist.

Notes: ASMR-P refers to ASMR-pleasure dimension of the ASMR checklist. ASMR-I refers to mean score of rated intensity of ASMR-triggers of the ASMR checklist.

*Significant at p <.05, ** Significant at p <.01, *** Significant at p <.001 (two-tailed)

Positive affect

A one-way ANOVA was conducted to explore differences in Calm-subscale scores (from the Multi-Affect Inventory) between self-assigned ASMR-groups signifying the experience of ASMR (Yes, No, Unsure). As Figure 1 shows, there was a significant difference between groups ($F(2219) = 17.686$, $p = .001$). Post hoc analyses (**Bonferroni correction**) revealed that the Yes-group scored significantly higher in the Calm-subscale compared to the No-group ($p < .001$). The No-group also scored significantly lower than the Unsure-group ($p < .001$). The Yes-group scored higher in Calm-subscale than the Unsure-group, but the difference was not statistically significant, although approaching **significance** ($p = .072$). As Figure 1 shows, there was a significant difference between ASMR-groups in the Excited-subscale ($F(2218) = 5.631$, $p = .004$). Post hoc analyses (Bonferroni) revealed that the Yes-group scored significantly higher in the Excited-subscale compared to the No-group ($p = .003$). The No-group also scored significantly lower in excitement than the Unsure-group ($p = .02$). There was no statistically significant difference in levels of social connectedness among ASMR-groups.

Negative affect

To explore differences between groups in negative affect of ASMR, a one-way ANOVA was conducted. As Figure 1 shows, we found a significant difference between groups ($F(2218)= 9.993$, $p<.001$). Post hoc analyses (Bonferroni) revealed higher reported stress in the No-group compared to the Yes-group ($p<.001$) and the Unsure-group ($p=.005$). There was no significant difference between groups in sadness-ratings.

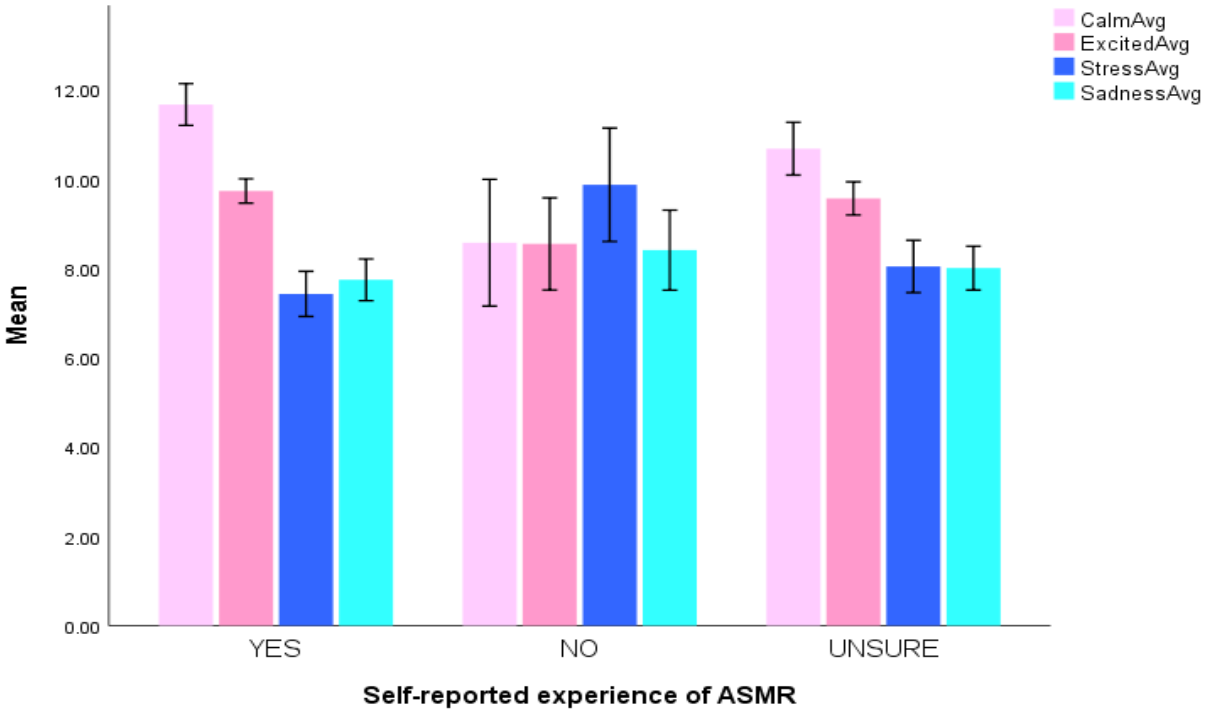

Figure 1: Summary of means under each subscale of MAI (Calm, Excited, Stress and Sadness) based on self-assigned groups of ASMR experience (Yes, No and Unsure groups).

Thematic analysis

A TA was conducted on the full qualitative dataset from the four open-ended survey questions. As detailed below, 'pleasure versus intensity' was identified as a super-theme that was prominent across all of the themes presented. Under the broad 'super-theme', three themes were identified:

1. Psychological dimension, defined as changes in psychological state resulting from immersing in ASMR-content (i.e. psychological affect)

2. Physical dimension, defined as the extent of 'tingles' (i.e. physiological affect)

3. Social dimension, describing perceived interpersonal intimacy of ASMR (i.e. social affect).

An outline of the main themes and sub-themes is presented in Table 3, with example extracts from the full TA provided in Appendix C.

'Pleasure versus intensity' super-theme

While conducting the TA, a great division of responses at the opposite ends of both of ASMR-pleasure and -intensity spectrums were identified. That is, a key finding in our analysis was the clear variability in participants' descriptions of both the intensity and the pleasurability of ASMR. Thus, while participants described the experience of ASMR in Psychological, Physical and Social dimensions, 'pleasure versus intensity' was identified as a super-theme that was prominent across all of the themes presented. The presence of this super-theme is marked with * within themes in Table 3.

Themes	Sub-themes		Example
Psychological dimension		1	'It's a very immersive, relaxing experience, helps a lot with anxiety, stress and insomnia.'*
		2	'uncomfortable: It's like a scratching chalkboard sensation, just without direct pain to my ears.'*
		3	'I think the best word I could think of is "weird"; it's pleasant and unpleasant at the same time.'*
		4	'Relaxing/concentrating while doing other computer tasks, headache relief, help with anxiety.'
	Misophonia	5	'I don't think it's possible to experience an ASMR response because my misophonia gets triggered.'
		6	'I'm autistic + misophonia – ASMR things help me stim + cope with other distressing sounds.'
Physical dimension		7	'Mainly for relaxation, but it's very important that I experience "the tingles" and goosebumps.'*
		8	'I cannot find myself getting tingles, however listening to ASMR can help me calm down.'*
		9	'It is relaxing and cathartic to experience "tingles". It's like scratching an itch.'*

		10	'Strong tingling on scalp, in ears, at top of spine, overstimulating, uncomfortable, almost painful.'*
		11	'Mildly unnerving; however, I had the asmr response which made it a lot more enjoyable.'*
		12	'As if there's something vibrating in my chest and warmly spreading out (sorta [sic] mindfulness?)'
Social dimension	Intimacy	13	'Makes you feel less alone, gives a calming presence'.*
		14	'I feel like someone is interfering with my personal space and being to close to me in general.'*
		15	When someone stares into your soul, it can be quite scary but it's also nice when they address you.'*
	Connectedness	16	'The voices feel very close up and provide a human connection I otherwise don't have.'
		17	'I expect it is in our nature to be calmed by sounds reminiscent of a mother calming her child.'
		18	'I have problems falling asleep alone, so especially personal attention ASMR helps me sleep.'

Table 3: Summary of findings of the main themes (Psychological, Physical and Social dimensions) and sub-themes under each theme with illustrative quotes. The themes were constructed in the thematic analysis of the qualitative data drawing from grounded theory.

Psychological dimension

In the psychological dimension, descriptions of responses to ASMR-videos ranged from extreme intense psychological pleasure (Example 1*) to an extremely intense unpleasurable experience (Example 2*), leaving the rest of participants somewhere in between (Example 3*). As shown in Table 3, misophonia was identified as a sub-theme of the psychological dimension. We found misophonia to be prominent in the dataset, as indicated through either direct descriptions of the term 'misophonia' or stark descriptions of psychological discomfort. Some participants appeared to perceive misophonia and ASMR to exclude each other (Example 5), while others reported seeking aid to distressing sounds from ASMR (Example 6). It was interpreted that these constructs provided further insight into a broad range in perceived pleasurability and intensity of responses to ASMR-content.

Physical dimension

The physical dimension related to an experience of 'tingles'. This physical experience was described in relation to psychological benefits (Example 7*), although some participants reported experiencing psychological benefits without inducing tingles (Example 8*). This suggests that, while often co-occurring, the physical and psychological dimensions can also be considered as being separate. Similar to the psychological dimension, descriptions in the physical dimension varied in the pleasurability and intensity of the physical 'tingling' from extreme pleasurability and intensity (Example 9*) to extreme unpleasurable and intense experience (Example 10*), leaving some participants somewhere in between (Examples 11* and 12*).

Social dimension

Analysis of the data suggests that responses to ASMR-content extend beyond the individual's internal physical or psychological state – to a sense of connectedness and intimacy with others. Some responses suggested a variability in the pleasurability and intensity of perceived intimacy of ASMR experience, ranging from pleasurable associations with social intimacy (Example 13*) to intense unpleasurable experiences (Example 14*). Some participants appeared to have mixed feelings about the pleasurability and intensity of the social intimacy in ASMR-content (Example 15*). The socially intimate nature of ASMR-stimuli promoting feelings of social connectedness was also interpreted from the data (Example 16). The potential of ASMR-stimuli in simulating parental caring behaviour was described (Example 17) and social aspects of ASMR were also identified as a reported purpose for using ASMR (Example 18).

Discussion

The aim of this mixed-methods study was to provide insights into the phenomenological aspects of ASMR and its potential therapeutic implications. Given the explorative nature of the study, multiple analyses were conducted to gain insight into the phenomenon. Hypothesis 1 was supported since there were significant differences in positive and negative affect between participants who reported experiencing ASMR and those who did not. Hypothesis 2 was also supported, as we found significant correlations between affect and ASMR (Pleasure/Intensity). Moreover, through TA of open-ended responses, we also aimed to gather

more in-depth insights from individuals in the phenomenology of ASMR. Our identified themes provided insights into the phenomenological aspects of this expansive phenomenon, suggesting that responses to ASMR-videos extend beyond the level of 'tingles' elicited – with participants describing distinct experiences of intensity and pleasurability in physical, psychological and social dimensions associated with ASMR.

Our findings, in line with prior studies (e.g. Poerio *et al.*, 2018), suggest that participants who experience ASMR reported significantly higher positive affect in both Calm- and Excited-subscales compared with non-ASMR-experiencers, with those unsure of whether they experience ASMR scoring in between (significantly lower than ASMR-experiencers and higher than non-ASMR-experiencers). When it comes to negative affect, the situation was reversed, as non-ASMR-experiencers showed significantly higher stress than ASMR-experiencers and the Unsure-group. These results suggest that reported physiological experience of ASMR could impact psychological affect following from immersing in ASMR-content. This observation was supported by our correlational findings: As shown in Table 2, there were significant positive correlations (weak/moderate) with both ASMR pleasurability and intensity, and positive affect as well as significant negative correlations (weak/moderate) with ASMR-(P/I) and negative affect. Additionally, the positive relationship between deactivating (Calm) and activating (Excited) sub-scales of positive affect reflects the emotionally complex and heterogeneous nature of ASMR (Poerio *et al.*, 2018). Together, these findings suggest that not only the experience of ASMR but also perceived pleasurability and intensity of that experience could impact psychological affect when immersing in ASMR-content. When considering the limitations of the present study, it is to be noted that in the ASMR checklist, participants were advised to focus on the *onset* and *intensity* of tingles, which could present a potential for expectancy effects for participants regarding their response to ASMR-content (Cash *et al.*, 2018). In future studies, adding control stimulus could be beneficial to help control for expectancy effects.

In relation to the phenomenology of ASMR, it was clear that participants described different responses to ASMR-content, both in our quantitative analyses and from our qualitative analysis. That is, through TA, we identified a great variability in the pleasurability and intensity of ASMR, as some participants appeared to perceive ASMR as an extremely intense and pleasurable experience, whereas some reported having an extremely intense yet very unpleasurable experience. Some reported having a mild, yet pleasurable experience, and

others reported low intensity as unpleasurable (see Table 3). These interpretations are consistent with a prior mixed-methods study that also identified a broad range of individual experiences through content analysis (Roberts *et al.*, 2019).

The interpreted variability in individual phenomenological experience both in Pleasure and Intensity of ASMR was identified as a super-theme in our analysis, suggesting that instead of a dichotomous uni-dimensional distinction between ASMR-experiencers and non-ASMR-experiencers, a multi-dimensional view could better represent the broad range of responses. These findings, therefore, led us to develop a new model of ASMR, which uniquely captures the clear spectrums of ASMR-pleasure and ASMR-intensity (see Figure 2). As shown in our model, these (P/I)-spectrums were present across the three dimensions of wellbeing: Psychological, Physical and Social. These dimensions were characterised as distinct yet interconnected. That is, the perceived intensity and pleasurability of the psychological affect *could* be associated with intensity and pleasurability of physiological experience, but not necessarily – which was apparent in individual reports of the current study (see Table 3). The presence of misophonia and variability among misophonia-experiencers in the TA not only provided support for prior speculations of a spectrum-based view of ASMR (Barratt and Davis, 2015; McErlean and Banissy, 2018), but also in the multi-dimensional intensity–pleasure spectrums highlighted in the current study.

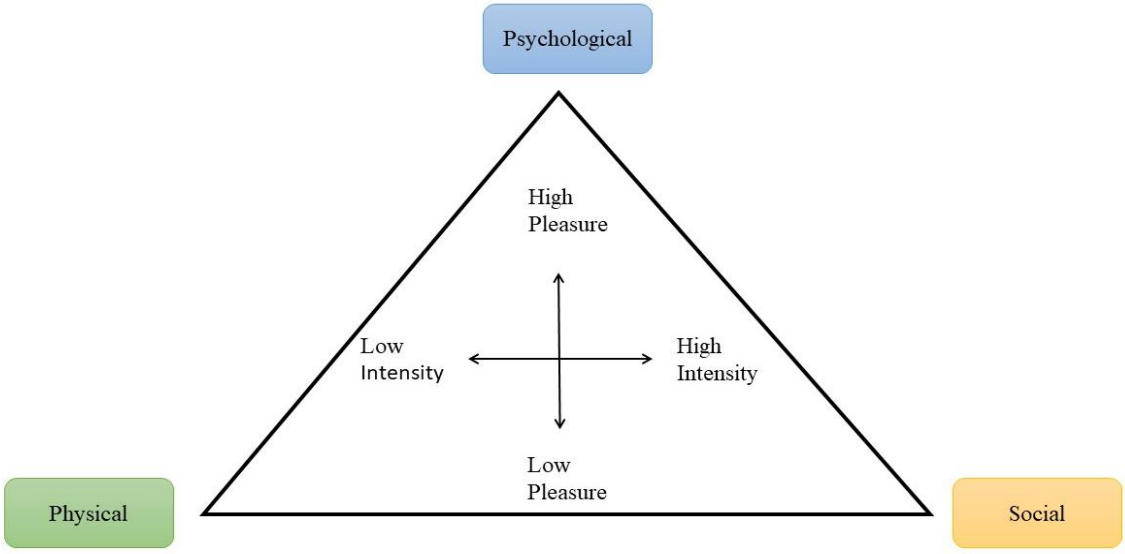

Figure 2: Multi-dimensional model of ASMR. The model was developed based on thematic analysis of open-ended survey responses.

One particularly novel finding of the current research is the addition of a social dimension of ASMR. Indeed, while the role of social intimacy in the hypothesised therapeutic associations of ASMR has been speculated in the literature, it has yet to be integrated with other dimensions in ASMR research. The association of social connectedness with affect and intensity of reported ASMR experience in the present study supports prior findings of the social aspects of ASMR (e.g. Lochte *et al.*, 2018). Furthermore, drawing from reported experiences of social intimacy in the current study, our multi-dimensional model takes into account the perceived pleasurability and intensity of social intimacy in ASMR-content. The aforementioned potential simulation of natural caring behaviour of ASMR-content could ultimately be considered a motivating factor for immersing in the experience to relieve stress, depression, anxiety and pain (Barratt and Davis, 2015; Ditchburn and Bedwell, 2018; Garro, 2017; Turtiainen, 2019). In the future, therefore, incorporating potential therapeutic benefits of social affect (e.g. social connectedness) with psychological and physiological affect in ASMR research could provide insight into the foundation of the phenomenon and assist in creating therapeutic applications of ASMR. Further insights into the social dimension and potential therapeutics implications of ASMR could especially benefit in understanding individual experiences in which physiological 'tingles' are not reported, but changes in psychological affect are perceived (See Table 3) – especially since no significant difference was observed in reported connectedness between ASMR-groups (Yes, No, Unsure). Additionally, investigating the role of various ASMR-triggers in mediating social connectedness could provide further insight into ASMR-content and its therapeutic applications.

While this multi-dimensional conceptualisation of ASMR is novel considering the predominantly dichotomised uni-dimensional definition (based on physiological response) in the literature (e.g. Poerio *et al.*, 2018; Smith *et al.*, 2019), our model is consistent with multi-dimensional approaches measuring other affective states. For example, in the Valence–Arousal model (Posner *et al.*, 2005; Russell, 1980), dimensions of emotion are measured through the Valence-continuum (pleasant–unpleasant) and the Arousal-continuum (low–high intensity), and this has been applied to measure the emotion of awe (e.g. Chirico *et al.*, 2017; Stern, 2017). Since ASMR is associated with changes in affect, support for a multi-dimensional categorisation of ASMR also stems from the biopsychosocial model of health (Engel, 1977) that defines wellbeing through interaction of psychological, social and biological processes (Suls and Rothman, 2004).

In relation to ASMR, some ASMR-pioneers have begun to suggest a more dimensional conceptualisation of the phenomenon that would take into consideration the a) degree of intensity varying from mild to extreme, b) extent and location of tingles and c) degree of emotional response (affect) (Hostler *et al.*, 2019). Furthermore, a newly developed scale for ASMR (ASMR-15) has a dimensional approach measuring altered state of consciousness, relaxation, affect and sensation (Roberts, 2019). Therefore, our multi-dimensional model provides a basis for understanding the complexity of the ASMR experience that is not only grounded in the data, but also develops insights from wider literature in this ever-expanding field. Applying this multi-dimensional model both in quantitative scale development as well as multi-modal ASMR research could allow us to better understand and characterise this under-studied phenomenon and, in addition, bring more insight into the full spectrum of human sensory-perceptual experiences and their relationship with wellbeing.

Conclusion

In conclusion, the present mixed-methods study provided insights into the phenomenological aspects of ASMR. Our results suggest that perceived pleasurability and intensity of ASMR are associated with psychological affect that often results from immersing in ASMR. Moreover, our analysis of participants' descriptions of their ASMR-immersion clearly highlighted a need to reconceptualise ASMR. To this end, our multi-dimensional model of ASMR represents the individual phenomenological variability in perceived pleasurability and intensity of ASMR across Psychological, Physical and Social dimensions of wellbeing. We propose that, going forwards, this model can be applied to ASMR research to provide a basis to more accurately assess the multi-modal complexity of this expansive phenomenon and great variability of individual experiences across identified dimensions.

Acknowledgements

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Appendices

Appendix A: Questionnaires

The multi-affect indicator (Warr, Bindl, Parker and Inceoglu, 2014)

Please indicate how you feel at the moment using this scale.

Little			Neutral			Much
1	2	3	4	5	6	7

CIRCLE one

connected with others	1	2	3	4	5	6	7
joyful	1	2	3	4	5	6	7
tense	1	2	3	4	5	6	7
relaxed	1	2	3	4	5	6	7
dejected	1	2	3	4	5	6	7
hopeless	1	2	3	4	5	6	7
enthusiastic	1	2	3	4	5	6	7
anxious	1	2	3	4	5	6	7
calm	1	2	3	4	5	6	7
depressed	1	2	3	4	5	6	7
excited	1	2	3	4	5	6	7
at ease	1	2	3	4	5	6	7
nervous	1	2	3	4	5	6	7

The ASMR checklist (Modified for the purpose of this study: shorter than original) (Fredborg *et al.*, 2017)

Are you familiar with ASMR? (YES, NO)

Do you experience ASMR response? (YES, NO, UNSURE)

Do you use videos or audio files designed to elicit ASMR response? (YES, NO)

How often do you use ASMR-videos or audio files to help you go to sleep? (Never, Less than Once a Month, 2–3 times a Month, 2–3 times a Week, Daily)

How often do you use ASMR-videos of audio files to help you relax (but not sleep)? (Never, Less than Once a Month, 2–3 times a Month, 2–3 times a Week, Daily)

Misophonia is a strong negative emotional trigger to certain sounds. Triggers for misophonia typically include non-verbal sounds made by the mouth, such as chewing and crunching. Do you experience misophonia? (YES, NO, UNSURE)

Next, you will be asked to watch these 2 short videos and answer a few questions regarding your experience. These two examples are intended to provide an example of ASMR-videos, however you can also draw on your own experiences with videos, as appropriate.

Based on these videos and your other experiences with ASMR, Please evaluate whether or not the following common stimuli trigger your ASMR and, if so, how intense the ASMR experience is on average when engaging with those stimuli. Also, after perceiving a triggering stimulus, please estimate approximately how long it would take for this stimulus to cause tingles.

Intensity scale (higher numbers represent increasing intensity)

No Tingles		Moderately Intense			Most Intense ASMR Experience		Unknown
0	2	3	4	5	6	7	

Stimulus	Intensity (please circle the appropriate number according to the scale above or select 'Unknown')	How many seconds after its onset do you feel tingles? (please circle one or select 'Unknown')
Whispering	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown
Soft-spoken voice	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown
Tapping sounds	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown
Scratching sounds	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown
Squeezing sounds	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown
Soap cutting	0 1 2 3 4 5 6 Unknown	0–10 31–40 11–20 41–50 21–30 51–60 Greater than 60 Unknown

Questions about ASMR

Are your experiences more intense when the stimulation is directed *towards you* (e.g. someone whispering to you)?

Y / N / Unsure

Is your ASMR experience more intense when you observe someone performing an action to/for themselves (e.g. applying their own makeup) rather than when you observe someone acting upon another person (e.g. applying makeup to someone else)?

Y / N / Unsure

Have you ever experienced 'chills' from beautiful music?

Y / N / Cannot Recall

If so, does the ASMR feeling differ getting chills from beautiful music?

Y / N / Cannot Recall

On average, how pleasurable is an ASMR experience?

a) Quite Uncomfortable
b) Mildly Uncomfortable
c) Neutral
d) Mildly pleasurable
e) Quite pleasurable

What is the earliest age you can recall having an ASMR experience? (For example, if you remember first having an ASMR experience at the age of four, please choose '4'). In this question, a 'first ASMR experience' refers to the first time that you noticed you were experiencing ASMR-related tingles, even if at the time you did not know what they were called. If you aren't sure, make your best guess.

Ad hoc qualitative questionnaire

Finally, we are interested in hearing your thoughts about the experiment in more depth. Please reflect on your emotions and thoughts during the experiment when you answer the following questions.

1. Have you seen any of the videos before? If yes, please indicate which one(s) below.
2. Describe the experience of watching an ASMR video.
3. If you use ASMR, why? (e.g. Sleep, relax, meditation, etc.)
4. Why do you think you experienced, or did not experience ASMR?

Appendix B: Videos

Edited videos presented in the study:

ASMR female voice:

https://www.youtube.com/watch?v=4Ea7g8sixuY

ASMR mix:

https://www.youtube.com/watch?v=x-VRnYg9ZBk

Next, you will be asked to watch these 2 short videos and answer a few questions regarding your experience.

Next, you will be asked to watch these 2 short videos and answer a few questions regarding your experience. These two examples are intended to provide an example of ASMR videos, however you can also draw on your own experiences with videos, as appropriate.
Based on these videos and your other experiences with ASMR, Please evaluate whether or not the following common stimuli trigger your ASMR and, if so, how intense the ASMR experience is on average when engaging with those stimuli. Also, after perceiving a triggering stimulus, please estimate approximately how long it would take for this stimulus to cause tingles.

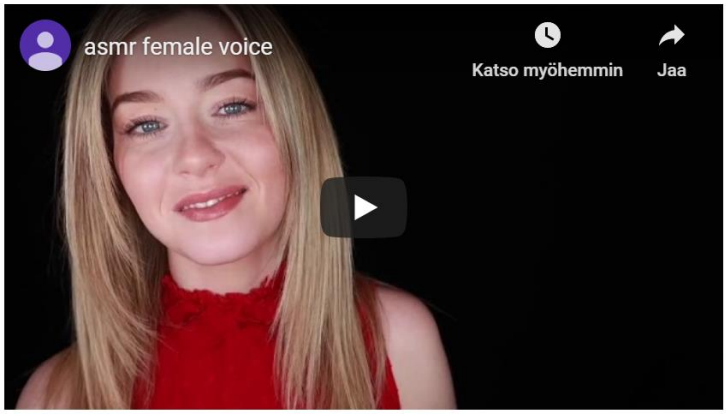

Figure 3: Instructions given to participants before watching ASMR-eliciting videos and screenshot of the first video that contained interpersonal ASMR-triggers.

Appendix C: Thematic analysis

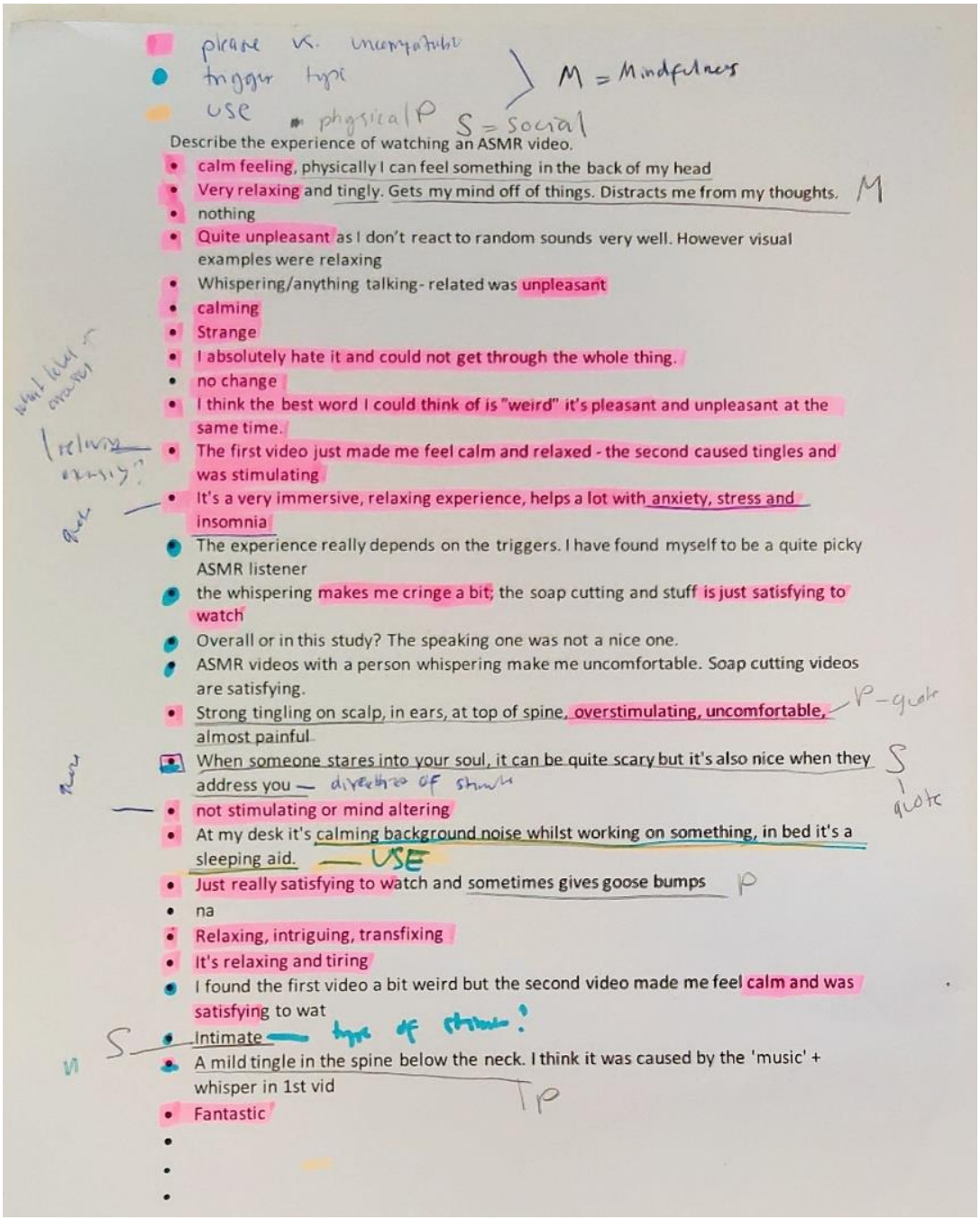

Figure 4: An example of Stage 2 of the thematic analysis. Initial codes were assigned a colour/symbol that were systematically used to collate data points under each code.

Notes

[i] Affect is a construct (e.g. psychological) that varies along continuums in three dimensions: Arousal, Valence and Motivation (Harmon-Jones *et al.*, 2013).

[ii] The verb 'immerse' was used in the present study to describe the act of intentionally exposing oneself to ASMR-eliciting stimuli (e.g. ASMR video) to represent the multi-sensory (visual, auditory, haptic) nature of the phenomenon.

[iii] The themes presented in the present study are based on analysis led by the main researcher in this study (the first author). As detailed, in (5), codes and themes were discussed at length among the co-authors, with additional refinement through discussion with an individual external to this research study.

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Glossary

Affect: A construct (e.g., psychological) that varies along continuums in three dimensions: Arousal, Valence and Motivation.

Autonomous Sensory Meridian Response (ASMR): A "tingling" sensory-perceptual experience in response to audio-visual or haptic stimuli.

Bonferroni correction: A multiple comparison correction that is used when several dependent or independent statistical tests are performed simultaneously

Correlation: A statistic measuring the degree to which two variables move in relation to one another.

Statistical significance: A statistical method examining the null hypothesis in which it is hypothesised that the results are due to chance alone.

Thematic Analysis (TA): A flexible data analysis approach for identifying 'themes' in the qualitative data set.

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