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Prior, not primed: the influence of belief on the social transmission of ritual

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Acknowledgements

Abstract

This research combines ethnographic and experimental research to explore the influence of belief on the transmission fidelity of ritual content. The experiment, a transmission chain study, involved presenting participants with a video and audio recording of a ritual which they were to recreate. Recordings were coded using propositional analysis and a novel, 'kinetographic analysis' coding framework was developed for the coding of the action-based content. The data were then analysed using Bayesian models to explore the influence of belief on the fidelity of transmission of content, and other parametric and non-parametric statistical tests to explore the influence of belief on the longevity of transmission of the core ritual content, as well as the influence of cross-modal semiotic consonance on the transmission of two points of content, as a proxy measure to explore the influence of causal opacity on the memorability of ritualised actions. The results of these analyses indicated that self-reported belief, but not primed belief, did have a positive influence on the transmission fidelity of verbal ritual content. Ethnographic research was conducted with a group of Pagans in North-East England to situate and extend the findings of the experimental research. I attended three rituals as part of this research, which demonstrated other mechanisms which work in conjunction with belief to increase the fidelity of transmission of ritual content, including dedicated study, memory aids, and intentional resistance to variation in order to retain an identity as Pagans in a wider imagined community of Pagans.

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Introduction

The field of cultural evolution uses evolutionary models to explore and explain cultural change (Boyd & Richerson, 1985; Mesoudi, 2011). For evolution by natural selection to be possible, three criteria must be met: there must be variation, selection, and inheritance (Darwin, 1859). In cultural evolution, it is clear that variation and selection both exist, since many different cultures and cultural forms are apparent, and people are exposed to a greater amount of cultural information than can be recalled and transmitted to others (Barrett, 2022, p35). It's also clear that cultural information is heritable, in the sense that it can be passed between individuals. However, this is where cultural evolution is arguably most distinct from biological evolution, since the inheritance of culture is not restricted to parents and offspring, which forms the vast majority of biological inheritance. Additionally, the inheritance of culture is not protected by the same stability or fidelity offered by genes. Genetic mutations are rare, and recombination during sexual reproduction still produces offspring that are very similar to their parents. In cultural inheritance, however, information can be inherited from anyone, and can undergo dramatic transformations whilst it is transmitted between people (Sperber, 1985) or during practice of the inherited trait (ibid.). Much research has therefore been dedicated to understanding how culture can be transmitted with high fidelity to form stable traditions.

This research will ask whether belief influences the transmission fidelity of religious content. Before describing the proposed research, I set out the literature motivating this study including transmission fidelity, the transmission of beliefs and believable content, rituals, and transmission chain experiments. I will also address the use of ethnographic research in cultural evolution research and provide a literature review of the chosen ethnographic case study: modern British Pagans.

The results section will address the experimental research first; each of the experimental hypotheses will be addressed with statistical results and a discussion which will feature literature from cultural evolution. The results of the ethnographic research will follow, with an account of one of the rituals I attended. Finally, a general discussion will explore the results together in view of the research questions and surrounding bodies of literature.

Literature Review

Transmission Fidelity

High fidelity transmission of information is important for stable traits to emerge, whether genetic or cultural. In cultural evolution, high fidelity transmission is of particular importance for cumulative

culture to occur (Lewis & Laland, 2012), without which it has been argued the human species would not have been able to thrive in such diverse environments as it does (Henrich, 2016), or to have developed such a diverse range of cultural traditions (Enquist et al., 2011). Therefore, a rich field of research explores the fidelity of cultural transmission. This includes social learning mechanisms such as imitation and emulation, and cognitive factors such as cultural attractors (Sperber, 1985) and transmission biases, all of which explore why certain models or concepts are transmitted more frequently or accurately than others.

The literature on social learning mechanisms includes studies seeking to explore how both imitation and emulation of models are used by learners (Whiten et al., 2009; Yu & Kushnir, 2020). The main point of difference between the two mechanisms is whether the focus is on replicating the goal or end result (emulation), or the actions (imitation). Overimitation is also evidenced (Flynn, 2008; Whiten et al., 2009), a term which refers to an individual copying actions which are irrelevant to the end result. Imitation, overimitation, and the transmission biases which utilise wholesale copying of a model's behaviour rather than selectively copying adaptive behaviours all contribute to the existence and maintenance of both traditions which may be, and which may not be directly adaptive (such as a particular style, which is neutral (Hurt & Rakita, 2000) versus a particular form of a tool, which is adaptive (Mesoudi, 2008)). Although there is discussion of religion in general as a potentially adaptive trait (Alcorta & Sosis, 2005; J. L. Barrett, 2022), it is not clear that all religious beliefs and behaviours directly improve Darwinian fitness, therefore these concepts will be useful for exploring how religious beliefs and practices are established and maintained as stable traditions.

Transmission biases are commonly grouped into content and context biases, and by their influence on the selection, transformation, and transmission of cultural content. Kendal *et al.*, (2018) gives an overview of much of this research. Broadly, transmission biases relate to the decision of when, how, and from whom learning should occur. In some cases there is a more direct and obvious link to evolutionary fitness, such as a bias to copy a more knowledgeable model (Henrich & Broesch, 2011), however in other cases indirect transmission biases are evident, in which individuals copy all of a model's actions, whether relevant to their success or not (e.g., the prestige bias (Henrich & Gil-White, 2001)). Cognitive biases have also been explored through the medium of narrative forms, with particular attention to the longevity of oral traditions, since narrative is a relatively stable form of cultural content, often transmitted verbally but with distinct stories that can be traced back thousands of years and that spread across vast populations in different, but still recognisable, forms (J. M. Stubbersfield et al., 2017; Tehrani, 2013). Such research has highlighted biases to transmit social information (Mesoudi, Whiten, & Dunbar, 2006) and ecological survival information (Nairne, 2010), content that arouses strong emotions (Heath et al., 2001), that is consistent with stereotypes

(Kashima, 2000), that appears higher up in hierarchical organisation (Mesoudi & Whiten, 2004), and that is minimally counterintuitive (Boyer & Ramble, 2001; Nyhof & Barrett, 2001). However, there is a lack of research concerning the effect of cognitive biases on the transmission of religious beliefs and practices.

Cultural attraction theory (CAT) responds to the problem of imperfect transmission of cultural content by arguing that transformations during transmission cluster around cultural attractor types (Sperber, 1985). This means that content which is unlike a cultural attractor type will be transformed to become more alike one, and content which is close to a cultural attractor type will resist modification to stay close to it. Thus, content which is not subject to other social learning strategies or biases can still be stably transmitted once it nears its attractor type form. It is important to note that these transformations are not necessarily, or indeed likely, to be intentional. Additionally, the attractor itself is not the cause or mechanism of the attraction (Scott-Phillips et al., 2018). Instead, attractors can be likened to observable statistical patterns or centres of gravity (ibid.), leaving researchers to explore the factors which influence or cause attraction in that case. Identifying attractors can help to explain the prevalence or transmission fidelity of various concepts which may not be readily explained by the social learning mechanisms and transmission biases explored above. Many transmission chain experiments, a method which will be explored in more detail below, arguably demonstrate this theory. A particularly notable example is Miton, Claidière, and Mercier (2015), in which content that was originally closer to a putative attractor type (bloodletting) was transmitted more stably than content which was farther from it, which was more likely to be transformed during transmissions, with some transformations shaping the content to become more like the bloodletting attractor type.

Transmission of beliefs and believable content

Rituals and religious beliefs are stably transmitted despite their apparent complications, such as the causal opacity of ritual content (Kapitány & Nielsen, 2015), the complexity of many religious beliefs (Whitehouse, 2004), and often the costliness of rituals and religious group membership (Sosis & Alcorta, 2003). It is therefore of interest to scholars of the cultural evolution and cognitive science of religion why this is the case. Whitehouse (2004) argues that religions are transmitted through one of two modes of religiosity; doctrinal (transmitted through extensive study) and imagistic (memorable due to high arousal of emotions during ritual practice). The imagistic mode of religiosity may be more applicable to informal religions (Boyer, 2020) for whom doctrine is not a usual feature. However, empirical research has shown (Kapitány et al., 2018) that increasing the proportion of ritualised behaviour (defined by the authors as causally opaque with emphasis on actions rather than results) inhibits the memorability to an observer of a sequence of actions. This contradicts some of the

literature concerning overimitation, which suggests that high-fidelity copying occurs even in the absence of causal transparency (e.g., McGuigan et al., 2007). More work is therefore needed to explore the memorability and transmission fidelity of rituals and especially relating to the causal opacity, or transparency, of actions contained in rituals.

Work has also been conducted concerning the use of ritual and other religious practices, analysing when and why people choose to conduct rituals or use ritual methods to achieve a certain goal. Hong and Henrich (2021) argue that divinatory practices should be viewed as epistemic technology (tools used "to reveal hidden information" (ibid.)), since from their research people use divination because they believe that it works most of the time. Watson-Jones and Legare (2022) discuss the contexts in which people attribute efficacy to rituals and argue that it is often connected to anxiety and uncertainty. Both of these point to a view of ritual practices which involves practitioners actually believing in them and practicing them based on that belief, rather than out of convention, tradition or habit alone.

There is research on the transmission of non-religious beliefs that is also relevant to the present study. Two key domains are the spread of rumours, and the spread of misinformation (including conspiracy theories). Franks et al., (2013) describe how conspiracy theories are similar to religions in terms of the cognitive biases they exploit in order to spread, and argue therefore that conspiracy theories can be considered 'quasi-religious'. A similar argument could be made for rumour and other misinformation, therefore in the absence of literature concerning the transmission of religious beliefs, I will turn to the literature concerning rumours and misinformation.

Several researchers (Jaeger et al., 1980; Pezzo & Beckstead, 2006; Rosnow et al., 1988; Wang et al., 2018) have found evidence to support the hypothesis that rumours are more likely to be transmitted if the transmitter considers them to be more believable, or believes in the rumour to a greater extent. Anxiety was also a factor in some experiments, with Pezzo and Beckstead (2006), Rosnow *et al.,* (1988) and Jaeger *et al.,* (1980) all finding that anxiety levels and likelihood of transmission were positively correlated. Additionally, a frequency bias was demonstrated by Wang *et al.,* (2018), whereby people were more likely to believe, and therefore more likely to transmit, a rumour with a high volume and consistency of arguments in online communities. However, in a study concerning rumours about cancer, Difonzo *et al.*, (2012) found that transmitters did not have more confidence in the rumours than non-transmitters. All of these studies were concerned with the likelihood of transmission of a rumour compared with other rumours, which maps onto the aspect of selection in cultural evolutionary models. There was no measurement of fidelity during transmission or longevity of rumours, both of which can reveal information about the stable transmission of content.

An important concept for understanding the transmission of content which is believed in to a certain extent is the confirmation bias, which is a term that is used to describe a suite of biases all of which involve the "seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (Nickerson 1998, 175). Nickerson (ibid.) provides an overview of the confirmation bias, describing various aspects to it including the restriction of attention to favoured hypotheses, and the preferential treatment of evidence which supports one's existing beliefs. In more recent research, Malthouse (2022) found that participants on both sides of the pro- and anti-vaccination issue made systematic errors when interpreting data about vaccine efficacy, in line with their existing beliefs. However, Jiménez, Mesoudi and Tehrani (2020) found that the confirmation bias did not affect the recall of vaccine-related information, since participants did not recall items better if they were aligned to their prior beliefs. Much of the research concerning the confirmation bias is concerned with presenting participants with different information and analysing their interpretation, retention, and transmission according to their existing beliefs. I could not find studies which had attempted to manipulate the beliefs of different participants to determine whether newly formed beliefs influenced recall or transmission.

Turning to cognitive biases relevant to religion, there are several important theories which should be addressed. A key concept in this regard is the minimally counterintuitive (MCI) hypothesis (J. L. Barrett et al., 2009; Nyhof & Barrett, 2001). This theory proposes that humans have a recollection bias that favours content which violates human intuitive knowledge or assumptions about expected characteristics or properties of different things, based on ontological expectations grounded in human psychology[1]. Concepts benefit from this bias only when they are counterintuitive to a minimal extent such that there are only one or two (Norenzayan et al., 2006), or from other research two or three (J. L. Barrett et al., 2009) violations to each item. Items which possess too many counterintuitive features are too difficult to understand or think about, and do not benefit from the same bias (Van Slyke & Slone, 2022). An example of a minimally counterintuitive item is a spirit which is able to pass through solid objects, violating human intuitive knowledge about physics (J. L. Barrett & Nyhof, 2016). This has been alleged to explain the spread and persistence of religious concepts since many religious themes are minimally counterintuitive. However, the MCI hypothesis has recently been challenged on the basis that it has not been cross-culturally tested (Willard et al., Forthcoming), is potentially limited to people under the age of 25 (J. Barrett & Gregory, 2009), and relies on the existence of ontological expectations, whereas it is possible that human knowledge and expectations about the world is schematic and

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[1] Note the importance of ontological expectations. A counterintuitive concept violates core ontological expectations about the world, such as an invisible person (violating intuitive expectations that living beings are visible), whereas a person who is 5 metres tall is certainly bizarre but does not violate any core ontological expectations about the characteristics of living beings (such as their height).

therefore subject to change upon the adoption of new beliefs or knowledge (Willard et al., 2016). Another important cognitive mechanism is called the hypersensitive, or hyperactive, agency-detection device (HADD) (J. L. Barrett, 2016). This concept refers to the tendency of humans to detect agency whether it is really present or not, which leads to religious concepts such as supernatural beings being believable. However, this does not necessarily mean that they will always be believed (Willard, 2019). Finally, cultural attraction theory (CAT) (Sperber, 1985) has been applied to some religious forms, such as divination or shamans which have been put forward as potential cultural attractor types (Boyer, 2020), which could explain their widespread success and the stability of some traditions associated with them.

A separate, but linked, area of research has explored biases which can inform and influence the extent to which individuals believe in certain content over others. A key example of the latter bias is Henrich's (2009) Credibility Enhancing Displays (CREDs), which have been shown to predict theism (Lanman, 2012; Lanman & Buhrmester, 2017) and are also alleged to influence non-religious beliefs (Willard et al., 2016). Studies have also shown that a repeated claim is more likely to be believed than a claim which is only heard once (Unkelbach et al., 2019), indicating that content which exploits cognitive biases, and is therefore transmitted more frequently, is more likely to be believed. However, the influence of belief itself on the transmission of content has not yet been fully explored.

Rituals and ritual actions: definitions, forms, and functions

Rituals, religions, and ritualised behaviours have enjoyed a great variety of definitions and debates around their definitions, some of which will be captured here. I will first address the ways in which rituals and ritualised actions have been defined previously before giving a definition of my own. It should be noted that some of the variance between definitions derives from whether the authors are seeking to define rituals generally, or specifically to define religious rituals. In my case, I am seeking to define religious rituals although there will be some overlap between my definition and the non-religious rituals which many people undertake. I will then address some of the literature which concerns the potential functions of rituals.

Rituals have been defined based on various characteristics of both the actions and the actors involved in their practice. Action-based definitions have focused on the automaticity (Boyer & Liénard, 2006; cf. Niczyporuk, 2022); the formality, stereotypy, condensation and redundancy (Tambiah, 1979); and the causal opacity and goal demotion (Kapitány & Nielsen, 2015; Watson-Jones & Legare, 2022, cf. Larson, 2023) of the actions, or sequences of actions, involved in the ritual. Actor-based definitions have focused on the special qualities of the actor, instrument, and/or patient (McCauley & Lawson, 2002), and the reference to culturally-postulated superhuman agents (ibid.). Finally, Whitehouse's (2004)

modes of religiosity are also used to define the different forms that rituals can take, with multiple possible features of the ritual falling under both the 'doctrinal' and 'imagistic' mode, leading to the long-term reproduction of that ritual to trend towards one mode over time.

Some definitions of rituals are based on functionality rather than form. Simes (1995: 173-4) provides an overview of many of these function-based definitions, stating that rituals have been defined "as a marking point in changing social status (van Gennep, Eliade); to define rules of conduct and to serve as expressions of belief (Durkheim, Radcliffe-Brown); to define acceptable social behaviour and to establish social solidarity and stratification (Burns and Laughlin); to cope with stressful situations and personal life crises (d'Aquili); to play, act out and celebrate life's dramas (Schechner, Turner); to control the unpredictable elements of society and the environment (Horton, Leach); [and] to carry out practically any routine procedure, whether religious or secular (Goody, Lewis, Needham)." In addition to these potential functions, cognitive scientists of religion have found evidence to support the notion that rituals function to decrease anxiety (Brooks et al., 2016), alleviate grieving (Norton & Gino, 2014), and promote group cohesion (Sosis & Alcorta, 2003).

For the purposes of this research, rituals are defined as a sequence of routinised actions, often with reference to a culturally postulated superhuman agent, which are distinguishable from non-ritualised actions by their repetition, formality of performance, and causal translucency (i.e., symbolically rather than causally linked to the ritual's goal, if applicable).

Transmission chain experiments

Transmission chain experiments[2] were first conducted by Bartlett (1932), concerned with exploring how cognitive biases relating to memory influence content that is transmitted during social interactions. They have since been used widely within cultural evolution research to explore how cultures evolve on a micro-scale, since the transmission chain experiment can be used as a micro-scale representation of culture that can be controlled and studied in lab conditions. Some experiments have explored the longevity or stability of content over repeated transmission (Kirby et al., 2008; Miton et al., 2015). In some experiments, the content to be transmitted was manipulated to determine whether the inclusion or exclusion of purportedly "catchy" concepts influenced the longevity or stability of that content's transmission (Miton et al., 2015). In other experiments, the evolution of the content during the experiment was the focus, with all participants presented with identical stimuli in the first generations and stable forms emerging over subsequent generations as the content evolved to become more easily transmitted (Kirby et al., 2015).

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[2] Also referred to as the serial reproduction method and as iterated learning.

The core components of a cultural transmission chain involve the transmission of content between individuals in a controlled environment. This comprises the provision of some initial material by the researchers, which the participant is then asked to study. If the transmission chain experiment is concerned with stories, then the initial material may be a short story which the participant is asked to read (J. L. Barrett & Nyhof, 2016), or if the experiment is concerned with music, the initial material might be a short audio clip which the participant is asked to listen to (Ravignani, Delgado, and Kirby 2016). Whatever the source material is, the participant is asked to study it and then replicate it. This forms the first generation of the experiment. Their attempt is recorded and subsequently used as the source material for the next participant. This forms the second generation. The process is then repeated for several generations. An experiment usually has several chains of participants in order to make sure the effects are consistent and replicable and to reduce the potential impact of one participant being an outlier, for instance by making an error, which would have knock-on effects on later generations, significantly influencing the entire experiment if there was only one chain of transmissions. The number of chains varies between studies, as do the number of generations per chain.

The changes between different participants' attempts are measured, such as the amount of propositions in a short story that are accurately recalled and recorded in the participant's version (Boyer & Ramble, 2001), and these data are analysed in line with the hypotheses and predictions relevant to the experiment. The information gleaned from the data can inform us about cognitive biases and constraints and how these influence the evolution of cultural content. This, in turn, can be used to explore macro-scale cultural phenomena, such as the prevalence of certain types of content in folktales cross-culturally (J. L. Barrett & Nyhof, 2016), or the existence of musical universals (Fitch, 2017).

Variations on this experiment type include the replacement group method and the closed group method (Mesoudi & Whiten, 2008), both of which group participants rather than keeping them separate, with the group attempting the same task repeatedly rather than individuals attempting a task along a chain. The replacement group method involves the phased removal and addition of group members over time (e.g., Caldwell and Millen 2010), while the closed group method maintains the same group of participants for the duration of the experiment (e.g., Kirby et al. 2015). Some experiments have incorporated interaction between participants in order to more accurately mimic the role of teaching in cultural transmission (Bietti et al., 2019; Lumaca & Baggio, 2017). The transmission chain method has also been applied to a range of content types including music (Ravignani et al., 2016), written narratives (J. L. Barrett et al., 2009), the production of paper aeroplanes and spaghetti towers (Caldwell et al., 2016) and artificial languages (Griffiths & Kalish,

2007). In some instances, each generation has consisted of pairs of participants (Bietti et al., 2019; Kirby et al., 2015; Lumaca & Baggio, 2017). Additionally, the data collected from transmission chain experiments has included the differences between participants' versions of a story across generations (J. L. Barrett & Nyhof, 2016), the number of generations for which each chain 'survived' (Miton et al., 2015), and the success of artefacts made by participants (Bietti et al., 2019; Caldwell et al., 2016). The transmission of action-based content and cross-modal (i.e., action-based and verbal) content is understudied. Whilst many transmission chains utilise written content, and propositional analysis is widely used to code the data, there is no equivalent methodological approach for coding action-based content to explore transmission fidelity. The development of a methodological approach in this regard could be useful for the study of tool production, dance, ritual, music, and other action-based cultural forms.

The application of ethnography to cultural evolution

The field of cultural evolution originated in mathematical modelling of cultural evolutionary processes (Mesoudi, 2011), and more recent experimental methods using human participants often involve WEIRD (Western, Educated, Industrial, Rich, Democratic) (Henrich et al., 2010) populations, in many cases specifically university students[3]. Some researchers have therefore called for more cross-cultural research to be conducted to explore whether the hypotheses for which support can be found among Western students are as universally applicable as they are sometimes claimed to be (Willard et al., Forthcoming). Related calls have been made to situate theoretical claims about the evolution of aspects of culture, such as religion, in specific ethnographic contexts (Bendixen et al., Forthcoming). Additionally, Tehrani (comment on Mesoudi, Whiten and Laland, 2006) recommends the use of ethnography to enhance understanding of the specifics of social interactions relevant to our knowledge about cultural lineages, and how they are formed and come to remain stable over time.

Ethnography can also be used to reveal and explore the meaning which is attributed to the behaviours under scrutiny by those who are scrutinised (Geertz, 1973), which in turn can aid in understanding how and why people behave in the ways that they do. Whilst experimental research can highlight observations such as, for example, that minimally counterintuitive items are recalled and transmitted with greater frequency and fidelity than intuitive items (Norenzayan et al., 2006), ethnographic research could reveal whether participants are aware that this has occurred, why they think it has, and whether it was on purpose. Such findings could impact the interpretation of results from the

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[3] See Mesoudi and Whiten's (2008) supplementary table for a concise overview of the participants in transmission chain experiments between 1932-2008, in which only 3 out of 34 studies had participants who were not students, and only 4 studies had participants who were not WEIRD.

experiment and can shape how future experiments are designed. In relation to cultural transmission and religious beliefs specifically, an ethnographic approach could contribute by highlighting the nuances of individual belief in rituals, the meanings attached to rituals, interpretations concerning their efficacy, and why people might find specific words or actions to be meaningful or relevant to specific ritual forms. This could then guide analysis of experimental results by helping to answer why some actions and words are recalled and transmitted more frequently or with greater fidelity than others, why some people might be more likely to recall and transmit ritual content than others, or indeed why some actions and words may be transformed in specific ways during transmission.

Together, these arguments paint a clear picture of the strengths of including ethnographic research when studying the evolution of culture. The question remains, however, which ethnographic context to choose. Boyer (2020) offers some guidance, arguing that cognitive evolutionary approaches to the study of religion must be grounded in, and relevant to, so-called 'wild' or informal traditions. These 'wild' religions, he claims, exist outside of, prior to, or despite hegemonic, mainstream religions. Although formal, doctrinal religions clearly evolve over time in terms of their practices and beliefs, Boyer (ibid.) suggests that since large-scale religions held up by institutions would not have been around in the earliest stages of human religion, they are less relevant to the study of the cognitive and evolutionary science of religion. Since the focus of this research is the influence of belief on the transmission fidelity of ritual content, however, either formal or informal religious traditions could arguably be used to provide ethnographic context. Boyer's (2020) informal traditions could provide a better case study due to the fact that formal religious traditions are more likely to be more constrained by institutions and centralised texts. Therefore, an informal religious tradition will be selected for the ethnographic aspect of this research. Boyer (ibid.) provides a suite of characteristics that are common to many of these informal religions, including that they deal with witches, souls, ancestors, ghosts, and spirits, they have no stable doctrine and no guild or corporation but instead are often comprised of individual specialists. In the UK today there is one religious group which stands out as a good fit for an informal religion: Paganism.

Paganism

Paganism is an acephalous, non-dogmatic religion, or to some people a collection of religions. It is commonly referred to as the native religion of the British Isles (Hutton, 1991), although many recognise Paganism, and especially Wicca, to be an "invented tradition" (Hutton, 2008); an attempt at a revival of assumed or known historical beliefs and traditions rather than a continuation of them, as was previously claimed to be the case (Murray, 1921). Paganism has had a significant uptake by new members over the last 70 years, since the Witchcraft Act of 1736 was repealed, reversing the ban on

practicing Witchcraft, and a popular book was published purporting to reveal the existence of groups of witches that had been practicing in secret since before the Act was repealed (Gardner, 1954). Today, Paganism is both the name for a religion itself, and an umbrella term which includes similar religions such as Wicca, Druidry, and Heathenry.

These religions are united by their focus on nature, and their eclectic and non-prescriptive style of adopting beliefs and practices (Simes, 1995). Many Pagans are polytheistic, and their beliefs and practices may involve those of other known religions, as well as an emphasis on nature, and solar and lunar cycles (ibid.). As well as private rituals, often with pragmatic goals such as for fertility or to banish negative influences or energy from one's life, which do not have fixed dates but may be more potent and therefore more likely to be practiced at certain points in the lunar and solar cycles, Pagans follow a 'wheel of the year' with eight festivals, called Sabbats, each of which is marked by a ritual. Wiccans follow the same wheel of the year but celebrate an additional 13 esbats, one for each full moon. The eight Sabbats celebrated by Pagans are: Yule (winter solstice), Imbolc (Feb 1-2, beginning of spring), Ostara (spring equinox), Beltane (April 31- May 1, beginning of summer), Litha (summer solstice), Lughnasadh (July 31-August 1, first harvest), Mabon (autumn equinox), and Samhain (October 31-Nov 1, final harvest/new year).

Although the schedule of rituals is consistent across Pagan groups, Paganism itself as a religion decentralised, with no central key text, or formal institution. As Pearson (2002) notes, "there are as many Paganisms as there are Pagans." Despite often being considered to be the pre-Christian European religion (Hutton, 1991), featuring purportedly Celtic figures, festivals and mythology, many Pagans also incorporate or make reference to other ancient or modern religions as part of their worship, including borrowing from ritual or magical practices, as well as including the mythology and gods of other religions in their own beliefs. This is a largely individual endeavour and there are no set rules about which other religions are appropriate for incorporation, but some notable influences include "ancient mystery traditions, such as the Hebrew Qabalah, the early Christian Gnostics, Asian and Indian esotericism, medieval alchemy and astrology, the tarot, and systems of geomancy, numerology and divination" (Simes, 1995) as well as Ancient Egyptian, Greek and Norse deities and mythology (ibid.).

Wicca was founded by Gardner in the 1950's (Pearson, 2002) and tends to focus heavily on rituals and magical practice, with an emphasis on goddess worship (Greenwood, 2000). Many followers join covens, which tend to be small groups, often of no more than 13 members (Greenwood, 2000). There are various different Wiccan traditions, notably the Gardnerian (developed by Gerald Gardner) and Alexandrian (developed by Alex Sanders) traditions (Pearson, 2007). Wicca is a decentralised religion,

though, and covens are autonomous (Greenwood, 2000). Some people also identify as Wiccan without joining a coven or following a specific tradition.

For many individuals, identification as a Pagan, Druid, Heathen, or Wiccan can be a decision made completely by themselves. Some groups, however, such as Gardnerian covens and a Druidic group called the Order of Bards, Ovates, and Druids, are initiatory, meaning that individuals must be officially initiated into the group in some manner. This often involves lengthy study and strong signals of commitment, and some initiatory groups include several levels of initiation for their members.

Paganism and Wicca have not been subject to extensive anthropological research in the UK, probably due in part to the secretive nature of some Wiccan traditions, such as Gardnerian and Alexandrian initiatory covens (Simes, 1995). However, there are three important works which I will highlight here, in chronological order.

Luhrmann (1989) wrote an ethnographic monograph based on fieldwork conducted with witches in England in the 1980's. Luhrmann's work sought to answer the question, "why do [witches] practice magic when, according to observers, the magic doesn't work?" This question also ties in to early anthropological theories concerning 'social evolutionism' which proposed that societies progressed in a linear manner from beliefs in magic, to religious beliefs, and finally to scientific rationality (Frazer, 1890), which was deemed to be the top rung. This approach is now considered by anthropologists and other academics to be both incorrect and problematic, as are other theories which arose from the linear social evolutionary model. Modern witches in Britain also challenge the idea, still held by some people, that magic and religion in some way lags behind science and reason. During her research, Luhrmann was initiated into a coven, and her participation in the coven formed part of her data collection, which resulted in the book being poorly received by many Pagans, since coven activities are for many people considered to be extremely private and not appropriate material for publishing.

Simes (1995) undertook her PhD research with Pagans in the East Midlands in the 1990's, combining sociological and anthropological approaches and with a focus on literature concerning new religious movements. A helpful generalised structure of Pagan rituals is included, and many references are made throughout to the emphasis which is placed by Pagans upon individual book research, and on the prevalence of individual or solitary practice among Pagans. Simes reports that many Pagans do meet regularly however, whether this be at a moot (a casual opportunity to get together and talk about all things secular or religious), or at an invite-only, initiatory coven's schedule of ritual behaviours.

Finally, Greenwood (Greenwood, 2000) published an ethnographic monograph focusing on ritual and magic, as well as feminist themes, within Wicca, high magic, and feminist witchcraft. She provides a

lot of detail concerning ritual practice within these groups, and also speaks to the highly individual, experiential nature of Paganism. Again, there is a great emphasis on reading, and as part of her research Greenwood was involved in the initial stages of a high magic apprenticeship. This involved individual work, including meditation and private ritual, extensive reading, and group meetings to discuss experiences and materials covered and to practice guided meditations and group rituals. This further serves to demonstrate the individualised nature of Paganism and highlight its suitability as a religion to study the transmission of rituals outside of dogma and formal institutions.

There is a strong ritual tradition in Paganism and Wicca, which together with its relevance to Boyer's (2020) category of informal religions makes it an appropriate cultural tradition with which to conduct ethnographic research to situate and extend the information that can be drawn from experimental research concerning the influence of belief on the social transmission of information and practices pertaining to rituals.

Conclusion

Various kinds of content which are transmitted are believed in to some extent by those transmitting it, including urban legends (J. M. Stubbersfield et al., 2017), rumours (Jaeger et al., 1980), conspiracy theories (Acerbi, 2019), and religious content (Gervais et al., 2011). However, much of the research concerning these types of content either explores the fidelity of transmission in the context of some other bias (MCI, stereotype consistent, emotional etc) or explores the choice or willingness to transmit in the context of factors including biases such as those listed above, and the extent to which participants believed in the content or considered it to be believable. The influence of belief in the content over the fidelity and longevity of content during transmission has not yet been explored. Additionally, the transmission of multi-modal (verbal and action-based) content is understudied. This research will seek to contribute to these gaps in the literature by conducting experimental research among the general population concerning the influence of beliefs on the social transmission of a ritual featuring verbal and action-based content, and by conducting ethnographic research with Pagans to complement, situate, and extend the knowledge that can be drawn from the experiment.

Ethnography

It is important to situate research in a social context. Since this research involves theory from the cognitive science of religion, it also involved research with members of an informal religious group: Paganism. An informal religious group was chosen since they are more relevant to exploring evolutionary theories about religion (Boyer, 2020) and because formal religions have other mechanisms for ensuring stable transmission, such as written doctrine. Unfortunately, it was not

feasible to conduct the experimental study with Pagan participants due mainly to the number that are available[4], and the number of participants that would be required for the results to be statistically valid. I therefore incorporated an element of ethnographic research where I combined ethnographic interviewing and participant observation with the experimental research to learn more about the meaning, practice, and transmission of Pagan rituals.

Methods

I attended several moots (social gatherings) and three rituals (Litha, Samhain, and Yule) connected to Brigid's Fire[5], a Wiccan coven based in North East England. I also conducted in-depth interviews with three members of the coven. The moots were held frequently across a range of cafés and pubs in County Durham and Tyne and Wear, and I attended as often as I could. Most of them involved catching up over a drink and some food, and welcoming new members, however one group also held talks during their moots where invited guests spoke on a range of topics throughout the year. Moots generally lasted around 3 hours. The rituals lasted approximately 5 hours (including time spent setting up and time spent socialising after the ritual had been completed). The interviews lasted approximately 1 hour each. The moots contributed to advancing my general knowledge and understanding of Paganism, as well as building trust with the members of the coven which made the interviews and my attendance at the rituals possible. The interviews and rituals formed the data collection. During the rituals, I used the participant-observation data collection method and wrote field notes after participation. During the interviews, I asked open questions concerning the rituals that they do or have done, the meaning behind these rituals and any materials associated with them, how they learned about them, whether they pass any of them on to others, how powerful or effective they consider those rituals to be, and why (see outline interview schedule at **Appendix 1**). The interviews were recorded and transcribed for analysis. Ethical approval was obtained from the Durham University Anthropology Department Ethics Committee prior to conducting this research.

The ethnographic research conducted was used to improve my understanding of the context in which I situated my experimental study, and therefore also helped me to interpret my results better and ask more appropriate questions during the post-experiment interviews. Since the experiment in part involved grouping participants into a 'belief' and a 'disbelief' condition, ethnographic research has helpfully consolidated existing knowledge that belief is not a binary, something which the post-

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[4] From the 2021 Census in England and Wales, in County Durham 0.4% of the population reported that they were affiliated with "other" religions. Nationally, Paganism constituted the largest category of "other" religions in the census, accounting for approximately 18% of the write-ins. It can therefore be very roughly estimated that there are approximately 379 Pagans in the entirety of County Durham.

[5] The name of the coven, and names of any of its members, are all pseudonyms to protect the anonymity of participants.

experiment interviews also aimed to address, and indeed that the conditions which can influence belief are not binary. Both the overall reason(s) for attributing efficacy to the ritual, and the reason(s) for specific ritual actions/verbiage will be explored in greater depth during ethnographic interviews and participant observation.

I will first address the results of the experimental research. Following this, I will give an account of a Pagan ritual, and discuss additional findings from the ethnographic research which both challenge and complement the findings of the experimental research.

Experiment

Research Questions

For clarity, I will first briefly describe the content of the transmission chain experiment which is examined in respect of the hypotheses and predictions. I created a novel ritual, based on examples of real religious rituals, which featured both action-based and verbal content. An additional myth was created to accompany the ritual and give some background including its purported origins and purpose. The demonstration video for the first generation of participants was a recording of me reciting the myth and then performing the ritual which involved simultaneous actions and verbal content. The meaning of the actions and verbal content was often, but not always, consonant, and the final action occurred at the same time as the final words. Participants were asked to recreate both the actions and verbal content in the same manner as the demonstration video (i.e., concurrently). More details concerning the demonstration ritual will be provided in the Methods section below.

Hypotheses and Predictions

Following on from previous research into the transmission of rumours and conspiracy theories, I hypothesise that belief influences the fidelity of the transmission of content (H1). This leads to a prediction (P1A) that individuals who believe that certain verbal content is true are more likely to accurately recall and transmit that content than individuals who do not believe that the same content is true. Additionally, prediction P1B is that individuals who believe that certain action-based content is linked to true verbal content are more likely to accurately recall and transmit that action-based content than individuals who do not believe it is linked to true content.

I also hypothesise (H2) that belief increases the longevity of transmission of the ritual content. This would be supported by the prediction (P2) that transmission chains where participants have been primed to believe in the content survive (i.e., the core information and/or practices will continue to be transmitted) for a greater number of generations than chains where participants have been primed to disbelieve in the content.

Finally, I hypothesise (H3) that causal opacity decreases the likelihood of successful transmission of ritual content. This would be supported by the prediction (P3) that content which has low verbal-action content consonance will be transmitted with lower success (will be missing or transformed more frequently) than content which has high verbal-action content consonance.

Hypothesis	Predictions
H1: Belief influences the fidelity of the transmission of content.	P1A: Individuals who believe that certain verbal content is true are more likely to accurately recall and transmit that verbal content than individuals who do not believe that the same content is true.
	P1B: Individuals who believe that certain action-based content is linked to true verbal content are more likely to accurately recall and transmit that action-based content than individuals who do not believe it is linked to true content.
H2: Belief increases the longevity of content.	P2: Transmission chains where participants have been primed to believe in the content survive (i.e., the core information and/or practices will continue to be transmitted) for a greater number of generations than chains where participants have been primed to disbelieve in the content.
H3: Causal opacity undermines the fidelity of transmission of content.	P3: Dissonant ritual content is more likely to be modified or forgotten entirely during transmission than consonant ritual content.

Table 1 Hypotheses and predictions.

Methods

This research will comprise a cultural transmission chain experiment based on Bartlett's (1932) serial reproduction method (Figure 1), conducted alongside ethnographic research with Pagans in the North-East of England who conduct rituals. There will also be follow-up interviews with the experimental study participants.
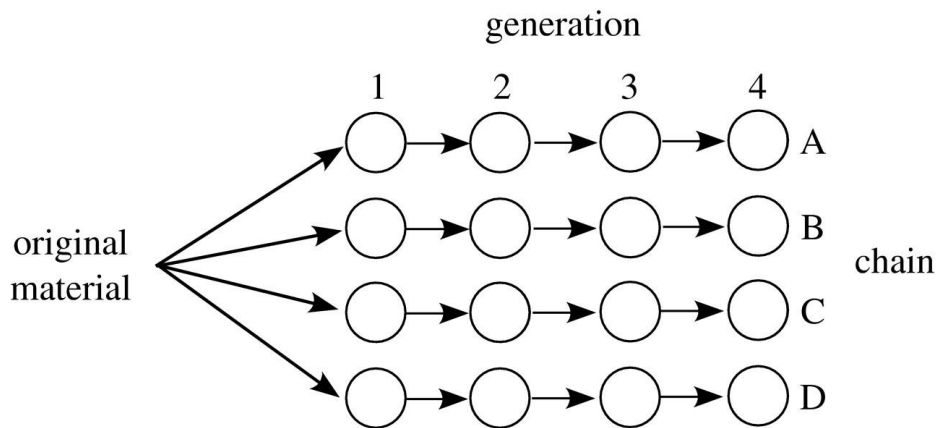
Figure 1(Mesoudi & Whiten, 2008). Typical transmission chain experiment design, with in this case four chains (A-D), each

<u>The experimental study</u>

There were 72 participants, divided into 18 chains of 4 generations each. In order to minimise wasteful data collection, and because gender and age were not used in the analysis, these were not recorded for participants. The participants all possessed conversational to fluent English speaking skills, and were recruited via snowball and opportunity sampling, and therefore came from a range of academic, professional, and other backgrounds. Ethical approval was obtained from the Durham University Anthropology Department Ethics Committee prior to conducting this research.

The experiment was based on a between-subjects design, with each participant subject to one of two conditions (9 chains per condition, and 4 participants per chain). Participants in the first generation viewed the seed material, a video recording of a woman (the experimenter) describing a ritual and providing other information about it, and additionally performing that ritual, which involved reciting the verbal content and physically demonstrating actions at the same time. A priming script was read out prior to watching the demonstration, to inform all participants that the ritual in the demonstration had been 'tested' experimentally against a control to see whether it achieves the results it purports to. In the two conditions, during the priming script the ritual was either claimed to:

a) Have a notable positive effect against a control group. In this condition, participants are encouraged to believe in the ritual (belief condition).

b) Have no notable effect when compared to a control group. In this condition, participants are encouraged to disbelieve in the ritual (disbelief condition).

The seed ritual involved a series of 17 routinised actions lasting approximately 33 seconds. A recording of the ritual is available here: https://youtu.be/4e6BWGqCxRU. It involved no additional materials, so that all participants could complete the ritual. The ritual was derived using Pagan rituals that were available online, as well as the Ahaya mudra taken from Hinduism, which is consistent with much of

modern British Paganism, which is often highly syncretic and draws on other religious traditions. In the video, the demonstrator also verbally communicated information about the ritual, such as the purpose of the ritual, and a myth associated with its origin. The origin myth also included irrelevant information which was not directly relevant to the ritual's efficacy, such as that it was created by a man and passed from him to his daughter when he was nearing the end of his life. Additional movements such as scratching the head were included during the pilot (6 participants total) to test for overimitation, but no participants transmitted those movements and therefore they were removed for the experiment. The seed ritual therefore contained no arbitrary movements or verbal content, however it did contain some intentionally consonant and dissonant points, where the meaning of the words and actions did or didn't align to one another.

The experiment was conducted either via Zoom or Teams video conferencing, with each participant present in an individual call with the researcher. In the meeting, participants first listened to the researcher read out a script, which they were informed was to ensure that participants all received the same information. The script contained both general information about the steps which their participation in the experiment would involve and two references to the efficacy of the ritual, which formed the priming portion of the experiment. Participants were either primed to believe that the ritual does work ('belief condition'), or that it does not ('disbelief condition'). Participants were next instructed to watch the video recording of the ritual, by the researcher playing the video whilst sharing her screen. This recording was either the initial seed or from the generation prior to them, and was played once unless some technical difficulty arose during playback, in which case it was played a second time. They were then prompted to complete a short distraction task by drawing three prompts from the website *Quick Draw*!, accessed at: https://quickdraw.withgoogle.com/. After this had been completed, they were directed to repeat the ritual and any verbal information that was included alongside it to the best of their memory, as a practice run. They were then able to watch the video recording they watched earlier again, after which they completed another three drawings based on prompts from the *Quick, Draw!* website. Finally, they were directed to repeat the ritual and any verbal information that was included alongside it to the best of their memory, which was recorded on Zoom by the researcher in order to communicate it to another person. They were informed that the person viewing it will only have access to their video, and not the video they had watched. This was both to reduce anxiety about making mistakes and being judged for it, and to highlight the importance of recreating the original video as accurately as possible, since it would be the only source of information about the content of the ritual available to the next participant in their chain. The researcher saved the recording to use as the demonstration video for the next participant in that chain, and for coding and analysis.

Finally, participants were required to complete an exit questionnaire where they indicated the extent to which they believed that the ritual worked for themselves, and the extent to which they believed it would work for others who had completed it, through a 6-point Likert scale questionnaire ranging from completely certain that the ritual did not work, to completely certain that the ritual did work, with no completely neutral or unsure option. This was followed by an interview comprising a series of open questions for discussion to explore the reasons for their belief or disbelief in the ritual, and any prior beliefs they have concerning rituals and religion. These data were used in the analysis to determine the extent to which the initial primer actually increases belief in the ritual, and whether increased belief in the ritual is associated with increased fidelity (P1A, P1B) and longevity (P2) of the transmission of the ritual. The interview data is used to complement the ethnographic data collected to understand *how* beliefs and the meanings attached to ritual content influences their transmission.

All the material for the ritual was drawn from real rituals, although some of the details were amended to fit the purposes of the experiment and to ensure feasibility (i.e., removal of additional materials in the ritual such as herbs). Participants were fully debriefed at the end of their participation through a verbal discussion after their interview and a debrief sheet (**Appendix 2**) with information concerning the actual purposes of the study, the source material out of which the ritual was created, and the explicit confirmation that the ritual has not been scientifically tested so any claims regarding its efficacy are not true. This was to prevent participants from leaving the experiment and maintaining a belief in something which has been produced for the purposes of the experiment.

Outputs were coded for statistical analysis using propositional and kinetographic analysis methods, set out below.

<u>Propositional Analysis</u>

The audio was transcribed by the researcher to produce text versions of the verbal content. This was broken down into propositions (Kintsch, 1974). Since this experiment explored the fidelity of transmission, rather than marking propositions from the seed ritual as present or absent, each participant's transcript was fully propositionalised and a masterlist of 654 propositions was compiled. Each proposition was assigned a unique number (P1, P2, P3, ..., P654). Because the seed did not include repeated propositions, when participants repeated a proposition more than once, only the first instance was recorded. Each participant therefore had a list of propositions (ranging from N=7 to N=42) with a total of 1605 propositions across all participants when repeated propositions are counted. Propositional analysis breaks text down into predicates and arguments, such that differently worded sentences with the same basic meaning can be represented by the same proposition. Coding can range from strict to liberal (Bovair & Kieras, 1981) and for this project a strict coding framework was adopted

in the first instance to enable closer study of fidelity during transmission, and a liberal coding framework was adopted for H3 to enable more meaningful analysis of the data.

For example:

"The man was very lucky" is propositionalised as:

P1 POSSESS MAN LUCK

P2 MOD LUCK SIGNIFICANT

So is "The man had a lot of luck."

And "this really lucky man".

However, "The woman was sometimes lucky" could be propositionalised as:

P1 POSSESS WOMAN LUCK

P2 MOD LUCK OCCASIONAL

<u>Kinetographic Analysis</u>

Video recordings were coded following a schema developed by the researcher, which draws on the Labanotation system (Hutchinson Guest, 2005). Similarly to the propositional analysis, each participant's ritual movements were fully coded into kinetographs, and a masterlist of 127 kinetographs was produced. Each unique kinetograph was assigned a number (K1, K2, K3, …, K127). Because one of the movements in the seed ritual was repeated four times, to reflect that a participant who repeated that movement four times had more accurately transmitted the ritual than one who only repeated it twice, repetitions were included in the coding by adding .1 to each kinetograph number for every repetition. So, the fourth time K1 was repeated by a participant it was recorded as K1.3 rather than K1. Each participant therefore had a list of kinetographs (ranging from N=0 to N=23), and a total of 884 kinetographs were recorded across all participants. For this research, only movements of the upper body were coded, and movements were 'clumped' to produce 'kinetographs' which include movement of the arms, hands, and core, as well as any body part which is touched by the hands, with the shortest single action in a group of concurrent actions forming the basis for each kinetograph. So, for example, if the participant were to turn 90° to the left in a single movement, but during that movement they raised their arms above their head twice, the arms would take priority and each be coded separately (up, then down, then up), with the correct proportion of the 90° turn allocated to each arm movement. This differs from Labanotation in its original form, which allows for one movement to take longer than others.

For example:
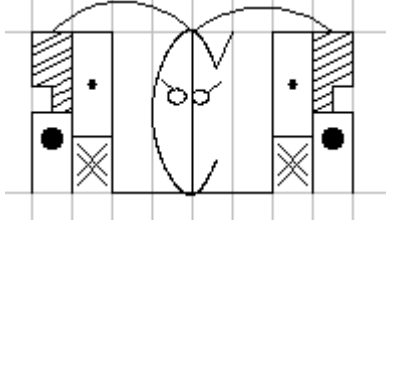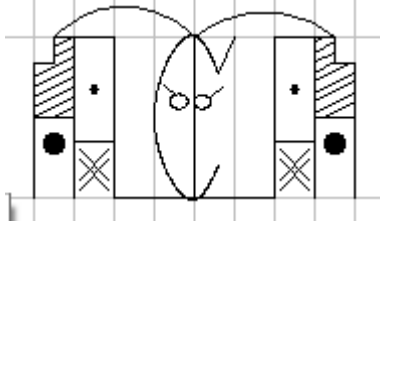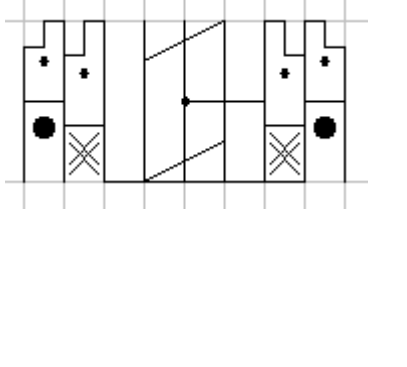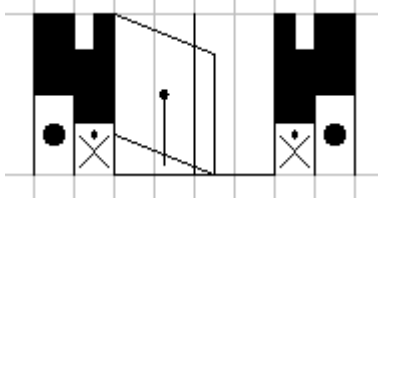
	This is K8 and shows that the arms were placed in line with the body, at a normal height, and contracted <90°, with palms facing backwards and placed high up, and hands touching the eyes.	
	This is K19 and shows that the arms were placed in line with the body, at a normal height, and contracted <90°, with palms facing forwards and placed high up, and hands touching the eyes.	
	This is K2, and shows that the actor is turning 90° to the right, with their arms forwards, at a normal height, and contracted <90°, with their palms facing forwards and at a normal height.	
	This is K99, and shows that the actor is turning 180° to the left, with their arms forwards, at a low height, and contracted >90°, with their palms facing downwards.	

Table 2 – Kinetograph examples.

I coded all of the video and audio, and a sample of 8 participants were coded by two additional coders who were blind to the participants' predictor variables (condition, belief in the ritual, chain number, generation). However, due to the extensive training required to understand the coding frameworks,

and the necessity of accuracy in coding to study the fidelity of transmission, the agreeability scores of the blind coders and the researcher were low. Therefore, an assistant created a sample of 8 participants and anonymised them such that the I was blind to their predictor variables, to enable the me to act as my own blind coder. This resulted in much higher agreeability scores. Using Gwet's AC1 score of inter-rater reliability (Gwet, 2014), conducted on the my own blind and original coding of the sample (to calculate intra-experimenter reliability), there was an agreement score of 0.74 for the kinetographs and 0.68 for the propositions.

In the data analysis, three response variables were calculated and compared against predictor variables; transmission fidelity, ritual longevity, and verbal-action semantic consonance. Transmission fidelity was calculated by comparing the propositions and kinetographs of each participant to the participant immediately prior to them, to determine the proportion of previous information bytes which were successfully transmitted. This was to ensure that the fidelity of the transmission of the ritual as they had seen it could be analysed, rather than merely the fidelity of their transmission compared to the original ritual. The predictor variables used in the transmission fidelity analysis were the experimental condition (belief and disbelief) and the self-reported belief (SR belief) of the participants in the ritual's efficacy (belief or disbelief). Propositional (P1A) and kinetographic (P1B) data were each compared to the condition and self-reported belief variables (H1).

Additionally, ritual longevity was measured by noting the generation numbers in which the core content of the ritual ceased to be transmitted, defined as the absence of either the purpose of the ritual (to improve luck and success), or any distinguishable ritual movements (formalised intentional actions rather than gestures or no action). If either the verbal or action-based core content was missing, the ritual was recorded as not transmitted. The number of generations before this occurs for transmission chains in both conditions will be compared to determine whether the belief condition is associated with greater longevity of transmission (H2). Since there were no chains of self-reported 'believers', as a proxy measure for comparing the ritual longevity against the self-reported belief of participants, the instances at which the ritual failed to be transmitted were recorded and compared against the self-reported belief of the participants. In this analysis, a lower probability of transmission failure would indicate that greater longevity of the ritual is likely, although future research should aim to pre-sort participants into chains of 'believers' and 'disbelievers' to directly assess the influence of self-reported belief on ritual longevity.

Finally, the ritual was designed to include two points in which the verbal and action-based content of the first point had high consonance, and in the second point had low consonance. The first point, in the seed ritual, contained the sentence "may obstacles I see be removed", whilst the actor placed their

hands near to their eyes. The second point comprised the sentence "and words of discouragement that I hear be silenced," whilst the actor placed their hands close to their mouth, which was not the appropriate body part when considering the meaning of the sentence which focused on hearing, not speech. All participants' propositions and kinetographs were re-coded using a more liberal scoring measure because the transmission fidelity was not the focus here, and the strict scoring measures used earlier would have resulted in coding too specific to record the transmission of consonant versus dissonant information bytes. In the liberal scoring, kinetographs were recorded as either gesturing to the eyes, nose, head, mouth, other, or absent. Propositions were recorded as either referring to sight, hearing, speaking, unattributed words, the head, the mouth, other, or absent. Based on the relationship between the kinetographs and the propositions involved, the points were then assigned either 'consonance' (i.e., a kinetograph of 'eyes' and a proposition of 'sight'), 'dissonance' (i.e., a kinetograph of 'nose' and a proposition of 'hearing'), or 'absence' (only assigned if both the proposition and kinetograph were absent). Each participant was compared to the previous participant, recorded as success or failure for each participant based on whether they had successfully transmitted each of the information bytes that had been transmitted to them. Both absences and changes from the previous participant were considered failures, and only accurate transmissions were considered successes. The two information bytes were compared to determine whether performance was better in the originally consonant point than the originally dissonant point.

Statistical Analyses

Hypothesis one (belief influences the fidelity of the transmission of content) was tested by building a series of six binomial multi-level Bayesian models using the R package brms, to include the kinetographic and propositional data as response variables; the generation, experimental condition and self-reported participant belief as fixed effects; and the chain as a random effect. The two belief effects (self-reported belief and experimental condition) were tested separately. The generation and chain are present in all models. The specific effects and variables used in each model are set out in **Table 2**. The fit of the models was analysed using the difference between expected log pointwise predictive density (Elpd_diff) scores against a baseline model using the LOO package in R. The LOO package sets the elpd_diff score at 0 for the preferred model, and other models are scored against it, with higher scores representing a more significant difference and poorer model.

Model Name	Description
Proposition baseline	Propositional data with generation as fixed effect and chain number as random effect.
Proposition + condition	Propositional data with condition and generation as fixed effects and chain number as random effect.
Proposition + self-reported (SR) belief	Propositional data with self-reported belief and generation as fixed effects and chain number as random effect.
Kinetograph baseline	Kinetographic data with generation as fixed effect and chain number as random effect.
Kinetograph + condition	Kinetographic data with condition and generation as fixed effects and chain number as random effect.
Kinetograph + self-reported (SR) belief	Kinetographic data with self-reported belief and generation as fixed effects and chain number as random effect.

Table 3 – Bayesian Models

The structure of the 'proposition + self-reported belief' model is shown below. All models followed a similar structure, with the propositions exchanged for kinetographs and self-reported belief exchanged for experimental condition. The baseline models do not feature the experimental condition or self-reported belief.

$$n_{\text{propositions copied}_i} \sim \text{Binomial}(n_i, p_i)$$

$$\text{logit}(p_i) = \alpha + \alpha_c \, \text{Chain} + \beta_B \, \text{Self\_Reported\_Belief} + \beta_G \, \text{Generation}$$

$$\alpha \sim \text{Normal}(0,10)$$

$$\alpha_c \sim \text{Normal}(0,10)$$

$$\beta_B \sim \text{Normal}(0,10)$$

$$\beta_G \sim \text{Normal}(0,10)$$

Hypothesis two (belief influences the longevity of content) was tested by comparing the chains in each condition to determine whether the ritual was more likely to survive for a greater number of generations in the belief condition than in the disbelief condition. An Exact General Independence Test was conducted, using the *coin* package in R (Hothorn et al., 2008) due to the ties in the data.

Additionally, I conducted a Pearson's Chi-Squared test to compare the proportions of instances where the core ritual content was lost during transmission against the self-indicated belief of the participant transmitting the ritual.

Hypothesis three (causal opacity negatively influences the successful transmission of content) was tested by comparing the amount of successful versus unsuccessful transmissions of the consonant and dissonant points of content using McNemar's chi-squared test in R, to account for the non-independence of the two points of content each being performed by the same participant. Consonant and dissonant content was used as an indirect test for causal opacity, due to the limitations of being able to measure how causally opaque a combined verbal and action-based information byte is. Dissonance is therefore used as a proxy for causal opacity, and consonance as a proxy for causally transparent or translucent content.

Experimental Condition Results

Before presenting the results relating to each of the hypotheses and predictions, I will address some results concerning the influence of the belief and disbelief condition primers. In both the belief and disbelief conditions, 8 (11%) participants indicated their belief in the ritual, compared to 28 (39%) participants who indicated their disbelief in the ritual. Consequently, there was no effect (χ^2 (1) = 0, p = 1) of the condition prime on the actual belief of participants. These findings provoked additional, exploratory analysis. These tests were not pre-planned at the study design phase.

Quantitative Results and Discussion

Hypothesis one: does belief influence the fidelity of the transmission of content?

A total of 6 models were produced and run in RStudio to explore the interactions of self-reported belief (fixed effect), experimental condition (fixed effect), chain (random effect) and generation (fixed effect) on the propositional and kinetographic data separately. The fit of the models was analysed using the difference between expected log pointwise predictive density (Elpd_diff) scores against a baseline model using the LOO package in R. **Table 3** describes the contents of each model.

Propositional Data

The 'proposition baseline' model was a better fit than the 'proposition + condition' model (elpd_diff: -1.6, se_diff: 0.9) which indicates that condition does not improve the estimated out-of-sample predictive performance for the transmission fidelity of the propositional content of the ritual over that of the baseline model. The results of the 'proposition + condition' model also indicated that condition did not have any predictive value (β =0.05 Est. Error 0.19, 95% Credibility Interval [-0.33, 0.44]). **Figure 2** shows the difference in transmission fidelity between the two experimental conditions for the propositional content.

The 'proposition + SR belief' model was a better fit than the 'proposition baseline' model, however the SE difference was larger than the elpd difference, so it is not possible to be certain that the 'proposition + SR belief' model had a better predictive performance than the 'proposition baseline' model (elpd_diff: -3.8. se_diff: 11.0). According to the 'proposition + SR belief' model, self-reported belief had a positive effect on the transmission fidelity of propositions (β =0.49, Est. Error 0.13, 95% Credibility Interval [0.25, 0.74]), with the odds of a participant who had indicated in their self-reported belief that they did believe in the ritual accurately transmitting a proposition being 163% of the odds of a participant who did not believe in the ritual. **Figure 3** shows the difference in transmission fidelity between the two self-reported belief groups for the propositional data.

Figure 2 Transmission Fidelity comparison of Propositions by Condition
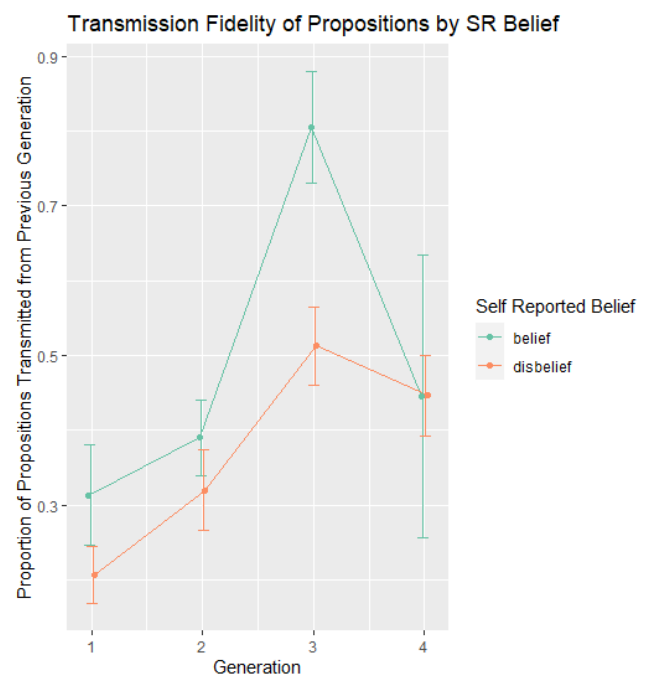
Figure 3 Transmission Fidelity comparison of Propositions by Self Reported Belief

The parameter estimates of the 'proposition + SR belief' and 'proposition + condition' model are shown in **Figure 4**.
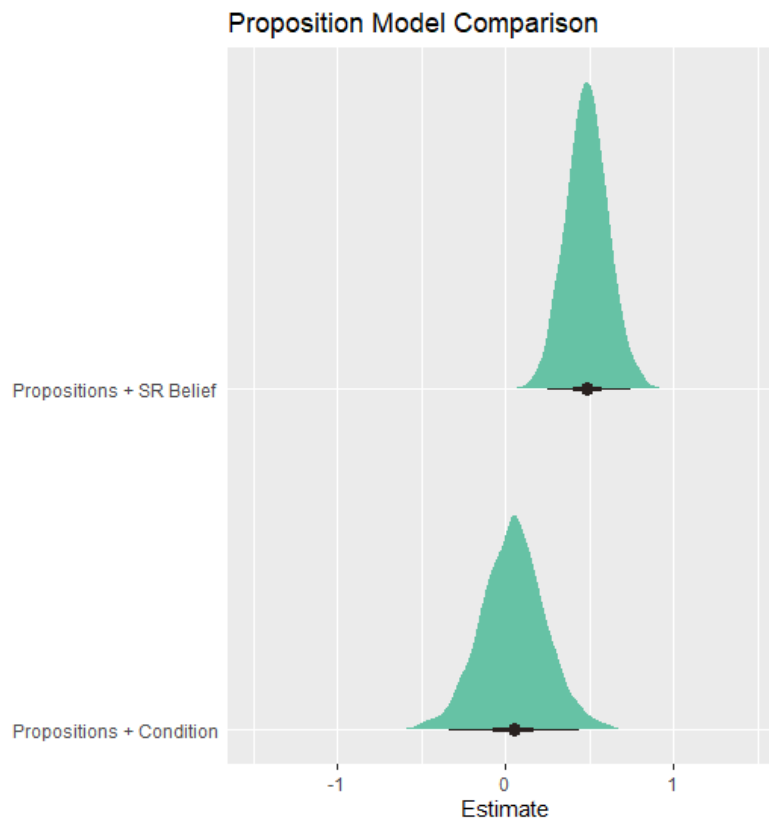
Figure 4 Parameter estimates and 95% prediction intervals for main effects in each of the propositional models

Kinetographic Data

The 'kinetograph baseline' model was a better fit than the 'kinetograph + condition' model (elpd_diff: 0.0, se_diff: 0.8), indicating that condition does not have out-of-sample predictive value for the transmission fidelity of the kinetographic content of the ritual. The results of the 'kinetograph + condition' model also show that condition did not have any predictive value (β =0.06, Est. Error 0.39, 95% Credibility Interval [-0.71, 0.84]). **Figure 5** shows the difference in transmission fidelity between the two experimental conditions for the kinetographic data.

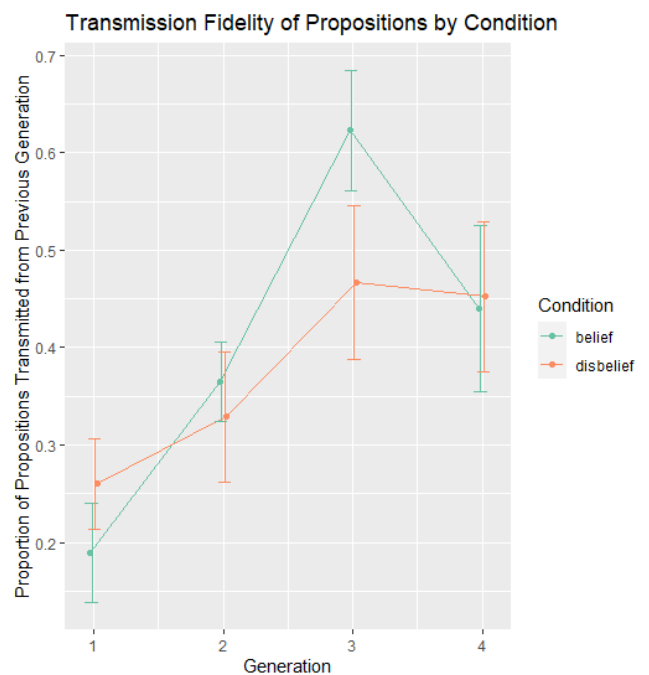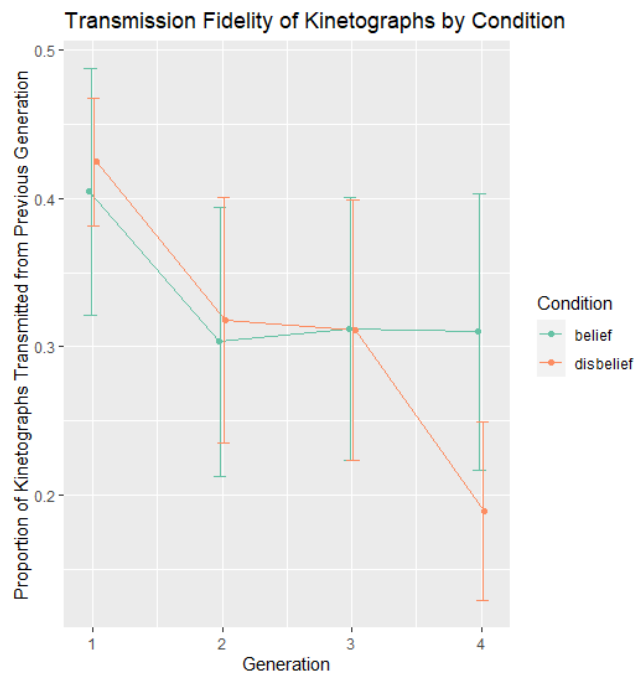*Figure 5 Transmission Fidelity Comparison of Kinetographs by Condition*

The 'kinetograph baseline' model was a better fit than the 'kinetograph + SR belief' model (elpd_diff: -0.7, se_diff: 1.6), which suggests that self-reported belief also does not have out-of-sample predictive value for the transmission fidelity of the kinetographic content of the ritual. The results of 'kinetograph + SR belief' model were in line with this finding (β =-0.16, Est. Error 0.18, 95% Credibility Interval [-0.51, 0.19]). **Figure 6** shows the difference in transmission fidelity between the two self-reported belief groups for the kinetographic data.

Figure 6 Transmission Fidelity Comparison of Kinetographs by Self-Reported Belief

The parameter estimates of the 'kinetograph + SR belief' and 'kinetograph + condition' model are shown in **Figure 7.**
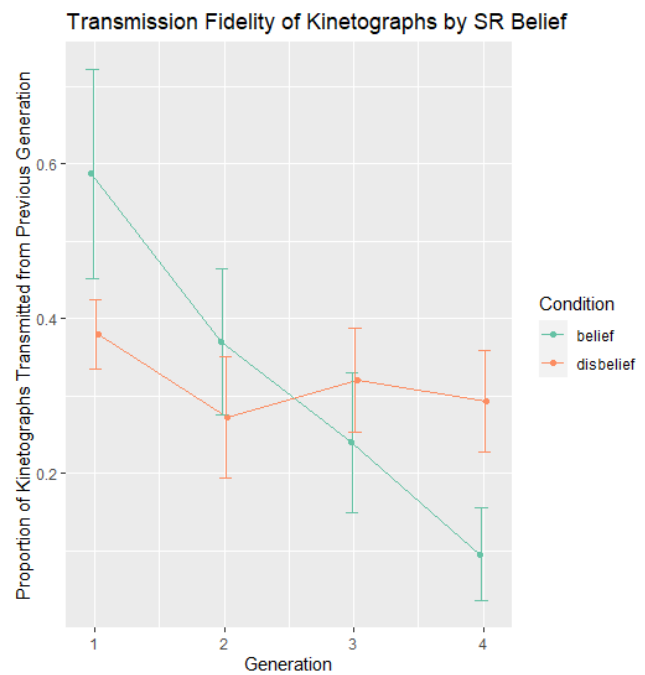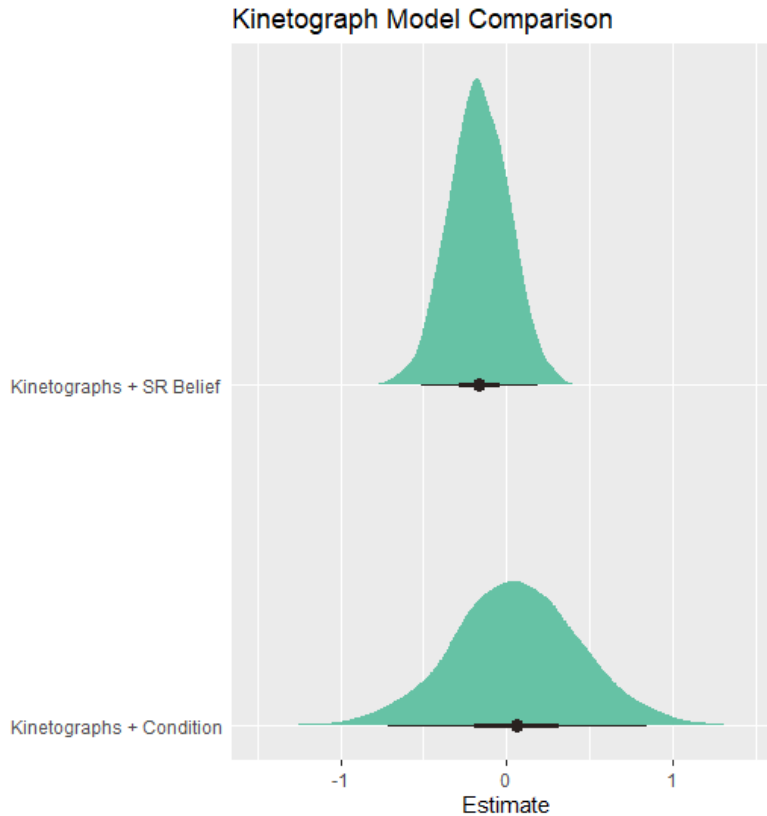

Figure 7 Parameter estimates and 95% prediction intervals for main effects in each of the kinetographic models

Discussion

These findings support the hypothesis that self-reported belief positively influences the transmission fidelity of the verbal, but not the action-based, content of the ritual. The discussion of these results will therefore focus primarily on the transmission of verbal content. Firstly, I will argue that the influence of belief on the transmission fidelity of verbal ritual content could explain how such content is accurately transmitted despite the cognitive costs of transmitting such content. Then, I will explore the relationship between the influence of belief on transmission fidelity of ritual content, and literature concerning costly rituals. I will address the relevance of these findings to other believable content, and its relevance to literature concerning confirmation bias and credibility enhancing displays. Finally, I will explore the possible explanations for why neither self-reported belief nor the experimental condition had an influence on the transmission fidelity of action-based content.

Rituals, and the religions of which they are a part, have been argued to be cognitively challenging to learn, recall, and transmit (Kapitány et al., 2018; Whitehouse, 2004). Research has investigated aspects of rituals to do with the type of content included in them (Kapitány et al., 2018) or to do with the mode of their practice (Whitehouse, 2004), which is explored in order to better understand how they can be transmitted with high fidelity despite these cognitive challenges. The results of this experiment suggest that contextual cues could also help to answer this question. Similarly to other context-based social learning strategies, such as copy if uncertain, or copy if personal information is outdated (see Kendal et al., 2018 for an overview), in this case the actor copies if they believe that the ritual is effective, in the absence of proof that it is. This finding, combined with existing theories such as credibility enhancing displays, could be of particular use in explaining the transmission fidelity of imagistic rituals within informal religions that do not have orthodoxic doctrine or institutions to aid in the fidelity of transmission of the content of their rituals. The influence of belief could therefore work in addition to other mechanisms such as the impact of imagistic rituals on episodic memory (Whitehouse, 2004), to further enhance the transmission fidelity of such rituals. This could also potentially go some way to explain the results of Kapitány et al., (2018) who found that including a high proportion of ritualised gestures in a sequence decreased the recall of that sequence. The supplementary materials of the paper showed that sequences with a greater proportion of ritualised gestures were deemed less effective by participants, which in the light of the results from this experiment could therefore explain why they were recalled with lower fidelity. Future research could combine approaches to explore both varying the proportion of ritualised gestures in a sequence, and measuring participants' beliefs in the efficacy of the overall sequence, in individual recall experiments to further explore the interactions of belief and ritualised actions on the transmission fidelity of rituals.

The influence of belief on the transmission fidelity of ritual content is also of relevance to costly rituals, which are the subject of study due to the fact that at first they appear to have far greater costs than benefits, and therefore from an evolutionary perspective should not be sustainable. It is important to note that costly signalling theory (Grafen, 1990) has been applied extensively to costly rituals (Brusse, 2020; Sosis, 2003; Sosis & Alcorta, 2003) and therefore there is already substantial work explaining how costly rituals can be maintained due to the hidden benefits of engaging in them (such as retaining membership of a group and benefiting from the shared resources of that group (Sosis, 2003)). However, the results of this research could complement this body of literature by demonstrating that belief is potentially an additional factor which ensures rituals, theoretically including costly rituals, are transmitted with high fidelity, which would therefore mean that the costly rituals remain costly. It is also the case that costly rituals themselves constitute credibility enhancing displays (Henrich, 2009) which have been shown to increase the beliefs of a viewer in the framework which the display is designed to make credible. Therefore, since costly rituals can be seen to enhance the likelihood of an observer believing that the ritual achieves its alleged purpose, the influence of belief on transmission fidelity as demonstrated in this research could ensure that the costly ritual is transmitted to the observer with high fidelity. In this way, costly rituals as credibility enhancing displays and the influence of belief on transmission fidelity work together to ensure that the rituals are transmitted accurately.

The findings of this experiment are potentially of relevance to literature concerning the confirmation bias. Research has already demonstrated (Nickerson, 1998) that humans are more likely to pay attention to and transmit content which adheres to their existing beliefs, and so it should be no great surprise that the results of this experiment suggest that humans also transmit content with higher fidelity if it adheres to their existing beliefs. This research extends the literature concerning the confirmation bias which is typically interested in the preference of different content, or the systematic transformation of contrasting content to make it conform more closely to existing beliefs. The results of this experiment indicate that information which already adheres to the existing beliefs of the participant will be transmitted with higher fidelity, which could be due to the fact that it does not need to be transformed to adhere to their views, but rather it should be preserved so as to remain in adherence to their views.

It should be noted that the findings of this experiment can be applied to other believable content which is transmitted among humans, such as misinformation and even conspiracy theories (e.g., Franks et al., 2013). If believing that certain content is true increases the fidelity of that content's transmission, then belief could be protecting harmful content during transmission, as well as beneficial and neutral content. However, this also means that lowering belief in such content could make it easier for the content to be transformed to a less harmful form during transmission; for instance credibility

undermining displays (Turpin et al., 2019) could be used to reduce observer belief in the truthfulness of content, following which even if they still chose to transmit it, they may do so with lower fidelity. This is one area in which the results of this study could be applied for positive societal impact.

Regarding the action-based content, I will now address some possible explanations and suggestions for future work. Firstly, it is possible that the transmission fidelity of the action-based content was not influenced by the self-reported belief of the participants because they did not believe the actions were connected to the efficacy of the ritual. Secondly, the absence of an influence of belief on the transmission fidelity of the action-based content could be due to either a floor or ceiling effect.

The self-reported belief of participants was collected based on their experience of, and opinion regarding, the entire ritual. This means that participants who believed in its efficacy due to the words in isolation of the actions could have transmitted the propositions with greater fidelity than the kinetographs, leading to this distinction in the results. Future work could aim to address this issue by asking participants to record their beliefs concerning the mechanisms by which the ritual was effective. Doing so could elucidate whether participants were attributing efficacy to the verbal or action-based content, or to a combination of both. Since it is not possible to determine the answer to this question currently, it is therefore possible that participants did attribute their belief in the ritual to both the actions and the verbal content, therefore I will address the other proposed explanations.

One of the strengths of this particular experiment was its pioneering approach to exploring transmission fidelity of action-based content through the development and implementation of a kinetographic coding framework to capture the change in movements during transmission. However, the lack of other transmission chain experiments featuring actions as the material to be transmitted made it more difficult to assess the appropriate length and complexity of the actions in the ritual. It is therefore possible that either a floor or ceiling effect influenced the transmission fidelity of the ritual actions. Either the ritual was too simple, and therefore too many people transmitted it with high fidelity regardless of their experimental condition or self-reported belief, or the ritual was too complex, meaning too few people transmitted it with high fidelity regardless of their beliefs in it. Future research could be conducted using the kinetographic coding framework to explore the transmission fidelity of sequences of actions with varying lengths and complexities to determine what the appropriate baseline is. Such an endeavour would be beneficial not only to researchers interested in the transmission of rituals, but to research concerning dance, music, and even tool production.

Prediction 1A was supported when self-reported belief was considered, whilst prediction 1B was not. The experimental condition had no effect on transmission fidelity of propositions or kinetographs. This suggests that self-reported beliefs, based on prior beliefs in rituals, did have an influence on the

transmission of the verbal ritual content. This finding could be of relevance to various areas of research in the cognitive science of religion, especially for scholars interested in how rituals, including but not limited to costly rituals, are maintained over time despite cognitive and practical costs or barriers. Future research could build on these findings to explore in more detail the relationship between belief and other factors of interest such as the costliness of a ritual or the proportion of ritualised actions in a sequence. Additionally, the kinetographic coding framework that was developed for this research could be used to explore the transmission of action-based and cross-modal content in not only rituals, but other action-based cultural traditions such as dance.

Hypothesis two: does belief influence the longevity of a ritual's survival?

To determine whether the ritual was survived for a greater number of generations in the belief condition than the disbelief condition, a non-parametric independence test was conducted using the *coin* package in R (Hothorn et al., 2008) due to the fact that there were ties in the data. The test was conducted comparing the generation at which the ritual's transmission failed to occur for each chain. In the sample (N=18), 6 chains (33.3%) survived for all four generations, 4 chains (22.2%) survived for three generations, 3 chains (16.7%) survived for two generations, 1 chain (5.5%) survived for one generation, and 4 chains (22.2%) did not survive past the seed ritual (**Figure 8**). The independence test showed there was no significant difference in the longevity of the ritual between the belief and disbelief chains (Z = -0.44, p = 0.65).
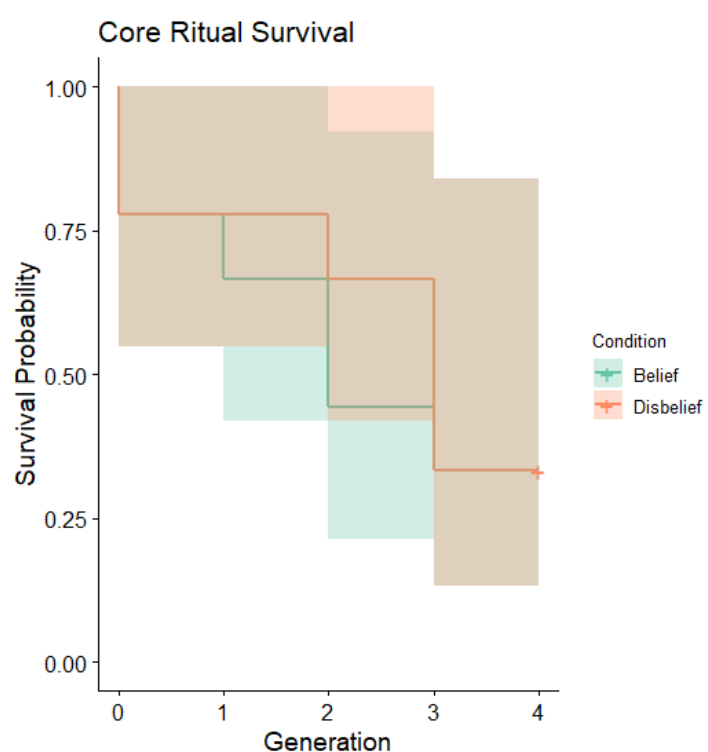
Figure 8 Survival Longevity of Core Ritual by Experimental Condition

To indirectly explore the longevity of the ritual's survival without comparing between chains, since the condition primer had already been shown to have no influence and the chains were not organised into believers and nonbelievers, each participant was additionally recorded as either having transmitted the core ritual or not having transmitted it. The criteria to be met for a failed transmission were the same as for the chain comparison. A subset of the data was created, removing all participants in subsequent generations of a chain where the ritual had already ceased to be transmitted. This was

because they were only able to watch the previous participant's demonstration, and therefore the ritual was not revived after it had been lost in any of the chains. A Pearson's Chi-Squared test was conducted to determine whether the self-reported belief of the participants had any effect on the likelihood that the ritual would survive. In the sample (N=55), 12 (21%) did not transmit the core content of the ritual, of which 3 had indicated they did believe in the ritual. This is consistent with the overall proportion of believers in the whole sample (**Figure 9**). A Pearson's chi-squared test
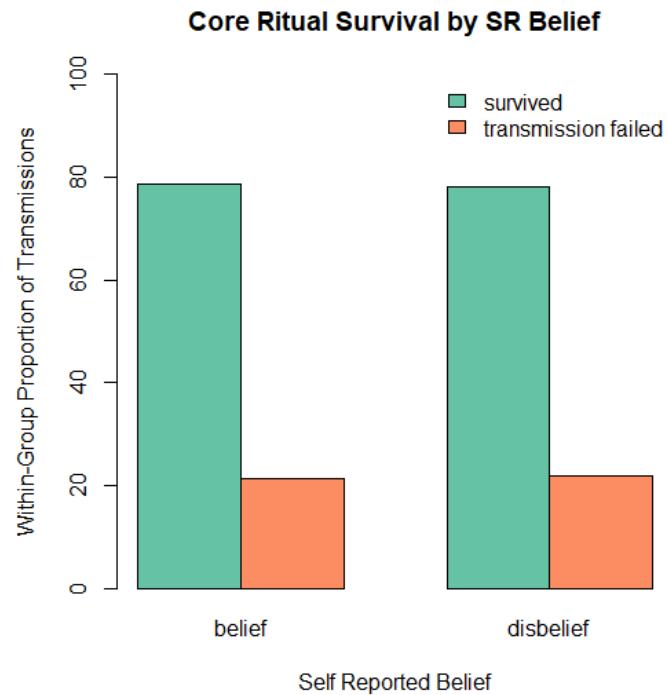
Figure 9 Survival Probability of Core Ritual by Self-Reported Belief

showed there was no significant difference between believers and non-believers in the transmission of the core content of the ritual than expected by chance ($\chi^2(1) = 0$, p = 1).

These results indirectly indicate that it is unlikely that belief influences the longevity of a ritual's transmission. This is due to the fact that they demonstrate that self-reported belief does not have an effect on the likelihood of the core ritual content being transmitted or omitted in each transmission event. It is therefore reasonable to assume that over time, groups of self-reported believers would not differ from groups of self-reported disbelievers in terms of the transmission longevity of the core content of the ritual.

Discussion

That the core content of the ritual was transmitted with consistent fidelity across participants in both experimental conditions and with both self-reported belief and disbelief in the ritual is an interesting finding primarily because it appears to contradict the results concerning the influence of belief on overall transmission fidelity. Although believers transmitted the whole ritual with higher fidelity, the same was not true for the 'core' content of the ritual. There are several possibilities that could explain this finding. Firstly, there could have been a ceiling effect where the core elements of the ritual were stably transmitted to the same degree by believers and nonbelievers because the chains were too short to be able to determine any difference between the two groups. Secondly, the results could

reflect some of the literature on overimitation that overlaps with research on rituals in the cognitive science of religion; the difference in transmission fidelity between the two groups occurring in the content that was extraneous to the core purpose of the ritual could indicate that believers were overimitating the entire ritual more than nonbelievers were. It is also possible that the choice of ritual 'purpose' led to that propositional content benefitting from other cognitive biases, such as the prestige bias, social bias, or even survival bias, since the core ritual purpose was to improve 'luck and success' and referred to a uniquely lucky man who had invented the ritual.

I will address each of these possibilities in turn in greater detail.

Since this was one of the first transmission chain study using a video of a ritual as the source material to be recreated by participants, there was not enough suitable literature to determine the necessary length of chains to prevent a ceiling effect from occurring. The core content of the ritual was lost a total of 12 times across 18 chains, mostly occurring in either the first (n=4) or the fourth (n=4) generation. This could indicate that the core content of the ritual was too difficult to remember, or that the ritual itself was too long or too complicated, and therefore that too significant a proportion of the content was lost in each generation. This is especially relevant for content such as religious rituals which in real life are not transmitted after only two demonstrations and one practice attempt but through long periods of repeated demonstration and practice, and often active teaching and learning as well. Additionally, the 6 chains which retained the core content of the ritual for all four generations could indicate that longer chains are necessary to establish whether there is an influence of belief on the transmission of the core content of the ritual. Finally, due to the design of the experiment, chains were not organised into believers and nonbelievers, since actual belief in the ritual was only recorded after each participant had recorded their version of the ritual. The experiment was designed so that the chains could be compared according to their condition to determine the longevity of transmission of the core content across each chain, but since the condition was found to have no influence on actual belief or the transmission fidelity of the overall ritual content, it is unsurprising that the longevity of the ritual did not vary by experimental condition. Future research could aim to resolve these queries by varying the length and complexity of the seed ritual, increasing the number of generations per chain, and/or pre-surveying participants to explore attitudes to rituals in order to assign them to chains based on their belief in the ritual, to enable survival analysis to be carried out.

Overimitation is the term used to describe the copying of behaviours that are not explicitly linked to a particular goal. It is argued to be crucial for understanding human cumulative culture (Boyd et al., 2011), and is a potentially universal (Nielsen & Tomaselli, 2010) human trait which begins at a very young age (Nielsen, 2006), and persists even when the behaviours are completely causally irrelevant

(McGuigan et al., 2007). Humans express both the ability to overimitate and the tendency to do so; a tendency which can be adaptive if the link between the behaviour and the goal exists but is not immediately obvious (enabling cumulative culture since advancements can be built on existing frameworks without needing to learn or design from scratch every time), or can be neutral or even maladaptive if the link between the behaviour and the goal does not exist (e.g., wasting time or resources because a model did so and the expenditure of those resources is not necessary to achieve the desired end result). Overimitation can therefore be a useful framework for understanding ritual practice among humans, since we have a propensity to copy models even if the link between the behaviour and the outcome is not evident. It is therefore also potentially a useful concept for understanding why the overall ritual in the experiment was transmitted with more variable fidelity than the core content of the ritual itself. Perhaps the believers had a greater tendency towards overimitation than the non-believers, leading them to transmit the whole ritual, including both actions and verbal content, with higher fidelity, whereas transmission of the core content was consistent across both groups because it pertained to the desired end result and not the unclear behaviours that may be linked to that end result.

There is a large body of literature dedicated to the exploration of social learning strategies (see Kendal et al., 2018 for an overview), which can be divided into context- and content-dependent biases for what information to learn, when, and from whom. It is possible that the purpose of the ritual, to 'improve luck and success' could be considered to be exploiting one of these biases and therefore could have been transmitted with consistent fidelity independent of the beliefs of the participant. Since the purpose of the ritual was tied to a story about a particularly lucky and successful man, it could benefit from the social information bias (Mesoudi, Whiten, & Dunbar, 2006), which states that humans preferentially transmit information that is social (i.e., pertaining to other people, or relationships with other people) over information that is not social, such as environmental information. It could also potentially benefit from the prestige bias (Henrich & Gil-White, 2001) . However, this connection is less strong because the demonstrator was not high-prestige, only the man referenced in the story about the origins of the ritual. Finally, it is possible that the core purpose of the ritual benefitted from the survival information bias (J. M. Stubbersfield et al., 2015) since 'luck' and 'success' are qualities which could contribute to the survival and reproduction of any person who gains them. However, for both the survival and prestige biases it would appear necessary for the participant to believe in the story and the ritual's efficacy for the biases to be relevant, in which case we would expect to see an influence of belief on the transmission of the core content of the ritual, which as shown did not occur. The explanatory potential for social learning strategies and content or context

biases concerning the consistency of transmission of the core content of the ritual across both believers and nonbelievers is therefore limited.

The prediction for hypothesis two were not met, and therefore the null hypothesis cannot be rejected. There are some possible limitations of the experimental design which could explain the lack of support for hypothesis one, in particular the possibility that a floor or ceiling effect influenced the transmission longevity of the core content of the ritual, limiting the amount of influence that belief could have. Additionally, it is possible that due to social learning strategies such as the survival or social information biases, or the tendency for humans to overimitate, the core content of the ritual was not transmitted with higher fidelity or longevity by believers than nonbelievers, whilst the overall verbal content of the ritual was. Future research could aim to address the limitations in the experiment design to determine whether a floor or ceiling effect was in place, or vary the content that comprises the core content of the ritual, for instance by modifying the ritual's purpose, in order to explore the possible influence of social learning strategies on the transmission longevity of the core content of rituals.

Hypothesis three: does causal opacity influence the fidelity of the transmission of content?

In the sample (N=72), 20 participants (27.7%) transmitted both points successfully, 31 (43.1%) transmitted neither point successfully, 12 (16.7%) transmitted only the originally consonant point successfully, and 9 (12.5%) transmitted only the originally dissonant point successfully (**Figure 10**). While the most frequent result was that neither point was transmitted, in the instances where

Figure 10 Number of Participants who Transmitted the Ritual Points Successfully. FF: Both points failed to transmit. SS: both points successfully transmitted. SF: First point successfully transmitted, second point failed. FS: First point failed to transmit, second point transmitted successfully.

one point was transmitted, this was slightly more likely to be the case with the consonant point than the dissonant one. A McNemar's chi-squared test showed this was not a statistically significant finding when compared to expectations by chance (χ^2 (1) = 0.19, p = 0.66). This indicates that there is a nonsignificant negative influence of ritual opacity on the fidelity of the transmission of ritual content.

However, some of the successes in each of the points occurred after transformations had occurred which changed the content from dissonant to consonant, or vice versa. In the originally consonant

point, a total of four successful dissonant transmissions occurred after two instances where the content was transformed from consonant to dissonant. In the originally dissonant point, a total of nine successful consonant transmissions occurred after four instances where the content was transformed from dissonant to consonant (**Figure 11**). Across both points, a chi-squared goodness-of-fit test showed that there were significantly more successful consonant transmissions than successful dissonant transmissions than expected by chance (χ^2 (1) = 4.54, p = 0.03), meaning that overall both points in the ritual were more likely to become or remain consonant than to become or remain dissonant.
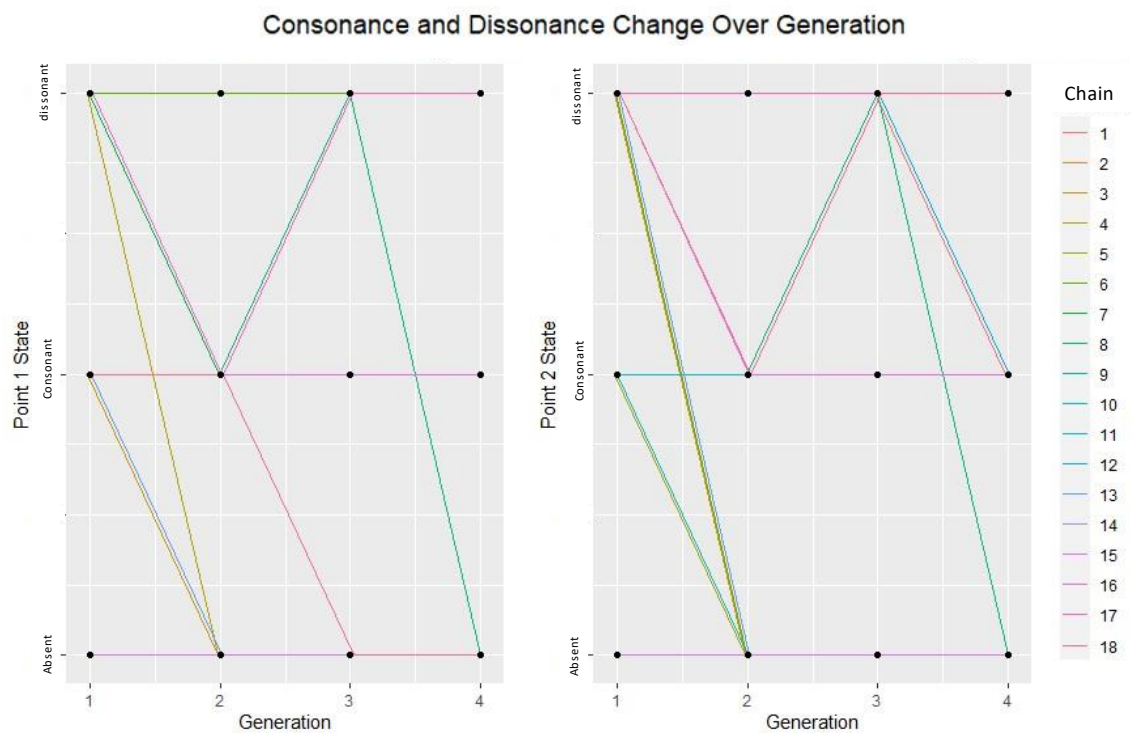
Figure 11 Consonance and Dissonance Change over Generation - point 1 (left) and point 2 (right)

A further McNemar's chi-squared test was conducted to compare participants against the seed ritual instead of comparing them to the participant's recording which they had watched. This was conducted to explore whether the originally consonant point was more likely to be successfully transmitted throughout the whole chain than the originally dissonant point, where successful transmission was assessed based on whether the point in the ritual matched the consonance or dissonance of the same point in the seed ritual. The test found that the consonant point was more likely to be successfully recreated by participants than the dissonant point, although this finding was not statistically significant (χ^2 (1) = 8.9, p = 0.34).

Taken together, these results suggest that consonance was transmitted slightly more successfully than dissonance, with the originally dissonant point being more likely to become absent or to be transformed into a consonant point and subsequently successfully transmitted. However, the lack of

statistical significance in the results indicate that more work is needed to explore the relationships between consonance, dissonance, and transmission fidelity.

Discussion

These results are relevant to a body of literature concerning causal opacity and rituals. Rituals have been defined (Kapitány & Nielsen, 2019) by their causal opacity and the goal demotion of actions within them, which has led to research questioning how ritualised behaviour (defined in the same paper as "any action that is typically causally opaque and goal demoted as a consequence of the repetition, redundancy, formality, and stereotypy of the motor features, and where accurate performance of process is prioritised over outcome" (ibid.)) can be memorable despite its cognitive costs (Kapitány et al., 2018). Firstly, I will address the definition of ritualised action by causal opacity, bringing a more ethnographic perspective to the links between meaning and actions, after which I will explore how causal translucency (Larson, 2023) could result in increased memorability and transmissibility of ritualised actions and verbal content.

Kapitány et al., (2018) explore how increasing the proportion of 'ritualised' gestures in a sequence affects the recall of that sequence, in order to understand how ritualised gestures influence the memorability of complex causal sequences such as rituals. Their findings indicate that high proportions of ritualised gestures in a sequence had a negative impact on memorability, which raises the question of how rituals, which typically feature a high number of ritualised gestures, can be stably transmitted between people. These findings are in line with the results relating to hypothesis three, and together suggest that greater extents of causal opacity (actions which are further separated from their goal outcome) negatively influence memorability of the actions in question, and greater proportions of causally opaque actions in a sequence negatively influence memorability of the sequence overall. Further research could elaborate whether the influence of causally translucent and causally opaque actions damage the memorability of causally transparent actions in the sequence, or whether the effect is limited to the causally translucent/opaque actions themselves.

There is an important distinction to be made between ritual and 'ritualised action' in the context of causal opacity. Kapitány et al., (2018) specify that ritualised behaviour does not refer to symbolism or culturally shared meanings, but instead is tied to the causal opacity and goal demotion in an action or series of actions due to its "repetition, redundancy, formality, and stereotypy" (Kapitány & Nielsen, 2019). This is similar to many definitions of ritual, however, which also refer to repetition, stereotypy, formality, and redundancy. In specifying that ritualised behaviour does not refer to symbolism or culturally shared meanings, Kapitány et al., (2018) are stressing the causally opaque characteristic of rituals when viewed from a mechanistic and detached point of view, which is helpful in understanding

how and why causally opaque behaviours exist, but leaves out some important context. Rituals are a cultural behaviour, and are embedded with cultural meaning. As Larson (2023) points out, whilst kneeling to pray might not have any direct, natural causal link to the desired outcome of praying, kneeling is a recognisable cultural gesture to signify respect and submission to an authority. With this knowledge, kneeling and praying have causal links; the desire to express submission and respect to the deity to whom the prayer is being directed. When the cultural meaning of the action is known, some causal links can be inferred from many ritualised actions. Therefore, Larson (ibid.) recommends the term 'causal translucency' to signify that there are detectable causal links between a ritualised action and its desired outcome, although those links are only detectable after knowledge of cultural norms and meanings are gained. This argument reflects Geertz's (1973) famous analogy of the wink in his distinction between thin and thick description: is a wink the mechanical twitching of an eye muscle, or a means of communicating conspiratorial intent? The cultural context is necessary to understand the action. I argue that the case is the same for rituals and ritualised actions.

The tentative findings of this experiment suggest that causally opaque ritualised actions are transmitted with lower accuracy than causally translucent ones, which is in line with the existing literature on causal opacity and memory. However, future research should investigate the relationships between varying extents of causal opacity and the resultant memorability of a sequence, bearing in mind the causal translucency of many ritualised actions in real rituals. The ethnographic section and general discussion will further elaborate on examples of causally transparent and opaque rituals in light of this section.

Qualitative Results and Discussion

This section will explore the key findings from the ethnographic research. Because the ethnographic and experimental research was conducted concurrently, and ethnographic research is by nature more explorative, some themes came up across interviews and participant information which the experiment had not been designed to investigate or even consider. These should be taken into consideration for future research where possible, and also illuminate the strengths of conducting ethnographic research. I will address the actual transmission of rituals within an informal religious group across several decades, by presenting an account of the rituals I participated in alongside the Brigid's Fire coven. I will also demonstrate the importance of group identity for the stable transmission of rituals in the context of Wicca, using Anderson's (2000) concept of the imagined community to show that there are social and cultural forces as well as the cognitive ones explored in the experiment which help to shape the change, or absence of change, in a ritual over time. The majority of the theoretical

analysis will be reserved for the general discussion section, which will bring together findings from the ethnographic and experimental research.

A Litha Ritual

I followed a long dirt and gravel path, across grassy fields towards a wooded area, listening attentively for the familiar voices from the moots I'd been to. I wasn't sure exactly what I was looking for beyond the description of 'roundhouse,' and I hadn't seen a single person since I arrived and started my walk. Finally, between the trees a small circular hut emerged. Hoping that I wasn't in the wrong place, I entered the makeshift doorway, unsure what to expect and found a group of about 15 people, many of whom I knew but some I didn't, gathered around and chatting in small groups. The floor was earth with wood chips, the seating wooden stumps and crates (with a few plastic schoolchairs dotted about), and the walls and ceiling made from sturdy branches and what appeared to be wattle and daub. There was an opening in the roof, wide enough that we could see the trunks of trees around us, and the green canopy above. Below it, the unlit fire sat on a bed of raised earth and coal, separated from the rest of the ground by four thick logs forming a rectangle. Two tables had been set up: one laden with food, the other clearly the altar, bearing chalices, candles, statues of deities, athames[6], and branches from an oak and a holly tree. In the corner was a bowl filled with shortbread biscuits, each topped with clotted cream and a strawberry, and a bottle of mead.

The dedicants[7] were mostly dressed in flowing, loose clothing; dresses, capes, tunics and long skirts, although some were in jeans and a t-shirt. A sizable minority wore matching tunics in different colours, reminiscent of a uniform and clearly marking their identity as members of the group. While we chatted and greeted newcomers with hugs and kisses, a priestess blessed the space, moving about the room in a circle, clockwise, holding an incense stick which danced about in the air as she spread its sweet smoke along the walls and across the seated dedicants.

Before the ritual began, our High Priestess handed out papers containing the order of the ritual, and the wording for the parts we'd all join in for. Those with special roles received additional sheets. One person, representing the East, had fallen ill, so someone else was invited to step in and take their place.

Seated in a circle as wide as the roundhouse permitted, we began.

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[6] A small, ceremonial knife or other blade.

[7] All the members of the coven, plus a few 'friends of' the coven, myself included, are referred to as dedicants. Coven members who were initiated to the first (of three) degree are 'acolytes', those initiated to the second degree are referred to as Priest(esse)s, and third degree initiated coven members are High Priest(esse)s. The vast majority of the group were initiated into the coven, but where I did not know which degree they were initiated to, I referred to them as dedicants.

First, our High Priestess delivered a talk about the significance of the Litha ritual and the history of the celebration, both in terms of why it is celebrated (to mark the summer solstice) and when it is celebrated (calendars and astrology are a passion of hers), then she and the Magus[8] invited all of the dedicants to join the circle, symbolising our entrance into the ritual space. The High Priestess and the Magus formed an arch between the altar and the fire, each holding an athame and crossing them against each other to form a barrier. That the barrier had been formed to ensure dedicants only entered the circle when granted permission to do so was clear, but the reasoning behind using athames to form the barrier was obscure. Much like the blessing of the space with sweet smelling incense before we began, using athames to signify our entrance into the circle conveyed the special qualities of a ritual (Kapitány & Nielsen, 2019). Each dedicant took their turn to approach the entrance, moving sun-wise around the fire, where we were asked "how do you enter this circle?" and responded, "in perfect love and perfect trust." Luca noticed me flipping through my handouts; we were the last two dedicants to enter the circle, and I couldn't hear what people were saying at the entrance. He leaned in to whisper instructions, which were missing from the pages, possibly deemed too obvious by initiated dedicants to require the memory aid granted by the handouts.

> *"You will be asked how to enter the circle. You must respond 'in perfect love and perfect trust,' and then they'll separate their athames so you can pass through."*

I repeated the six words when my turn came, and the athames separated, allowing me to enter the circle. Once Luca had joined me, the Magus and High Priestess invited each other into the circle using the same verbiage as for the rest of the coven, after which the blessing of the salt and water took place. This part of the ritual only involved the High Priestess and the Magus, and they stood at the altar, with their backs to us and to the fire, as they used the items on the altar. We sat quietly, but even so I couldn't make out what they were saying. This was the most causally opaque part of the ritual-not helped by my inability to see or hear clearly what was taking place at the altar, and as a result I would not be able to transmit this aspect of the ritual to another no matter how sincerely I believed in its efficacy. Once complete, the salt and water were mixed together, and the Magus traversed the circle sun-wise, dipping a large white feather into the mixture and sprinkling it gently over our heads, murmuring 'blessed be' to each of us as he did so. Afterwards, we were all invited to take a few steps closer to the fire, so as to enable the Magus to walk around us, forming a loop within which we were all contained, whilst reading out the necessary prose from his printout, and holding the athame in the

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[8] The coven does not have a High Priest, so for each ritual a Priest or Priestess takes on the role of Magus in his place.

air, pointing towards the centre of the circle. As soon as he'd finished, everyone turned to face the altar, as we prepared to invoke the guardians of the four cardinal directions to be present at our ritual. Here, four dedicants had previously been nominated to each call a quarter, and their handouts contained the wording to be used. I couldn't see each of them on their turn because we turned to face each direction before invoking its guardian, so my back was often to the caller, but West was reading from her script. We faced north first, having established its direction earlier, and because the guardians of the north were the first to be invoked to attend the ritual:

> *"I call upon the guardians of the Watchtowers of the North, the Earth*
> *of Growth, the rock of strength, and the sands of time. We invite you*
> *into this sacred space and ask that you aid us in our workings tonight!*
> *Hail and welcome!" To which we cried "Hail, and welcome!"*

Only the High Priestess and Magus were in my view, and both had raised their arms up in front of them with their palms opened to the sky, as I turned to the east I was facing the wall of the roundhouse with no-one in front of me, but when I turned again I saw how everyone had their arms out, whether high or low, fully outstretched or half-bent, palms forwards or upwards. I quickly adapted my own stance to better mimic those around me.

> *"I call upon the guardians of the Watchtowers of the South, the fire of*
> *rebirth, the flames of desire, and the embers of our soul. We invite you*
> *into this sacred space and ask that you aid us in our workings tonight!*
> *Hail and welcome!" To which we again cried "Hail, and welcome!"*

Once we'd made it back round to North again, we sat for the High Priestess's statement of purpose, which she read from a typed copy on a piece of paper. She later confirmed the typed notes were a memory aid and were necessary for her to make sure all the details were included accurately. She reminded us of the purpose of the ritual; to mark the summer solstice and the passing from the waxing year to the waning one, and the transition from the rule of the Oak King to that of the Holly King, mythological characters of ancient Britain who battled for dominance at the solstices and alternated in their victories. From the printed order of the ritual, I could see that we'd be enjoying a reenactment of this mythological battle later. But first, one of the more well-known ritual elements for a Wiccan coven; Drawing Down the Moon. Still seated, we watched as the Magus read out an invocation whilst the High Priestess stood in front of him, with her arms outstretched and her face turned towards the opening in the roof of the roundhouse. The ritual pulls the moon goddess down into the body of the High Priestess where she resides for the remainder of the Litha ritual. As in the invocations of the guardians of the four cardinal directions, the High Priestesses pose and movements were connected

symbolically to the purposes of the ritual, although a literal interpretation which excluded the symbolism or the intentions of the movements would render the links between them and the purpose of the ritual causally opaque. Embodying the moon goddess, the High Priestess read out the poem "Charge of the Goddess," written by a famous Wiccan High Priestess called Doreen Valiente.

Luca shuffled in his chair next to me, and I remembered that the next item on the ritual order involved the whole group. This time, our physical actions were described as well as what we needed to say, but he whispered to me anyway,

> *"we're going to get up and hold hands in a circle now around the fire*
> *to swear our Druid Oath."*

Foolishly, I placed my papers on my chair behind me as I stood up. Everyone else had done the same and I was caught up in trying not to stand out and neglected to consider that I hadn't learned the oath in previous rituals, unlike the rest of the group. Thankfully our High Priestess led the oath confidently, and I was able to copy her words, lagging behind her only slightly. The oath was repeated three times, and by the third I knew it;

> *"We swear by peace and love to stand // Heart to heart, and hand in*
> *hand // Mark, oh spirit, and hear us now // Confirming this, our sacred*
> *vow."*

Presumably, the rest of the group had had multiple opportunities to copy the High Priestess as I had done, and in so doing, learn the words themselves, because all but a few of them left their papers aside and repeated the words from memory in synchrony with the High Priestess. Although the Druid's Oath was written on the order of the ritual, unlike other clearly familiar moments such as the entering of the circle, this seemed to be a part of the ritual which was memorable enough to be transmitted by observation, imitation and repetition alone, like the transmission of the ritual in my experiment, rather than by reliance on memory aids. Several chants, for which we all read from our song sheets and were accompanied by a recording with guitars and singers, played on a CD player, and several personal contributions of poems passed before it was time for the battle of the Oak and Holly Kings.

Three dedicants stood to perform the dramatic retelling; a narrator, an Oak King, and a Holly King. The Kings donned crowns made of the branches and leaves of their namesake trees, and took up staffs which I later learned had been sourced from the woods we were in prior to the ritual. They acted out a fight with their staffs – this was a very lively and unserious affair, until the High Priestess eventually intervened to remind them there was a script that they were neglecting. The Oak King's staff broke in half during the battle, and the Holly King's crown was knocked to the ground, neither of which had

been planned, and the dramatic language deteriorated into jokes and jibes from the audience about the Holly King's risk of loss, to which she quipped that she was still going to win because it was Midsummer and winter would soon be approaching, when the High Priestess interjected, "you're supposed to read your words out!" prompting them to get back on script and finish their dramatic reenactment. The Holly King defeated the Oak and threw both pieces of her staff into the fire. We applauded, and picked up our pages again to turn to the next section of the ritual.

More chants, prayers, poems and readings ensued after which another participatory section was due: the Witches' Mill. This involved a lot of movement and reciting a long invocation whilst circling the fire, so our High Priestess first read out instructions to ensure everyone knew what to do, including a note on the pronunciation of Aradia – normally pronounced Ah-Rah-Dee-Ah by the coven, but since we were chanting along to a recording by Patricia Crowther who pronounced the Goddess's name "Ah-Ray-Dah", we were instructed to adopt the same pronunciation as the recording in this instance. The Witches' Mill is a ritual used to raise the combined power of the coven to send a spell out into the universe, and in this case in particular to support some members of the coven who were dealing with personal issues at the time. We were instructed to circle the fire sunwise, led by the Magus, and chanting Aradia at the end of each line of the invocation, read out by the Magus, which was 13 lines long and would be repeated three times in total. As we chanted and circled we were to increase our speed and energy, and at the end throw our energy down to the fire, as we intoned "ehh-ohh-ahh-ehh-ahh-ohh-umm" in a long continuous sound that resonated like a humming, and whilst repeating this lifted our energy up, and raised it out of the roundhouse, where it would form the shape of an inverted 'Cone of Power' (see **Figure 12**).
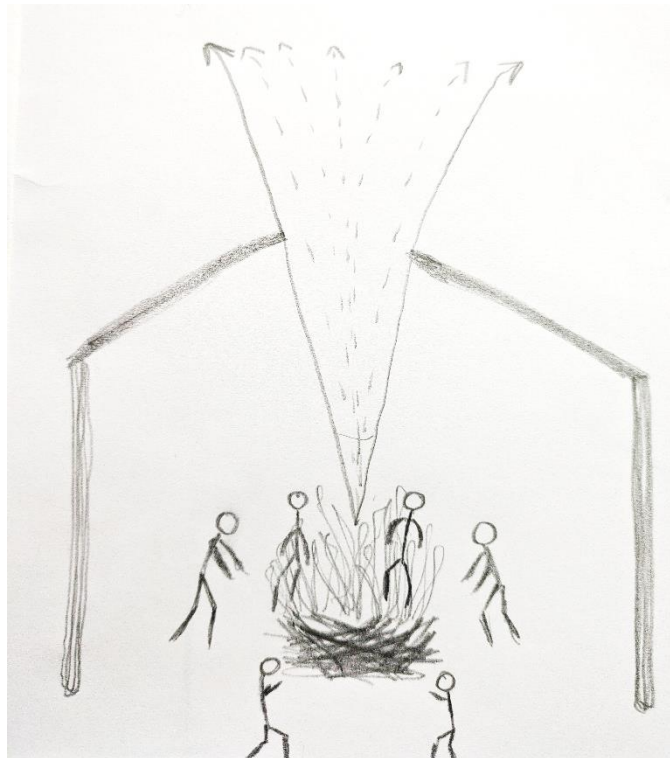
Figure 12 Fieldwork sketch showing the Witches' Mill and Cone of Power

There was some confusion after the first repetition had been completed; some dedicants stopped circling the fire to throw their energy at it, and others quickly copied, before the High Priestess (who was sitting out of the Witches' Mill due to mobility issues) reminded us there were another two repetitions to go, and we resumed our circling of the fire. As we circled the fire our chants grew louder

and faster, and the energy was palpable by the time we were throwing it to the fire and raising it out to the universe. One dedicant remained standing by the fire, his arms outstretched to the sky and his body faintly trembling for a few seconds longer than the rest of us. Again, once the purpose of the ritual was clear, the movements were symbolically linked to it; offerings were often placed in the fire and so to throw our energy down in the same way before raising it up was a causally translucent action, and the action of turning rings around the fire whilst chanting faster and faster had the effect of generating a feeling of energy and power in the group, whereas remaining seated and chanting in progressively slower and slower fashion would have had the opposite effect. Perhaps the links between the actions and the intention of the ritual in terms of their meanings make it easier to remember and therefore to accurately transmit to others; as in other parts of the ritual, our instructions on the order of the ritual referred predominantly to the words that were to be spoken, and the actions we were to take were communicated verbally.

One more section of accompanied chants and contributions of poems and prayers followed, before the wrapping-up of the ritual began with the sharing of the cakes and ale. This was another aspect of the ritual which, like entering the circle, clearly was considered self-explanatory, and I was once again grateful to Luca who leaned over to whisper that I should respond 'Blessed be' when offered a cake and a drink. The High Priestess and the Magus each made their way around the circle sun-wise but separately, offering the strawberry-topped shortbreads (cakes) and blessing the receiver "may you never hunger", and a sip of mead from a drinking horn (ale) with the blessing "may you never thirst", another example of causally translucent ritual content, which again was being transmitted through observation, imitation and repetition rather than via the written instructional memory aids. Some people reserved a small amount of their cake in their palm and crumbled it over the fire in silence once they'd received both cake and ale.

It was time for devocations; working widdershins[9] this time, beginning facing west and calling to the west, the representatives of the four cardinal directions thanked the guardians of that corner for their presence and protection at the ritual and bid them 'hail and farewell,' met with a cry of 'Hail and farewell!' from the rest of the coven. Re-tracing our steps from earlier, we stepped closer to the fire so the Magus could un-cast the circle around us, and the ritual was complete. We were invited to stay, talk, eat, and drink, and I made a mental note to bring food should I be invited back for another ritual. As we chatted about our lives, the fire slowly died out, and the ashes were eventually spread out and then gently doused. I hadn't noticed the hazy quality in the air until it began to clear. I looked at my

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[9] Counter to the direction of the sun.

watch and noticed that three hours had passed. The normal world was seeping back in through the now-open doorway and the opening in the roof.

General Discussion

This section will combine findings from the experimental and ethnographic research, demonstrating how the findings of each part of the research challenge, extend, and complement one another. I will first address the interactions of belief and other factors on the transmission fidelity of ritual content across both aspects of the research. Following this, I will explore the survival of the ritual with a view to what future research could do to expand on the findings of this research, and the benefit of incorporating ethnography to research on rituals. In this section I will focus particularly on the benefits of ethnography for basing how rituals are defined and how rituals for experiments should be designed especially in real-world contexts. Finally, I will focus on causal opacity in rituals, both in terms of the presence, or absence, of causal opacity in the rituals I participated in during my ethnographic research, and of the effects that causal opacity, explored indirectly via cross-modal consonance and dissonance, had on the transmission fidelity of the ritual.

Rituals and Transmission Fidelity / Memory and Belief

The experimental research indicated that belief did have a positive influence on the transmission fidelity of the verbal ritual content, and no effect on the transmission of the action-based ritual content. This suggests that belief in rituals could act in conjunction with other factors which enable or prevent rituals from being transmitted with high fidelity, such as the confirmation bias or the cognitive costs associated with remembering a sequence which contains a high proportion of ritualised content. However, real-world rituals are recalled and transmitted with high fidelity due to a number of factors not captured by these recall experiments, and therefore ethnographic research should be considered in the discussion of the experimental results.

The High Priestess of Brigid's Fire brought numerous copies of printed orders of the ritual to each ritual, including additional sheets for those with a larger role in the ritual. The actual proportion of the rituals which the members of the coven would have been able to recall accurately without their physical memory aids is unknown but given the amount of time people spent looking at their pages, it would be fairly safe to assume that a lot of the specific wording would be altered. The extent of these alterations and whether the same meanings would still be conveyed, albeit in more direct, less archaic language, would be an excellent point for future study. However, the secretive nature of much of modern Pagan and Wiccan practice would make taking recordings and conducting propositional analysis a challenge, not considering the ethical issues in requiring a group of people to recreate a

ritual solely for the purposes of it being recorded and likely in addition to their actual performance of that ritual.

In addition to having memory aids, the mere act of repetition also serves to embed content more securely in one's memory, enabling higher fidelity transmission of that content, a factor which again the experiment did not adequately address due to the limitations of feasibility. In the experiment, participants were able to watch the video once, recreate it, watch it again, and recreate it again. However, in my involvement with Brigid's Fire, I found that by my third ritual (each spaced at least a month apart), I could recall the Druid's Oath (a short oath of three lines, repeated three times in a row during each ritual) from memory perfectly without the need to look at the written version. Incidentally, I also was able to learn the ritual that I devised for the experiment within an afternoon, so that I could record a demonstration of it in which I wasn't reading from a script. Clearly, then, repetition alone enables high fidelity transmission of ritual content since the content is committed more accurately to the learner's memory and therefore repeated with fewer errors.

In an extension of the repetition argument, it's also evident that many religions require that followers, albeit sometimes only a select few specialists, undergo extensive training in order to perform and transmit rituals. This is true of Boyer's (2020) 'informal' religious traditions as much as it is of formal religious traditions, and as true of Whitehouse's (2004) doctrinal mode of religiosity as it is of his (ibid.) imagistic mode. In the coven of Brigid's Fire, as with the majority of Wiccan covens, dedicants are required to undergo intensive periods of study and practice of at least one year prior even to their first initiation, with further study and practice taking place before each additional initiation, prescribed by the coven's High Priest and High Priestess. The High Priestess of Brigid's Fire described the process to me in more detail, and how dedicants were assigned

> *"training materials to read and absorb, and then there'll be a task […]*
> *things that you have to do, it might be to find some herbs, or to cast*
> *a spell, or to make a potion, or anything like that. Or a private ritual*
> *as well – so perhaps it would be to perform one of these. And then*
> *they send me their [notes] and then I send out a response which is my*
> *reaction to what they did and whether I think they did it right or*
> *wrong. And so it goes on, from one full moon to the next".*

In addition to preparing for and attending eight Sabbats, the coven dedicants were also therefore busy working on their training with assigned tasks and readings due every four weeks, on which they were assessed and corrected if necessary. Of course, extensive training such as this is extremely difficult to replicate in an experiment, and the findings of experiments which do not replicate it are still valuable

and relevant to the study of rituals, but it is important to bear this context in mind when discussing the results of the experimental research. It can be true both that belief positively influences the transmission fidelity of a ritual, and that other factors such as repetition, training and supplementary memory aids such as written texts can additionally influence the transmission fidelity of the ritual.

Finally, the motivations of the individual who is transmitting the ritual must be taken into consideration. There is relatively little work exploring the role of intentional variation in cultural evolution, with the majority of research investigating which content is favoured under recall experiments. Stubbersfield et al., (2018) have demonstrated that intentional variation mimics recall-biased variation in an experiment which focused on the transformation of news stories through transmission. Wicca is an acephalous religion in which each coven operates on its own and under its own instruction and leadership, albeit often following a particular tradition. Initiates train up within their coven and then, once initiated to the highest degree, break away to become the High Priest(ess) of their own coven. I spoke to the High Priestess of Brigid's Fire about this process, and about the flexibility of the rituals as a result of this, and she confirmed that she was at liberty to re-write every ritual herself and choose which parts she wanted to keep, and which she wanted to reject or amend. She spoke a lot about how she could make up the ritual and *"steal mercilessly from everybody else,"* given that there's *"no kind of Wicca-central or anything like that, so I write [the rituals]"*. Yet the rituals I attended were not only similar to one another, they were similar to the rituals attended by Greenwood (2000), (Simes, 1995), and Luhrmann (1989). As elaborated on below, this is in large part due to the sense of identity and belonging conferred by retaining aspects of a unifying 'tradition' both dating back to covens and High Priest(esse)s of the past, and expanding obliquely into the covens which are due to spring up from her own. However, it was also apparent that a significant factor guiding this intentional variation, or perhaps more accurately intentional lack of variation, was her belief in the efficacy of the rituals themselves. Had she not believed that by invoking the guardians of the four cardinal directions, they would be present and protective during the ritual, she could simply have left that part out. Had she not believed that the witches mill would generate and focus the energy and power of the coven, enabling it to be sent out to aid other members who had been unable to join due to the difficulties they were facing in their lives, she would not have asked us to risk tripping and falling into the fire to do so. Belief therefore appears to positively influence transmission fidelity in the sense of guided variation as well as biased recall.

A final point which came up in several conversations and some of my interviews is that the members of Brigid's Fire avoided changing the rituals which they perform because the notions of tradition and heritage are important for their sense of identity as a Wiccan/Pagan amongst other Wiccans/Pagans. This is potentially especially important for informal religious groups for which members are more thinly

distributed and which may be viewed as a subculture. Engaging in traditions, wearing matching tunics, knowing that they are connected to other Wiccan covens through the similarities of their practice are all manifestations of 'heritage' as an intangible sphere of knowledge and symbolic references (Graham & Howard, 2008), which might be more important to help them feel part of a larger, organised 'imagined community' (Anderson, 2000). If this is the case, then that would explain why care is taken not to change the ritual too much when learning and transmitting it. Paganism and Wicca are eclectic religions. It's been said there are "as many Paganisms as there are Pagans" (Pearson, 2002), and practitioners identify with their own deity or deities, often borrowed from other pantheons (Greek, Roman, ancient Egypt, Hinduism, Celtic, Nordic, even Christian), and decide for themselves whether these deities are archetypes, metaphors, or real beings. Being able to identify with a group is therefore important for this thinly-spread, vastly diverse religion, and this may be the case for other informal religions which exist on the peripheries of formal ones. Perhaps because Paganism and Wicca are often defined by their eclectic nature, and encourage dedicants to find their own path and their own unique collection of beliefs and practices, the expression of community identity can be found in the intentional avoidance of amendments to rituals during transmission.

The experiment conducted as part of this research demonstrated that belief has a positive Influence on the transmission fidelity of a ritual, with implications for confirmation bias, costly rituals, and conspiracy theories. The ethnography conducted as part of this research complemented and extended these findings by providing real-world context about the additional ways in which Pagans ensure their rituals are transmitted with high fidelity, including their belief in them, but also including factors such as visual aids, repetition, training, and guided variation.

Rituals and core content/purpose:

The experimental results showed that there was no influence of either experimental condition or self-reported belief on the longevity of the ritual, measured by determining for how many generations the core content or purpose of the ritual was transmitted. This finding was situated in the overimitation and social learning strategies literature, and potential limitations of the study design were highlighted including the possibility of a floor or ceiling effect due to the complexity of the ritual. From a more ethnographic perspective, it is important to keep in mind that many rituals do not have a specific purpose or function other than veneration, and therefore the 'purpose' of the ritual might not be its most important feature in much of real-world rituals. In this case, it would make sense that belief could have an influence on the transmission fidelity of the ritual without influencing its overall survival; some rituals are re-used for different purposes or have no single, clear purpose at all, and yet are still transmitted between people.

Luca pointed out in our interview that the eight group rituals undertaken for the Sabbats on the Pagan Wheel of the Year were purely devotional in nature and served no specific purpose, nor sought any particular goal.

> *"I couldn't imagine a Sabbat not 'working,' if you know what I mean, because it's devotional […] if you are doing a ritual which contains a sort of spell like a […] specific prosperity ritual with a name, you might argue if you don't use that ingredient or if you don't say that word it might not work. I think in 2023, serious practitioners are all very aware that magic is made of many many things, and it would be very, you know, childish almost to claim that if you don't use a specific word, the ritual won't work."*

This reflected responses that my experiment participants had given in their interviews; among both the participants who did believe in the ritual and those who did not were several who dismissed the specific wording or movements in their explanation of *how* the ritual did or didn't work – focusing more on the attitude of the individual performing the ritual. Those who believed in the ritual sometimes suggested it had worked because they believed in it, and those who disbelieved suggested it didn't work because of their lack of belief and that if a believer performed the same ritual, then it might be more successful.

These qualitative data seem to indicate a challenge to the approach towards defining rituals typical of many cognitive scientists of religion, which focus on the routinised actions, where the emulation of the practice is more significant than the achievement of results (Kapitány & Nielsen, 2019). Instead, ritual practitioners and other laypeople when asked about ritual focus on the attitudes and beliefs of the practitioner, enabling more flexibility in the actual form of the ritual itself. This begs the question, though, if the specific words and movements of a ritual don't matter, why do they not undergo more significant changes when they are transmitted between people?

Perhaps a consideration of anthropological definitions of rituals is required in the cognitive science of religion. Simes (1995: 173-4) collated a series of definitions linked to the purpose and context of rituals and ritualised behaviour that comes from a more interpretivist approach, rather than the strictly mechanical view taken by CSR researchers. Rituals, she argues, are used: "as a marking point in changing social status (van Gennep, Eliade); to define rules of conduct and to serve as expressions of belief (Durkheim, Radcliffe-Brown); to define acceptable social behaviour and to establish social solidarity and stratification (Burns and Laughlin); to cope with stressful situations and personal life crises (d'Aquili); to play, act out and celebrate life's dramas (Schechner, Turner); to control the

unpredictable elements of society and the environment (Horton, Leach); to carry out practically any routine procedure, whether religious or secular (Goody, Lewis, Needham)." These interpretivist approaches to defining rituals speak to a more proximate exploration of rituals, whereas cognitive scientists of religion are often interested in the ultimate side of May'rs (1961) distinction (see also Tinbergen, 1963). I am therefore not proposing a complete blending of the two approaches, since making the distinction between proximate and ultimate causation is useful in developing research questions that can tackle every angle of an area of focus. However, I am suggesting that when designing experimental research to explore rituals, these interpretivist definitions should be considered against the design of the ritual in the experiment to ensure it is firmly grounded in actual ritual practices, thereby increasing its ecological validity.

Rituals and Causal Opacity:

The findings of the experiment demonstrated that a causally opaque action was recalled with slightly lower fidelity than a causally translucent one, however in real rituals such as those practiced by the Brigid's Fire coven, many aspects of a ritual are causally translucent, given that the actor understands the symbolism behind the ritual content. Even as a novice, without the same extent of relevant cultural and symbolic knowledge as the rest of the coven, much of the ritualised action undertaken as part of Brigid's Fire's rituals was causally translucent. I will elaborate on some examples from the rituals I attended to evidence this point.

> *Invoking the guardians of the cardinal directions*
>
> *I arrived early, to find I was one of the first few dedicants there. We'd been forewarned that our usual roundhouse was flooded. Thankfully, there were two alternatives on site, and the owners left it to us to decide which was the more appropriate for our purposes. One was a semi-circle with what would have been the straight wall completely open, and the firepit in front of it. The other was two semi-circles, each with the straight edge open, and a corridor running between them with a fire-pit in the centre. As I approached the conversation was centred on which roundhouse our High Priestess, who was yet to arrive, would choose. After contemplating the consistency of the ground around each of the fire pits (both very muddy and slippery), two dedicants pulled out compasses so we could locate north. This was important for setting up the altar but also for invoking the guardians of the four cardinal directions. At Litha, I had just followed*

along when people turned to face the altar to invoke the north; now I knew we were facing north.

<u>*Sharing the cakes and ale*</u>

Towards the closing of the ritual, our memory aid sheets had 'Cakes and Ale' listed. I'd flicked to the last of the pages when we were milling around before the ritual began and hadn't seen any instructions about what I was supposed to say or do during this section, but I knew from the entering of the circle that this didn't necessarily mean I wasn't required to do anything. Thankfully, Luca hadn't tired of helping me out and he leaned over to whisper guidance when the High Priestess and the Magus began making their way around the circle with the basket of strawberry-topped shortbreads (cakes) and drinking horn of mean (ale). I was to be offered the cakes and ale, and if I wanted to accept I should respond to the blessing offered to me with "blessed be". I did so, and I watched as the other dedicants did, too. Although everyone drank their sip of mead, some dedicants reserved the last bite of their shortbread, crumbling it in their fist a few moments after they'd finished their mouthful and then scattering it into the fire. Fire offerings made frequent appearances in the ritual and signify a communication between the dedicants and their deities, since the fire consumes the offerings and bears their essence upwards in the rising smoke and hot air.

Divorced from their context, these two aspects of Pagan rituals appear causally opaque. How does turning in a circle in four 90-degree turns achieve any goal? Why would someone throw part of their food in the fire? However, when the context is added in – that the four quarter turns were designed for us to face each of the cardinal directions whilst we invoked its guardian to be present at our ritual, and that an offering can be made to a chosen deity by placing it into the ritual flames – the actions bear some causal meaning. Specifically, the meaning that is associated with the action makes sense with the action. If we were to turn to north and then turn 360 degrees to face north again whilst invoking the guardians of the east, it wouldn't make sense. If people were to receive their cakes and then carefully crumble a piece of it on the ground near the fire, that wouldn't make sense either. This mirrors the example in the experiment where an action that made sense (gesturing towards the eyes whilst referring to obstacles that can be seen) was transmitted with higher fidelity than an action that

didn't make sense (gesturing to the mouth whilst referring to words that can be heard). Taking the examples from real rituals and the findings of my experiment together, it is therefore apparent that causal translucency can aid in the transmission fidelity of sequences of ritualised actions when compared to causal opacity, leading to increased transmission fidelity of rituals overall.

Conclusion

This research combined ethnographic and experimental research methods to explore the influence of belief on the transmission fidelity of ritual content. The findings of the experiment suggested that self-reported belief, but not the belief 'prime' in the experimental condition, did have a positive influence on the transmission fidelity of the verbal content of the ritual. Additionally, there were tentative findings to suggest that cross-modal semiotic dissonance, used as a proxy measure to study causal opacity, negatively impacted the likelihood of a point in the ritual being accurately transmitted when compared to a consonant point. There was no effect of either primed or self-reported belief on the transmission longevity of the core content of the ritual. These findings were situated in, and extended by, ethnographic research which was conducted with a group of Pagans. The ethnographic research involved my participant observation of rituals as well as interviews with ritual practitioners from the coven. Conducting both experimental and ethnographic research enabled me to have a more holistic understanding of the transmission of rituals as I was able to explore causation in a controlled environment whilst also gaining insight into real-world ritual transmission and practice. The rituals practiced by Brigid's Fire were similar to those reported on by anthropologists who have conducted fieldwork with Pagans over the past several decades, and my participant observation and interviews revealed that this was not only due to the practitioners' belief in the rituals, but was also supported by their extensive training, memory aids during ritual practice, and intentional resistance to variation which related to their connections to an imagined community of Pagans, enacted through the concept of a shared heritage with other Pagans. Throughout, suggestions have been made for future research which could further explore the influence of belief on the transmission fidelity of ritual content, for instance through varying the core content of the ritual, through varying the proportion of ritualised sequences in a gesture, or through varying the length and complexity of the ritual. Many of these suggestions have stemmed from the fact that the use of action-based content in transmission chain experiments is rare. As part of this research, I developed a kinetographic coding framework based on the Labanotation system and the propositional analysis of textual content, and this framework could be used in the future research which has been suggested. Whilst the findings of this research indicate that belief does influence the transmission fidelity of ritual content, many of the analyses conducted on the quantitative data were at least somewhat exploratory in nature due to the novelty of the use

of video recording and action-based content in the transmission chain, and there is therefore a great deal more research to be conducted in this area.

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Appendix 1

Draft Interview Schedule

- Please can you tell me about any rituals that you do as part of your Pagan beliefs?
    - Repeat this question in various forms to find out as many different rituals as possible that the participant does.
    - For rituals with a clear purpose (i.e., ritually cleansing a space, empowering an object, etc): do you believe that this ritual is effective? To what extent do you believe it is effective? Why?
        - This line of questioning will be followed by prompts to clarify both religious and nonreligious frameworks for attributing efficacy to rituals, since many Pagans use both. Where possible I will refer to specific parts of the ritual itself to clarify the framework used by the interviewee for attributing efficacy to that part, e.g., if a particular herb is used, is that considered effective because of magical properties of the herb, association with a religious figure in myth, biological properties of the herb, some combination of these factors?
- Please can you tell me about how you learned about the rituals that you have told me about today?
    - This question I will aim to ask after each ritual is described, rather than all together at the end.
- Have you passed this ritual on to anybody else? (E.g., by telling them about it, or showing it to them, or recommending the source that you heard it from to them). Why/why not?

Appendix 2

Debriefing Form

Project title: Social Transmission of Beliefs (Full title : The influence of belief on the fidelity of transmission of information and practices concerning rituals).

Researcher(s): Sarah Wright
Department: Anthropology
Contact details: sarah.wright2@durham.ac.uk, 07776751974

Thank you for your participation in our study! Your participation is greatly appreciated.

Purpose of the Study:

Earlier in our consent form we informed you that the purpose of the study was to research about whether people's beliefs in different things change how well they remember and communicate them to others. In actuality, our study is about whether varying people's belief in something changes how well they remember and communicate it to others. This means that everyone involved in the study learnt about the same ritual, but we changed the contextual information about it so that some participants might believe it was true to a greater extent than others.

The ritual that you were taught about was created for the purposes of the experiment and is not a ritual that is practiced by any groups or religions. However, it was created by combining different elements of real rituals, these include:

- Calling upon the energies of the four elements – this was derived from modern Pagan rituals, including one accessed via YouTube at https://www.youtube.com/watch?v=1nPsyZJBTeQ
- Hindu Mudras were included – symbolic hand gestures often included in yoga and meditation. The Abhayamudra and Varadamudra were used in the ritual. These are used to signify protection or fearlessness, and the granting of gifts respectively.

You were also told that [**this ritual has a notable positive effect despite their being no empirical evidence to explain why that may be the case / this ritual had no notable effect, neither positive nor negative (delete as appropriate for each condition)]**. This information was not true and was used for the purpose of the research.

Unfortunately, in order to properly test our hypothesis, we could not provide you with all of these details prior to your participation. This ensures that your reactions in this study were spontaneous and not influenced by prior knowledge about the purpose of the study. The ritual is not a ritual that is practiced by any known group or religion and has not been tested for efficacy. **Any claims that either supported or countered claims that the ritual is effective were produced solely for use in this experiment and should now be disregarded by all participants.** If we had told you the actual purposes

of our study, your opinions and beliefs about the ritual could have been affected. We regret the deception, but we hope you understand the reason for it.

Confidentiality:

Please note that although the purpose of this study has changed from the originally stated purpose, everything else on the consent form is correct. This includes the ways in which we will keep your data confidential.

Now that you know the true purpose of our study and are fully informed, you may decide that you do not want your data used in this research. If you would like your data removed from the study and permanently deleted, please tick the following box.

"I **do not agree** to have my data used from the study".	

Please do not disclose research procedures and/or hypotheses to anyone who might participate in this study in the future as this could affect the results of the study.

Final Report:

If you would like to receive a copy of the final report of this study (or a summary of the findings) when it is completed, please feel free to contact us.

Useful Contact Information:

If you have any questions or concerns regarding this study, its purpose or procedures, or if you have a research-related problem, please feel free to contact the researcher or supervisory team:

Researcher: Sarah Wright
Contact details: sarah.wright2@durham.ac.uk, 07776751974

Supervisor name: Jamie Tehrani and Jeremy Kendal
Supervisor contact details: jamie.tehrani@durham.ac.uk, jeremy.kendal@durham.ac.uk

Once again, thank you for your participation in this study!

Appendix 3

Higher Degree Entry Form

This form should be submitted to the Academic Quality Service online with the thesis. Further details on submission here.

Personal Details:

DEGREE FOR WHICH THESIS IS BEING SUBMITTED:	MSc By Research – Biological Anthropology
STUDENT ID:	001066673
SURNAME (Block Capitals):	WRIGHT
FORENAMES (Block Capitals):	SARAH, ELIZABETH
UKRI FUNDED (Yes / No):[1]	No
DEPARTMENT:	Anthropology
COLLEGE:	University College
ADDRESS TO WHICH ALL CORRESPONDENCE SHOULD BE SENT:	LSWN34@DURHAM.AC.UK
NON-DURHAM EMAIL ADDRESS:	148SARAH@gmail.com

Candidate Declaration:

I understand that:

1. if award of the degree is approved following examination of my thesis, I will be required to deposit with the University one electronic copy of the thesis which will be listed in on-line catalogues and databases.
2. in the interests of scholarship, the electronic copy will be made available in the University's digital repository to a wide variety of people and institutions – including automated agents – via the World Wide Web.
3. an electronic copy may also be included in the British Library Electronic Thesis On-line Service (EThOS)

4. I own the copyright in my work and am free to publish the thesis in its present or future versions. The University is granted non-exclusive rights to make the thesis available as described.

5. to ensure preservation and accessibility via future computer systems, the University may need to amend the storage format of the electronic copy.

6. I may request an embargo not exceeding three years on public access to my work for the protection of patent applications or other intellectual property or third party rights; it is not usual for access to theses to be withheld and good reason for the request must be provided.

I confirm that:

7. the thesis conforms with the prescribed word length set out in the **Core Regulations for Research Degrees by thesis or composition** OR I have approval on behalf of my Academic Department to submit a thesis which exceeds the prescribed length.

8. no part of the material offered has previously been submitted by me for a degree in this or any other University.

9. if material has been generated through joint work, my independent contribution has been clearly indicated.

10. I have exercised reasonable care to ensure that the thesis is original and does not to the best of my knowledge infringe any third party's copyright or other intellectual property right. Material from the work of others has been acknowledged and quotations and paraphrases suitably indicated.

11. I wish to request that public access to my thesis is withheld for ……………. years and I have completed and attached the form '**Restricting access to my thesis'.**[10]

Signature:	
Date:	31st March 2024

Supervisor's endorsement:

I certify that the above amend student has completed the required period of study for the award for which s/he wishes to be examined.

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[10] Under UKRI rules and regulations, students who have received UKRI funding may apply for access to their thesis to be withheld for **no more than 12 months**.

Supervisor's signature[11]:	
Date:	28th March 2024

This form must be completed <u>by the candidate</u> and returned to <u>pg.admin@durham.ac.uk</u>

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[11] Only one member of the supervisory team is asked to endorse the HDE. An email can be accepted in lieu of a supervisory signature, if necessary.