If a Medium Can Speak to Ghosts, Imagine What a Large Language Model Could Do.

A Framework for Evaluating Belief Representation in LLMs, Using Ghost Belief as a Case Study

Rick Heemskerk

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Leiden University, LIACS, MSc Media Technology.
Supervised by: Rob Saunders, Zane Kripe

Abstract

This study introduces a novel two-dimensional framework for evaluating the representation of belief in Large Language Models (LLMs), using ghost belief as a specific case study. The framework distinguishes between ontological stance (whether a belief is considered real) and belief rigidity (how dogmatically the belief is held). Utilising zero-shot persona prompting, the research investigates how LLM-generated representations of ghost beliefs are influenced by sociographic traits (age, gender, religiosity, paranormal media consumption). Furthermore, it assesses how exposure to narrative influence, specifically ghost stories, influences the expression of these beliefs within the LLM personas. The study also aims to expose the underlying reasoning patterns, assumptions, and epistemic framings that emerge in LLM personas when justifying ghost beliefs. A key finding is that while sociographic traits, particularly religiosity and paranormal media consumption, significantly influence both ontological stance and belief rigidity, exposure to ghost stories has a limited and even counter-intuitive effect, leading to a slight decrease in ghost belief. The study reveals that the model tends to default to scientific rationalism as a standpoint, even when the assigned traits should not reflect this, highlighting underlying biases in its representation of ghost beliefs. This study and its findings offer a nuanced understanding of how LLMs simulate and justify beliefs, creating a transferable framework and methodology for future research on belief representation in AI systems.

1 Introduction

At the end of his life, Thomas Alva Edison proposed one final invention: a machine capable of communicating with the dead. He believed that, if a person somehow persists after death, they might leave subtle traces in the physical world. These traces would be too small for the human perception, but not for machines. By designing instruments sensitive enough to detect these fluctuations, Edison hoped to offer spiritualists a more empirical foundation for their claims (Dotto, 2019). Though Edison never finished the "necrophone", his idea reflects a long-standing cultural entanglement between ghosts and technology.

Technologies have long served as tools to detect ghosts, but they have also played a big role in shaping how ghosts are imagined. A clear example is the 18th-century phantasmagoria: a form of horror theatre where lanterns projected ghostly images into mist and smoke, making spirits appear to float in front of the audiences' eyes. Prior to this, ghosts in Western iconography were typically depicted as opaque. But after phantasmagoria and, later, Victorian-era spirit photography, the image of translucent ghosts became dominant (Owens, 2017). The ghost, as a concept,

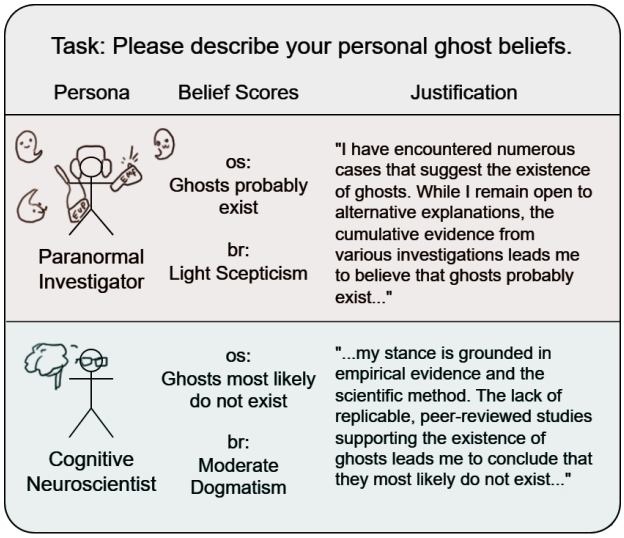


Figure 1: *LLM belief score attribution and generated justifications across different personas when tasked with describing their ghost beliefs.*

evolves with the mediums that represent it.

Ghosts have historically adapted to the dominant technologies of their time. Today, one of the most pervasive is the Large Language Model (LLM). Trained on a vast corpora of texts, these systems are used to generate language, simulate knowledge, opinion, and beliefs. Embedded in their training data are ghost stories, spiritualist texts, scientific critiques, and internet discussions; all fragments that hold information on cultural discourse around ghosts. Yet LLMs do not simply reflect this information. Instead, the system reproduces and transforms patterns within their training data, including any potentially harmful latent assumptions (Fountain, 2022; Weidinger et al., 2022). As such, they offer to be a new kind of medium through which ghosts once again become visible. This study investigates how ghost beliefs are represented within these systems.

Ghost beliefs occupy an unusual space. They are too metaphysical to be scientific, but too secular to be purely religious. In the spiritualist movement, ghosts are framed as the continuation of life after death. In others, they are treated as paranormal phenomena to be investigated through cameras and EMF detectors (Emmons, 2003b; Obadia, 2021). Ghost beliefs cut across domains, shaped by religious concepts, pseudoscientific explanations, local folklore, and lived experience. As such, ghosts represent what might be somewhat of a liminal belief; a belief that hovers between the supernatural and the paranormal, the sacred and the empirical. This ambiguous status makes them a rich subject for probing how belief is represented within LLMs.

To do so, this study introduces a two-dimensional belief framework designed to evaluate belief representations in LLMs. The framework distinguishes between *ontological stance* (whether a belief topic is considered real) and *belief rigidity* (how dogmatically the belief is held). Ghost belief is used as a test domain to examine how the model simulates belief across different conditions. Using zero-shot persona prompting, the model is instructed to adopt various identity traits and asked to score their ghost beliefs. Some personas are also exposed to narrative input in the form of ghost stories, allowing the study to assess whether beliefs shift in response to an increased narrative context. Through this approach, the study explores what the model's representation of belief looks like, and how those patterns are justified and embedded within broader epistemic structures. Findings suggest that the model often defaults to a scientific-rationalist viewpoint, even when assigned traits do not warrant such a perspective. This highlights underlying biases in the model's representation of ghost beliefs.

2 Background and Related Work

With the advancement of technology, one might have expected that increased exposure to glitches, noise, and mechanical explanations would reduce belief in ghostly phenomena. Yet, despite their supposed anachronism, ghosts have not disappeared. Instead, ghosts have proven to be particularly vivid in a technospheric environment (Obadia, 2021). A space in which technical mediation facilitates, rather than suppresses the appearance of ghosts. Surveys confirm that belief in ghosts has increased in both the United States and in the Netherlands (Emmons, 2003a; Hoogeveen et al., 2023; McCarriston, 2017), even as other paranormal beliefs decline. Ghosts continue to serve as social agents in cultural domains.

Ghost beliefs are not monolithic. Across cultures, they are framed in profoundly different ways. In many East Asian traditions, such as the Chinese Hungry Ghost Festival, ghosts are often depicted as restless or vengeful spirits who return due to unmet obligations or improper funerary rites. They require offerings and ritual attention to prevent misfortune. By contrast, traditions like Día de los Muertos celebrate the dead with vibrant rituals that affirm emotional connection and continuity between the living and the dead. This differs again from Halloween, which, though originally linked to Samhain, has evolved into a more entertainment-focused event (Bryant, 2003). While all these traditions share an interest in the return of the dead, their structures and emotional tones differ significantly.

These divergent framings reveal how ghost beliefs act as mirrors of cultural values: they reflect what societies believe about life, death, and the boundaries between them. Just as ghosts are shaped by the cultural systems that imagine them, they are also shaped by the technologies that represent them. In that regard, LLMs become a particularly interesting medium. As they are trained on a vast corpora of information, largely composed of English texts from online Western sources, LLMs are not neutral mirrors. They contain all biases and assumptions that it's training data implies.

Within this English literature, ghost beliefs are structured through multiple epistemic traditions. The spiritualist perspective interprets ghosts as the continuation of life after death, capable of communication with the living world. Parapsychologists explain ghosts through alternative mechanisms such as telepathy or residual energy. Scientific sceptics dismiss all such claims as untestable and irrational, while social and behavioural sciences treat ghost experiences as symbolic rather than objective truth (Emmons, 2003b). Each tradition defines not only what

ghosts are, but what kind of knowledge is considered valid, what forms of evidence are accepted, and what roles ghosts are imagined to play. Considering the dominance of the English language within the training data of LLM systems, understanding these epistemic positions on ghost discourse is necessary in interpreting how the model represents ghost beliefs.

It is important to note that LLMs do not "believe" in the human sense. However, through persona prompting, they can simulate belief-like outputs. In zero-shot persona prompting, the model is instructed to respond as if it were a person with specific identity traits, without being told how those traits should influence its behaviour. This technique has been used to test for bias and social assumptions in LLM outputs, especially when evaluating how the model generalises from identity cues such as gender, religion, or culture (Cheng et al., 2023; Gupta et al., 2024; Joshi et al., 2024; Plaza-del-Arco, Curry, Curry, et al., 2024). Recent work has begun to use persona-based prompting to investigate belief expression, such as in Divine LLaMAs (Plaza-del-Arco, Curry, Paoli, et al., 2024), which looked at the representation of religious beliefs through the lens of emotional expression. However, no general framework yet exists for studying belief domains outside the boundaries of institutionalised religion.

Previous work on measuring paranormal beliefs relied on scales such as the Revised Paranormal Belief Scale (Tobacyk, 2004), which captures a broad assessment of general paranormal phenomena, including ghost beliefs, but do not capture the nuances within a single category of belief. Furthermore, literature often frames ghost beliefs as being divided in two opposing groups: sceptics and believers. For example, in the works of Emmons (2003b), Rice (2003), and Bader et al. (2017), where ghost beliefs are being discussed as being a challenge to scientific rationalism and scepticism, reinforcing the notion of a binary opposition between the two groups. [1]

This framing, however, oversimplifies belief dynamics, creating a false dichotomy. Scepticism is often conflated with disbelief rather than being recognised as an individuals willingness to evaluate claims critically. An individual is capable of believing in ghosts while remaining open minded towards natural explanations, or disbelieving in ghosts while dogmatically rejecting any contrary evidence. To address this conceptual limitation, this study proposes the creation of a new framework that manages to capture this difference.

[1] Most of these works don't directly claim scepticism is the binary opposite of belief, but the way the works are formatted does give the impression that "sceptics" and "believers" are, at the very least, groups with opposing beliefs.

3 Research

This study aims to develop a framework and methodology for analysing how beliefs are represented within Large Language Models. While prior research has focused primarily on religious beliefs, this study takes a broader view by exploring beliefs that sit between the paranormal and the supernatural, between religion and science. Ghosts beliefs serve as a compelling test case because they are culturally flexible, emotionally charged, and epistemically ambiguous. They can be interpreted as spiritual phenomena, scientific anomalies, or folklore, depending on the context. This liminal status makes them an ideal subject for examining belief representation within LLMs.

Accordingly, the study's main research question is:

How are ghost beliefs represented within a Large Language Model (LLM)?

To unpack this broader inquiry, four sub-questions have been formulated:

RQ1. **Does assigning different personas lead to measurable differences in ghost belief representations within the LLM?**
This question examines whether LLM personas exhibit consistent and distinct belief profiles based on their assigned identity traits.

RQ2. **How do sociographic indicators influence ghost belief representations within the LLM, and how do these patterns compare to real-world populations?**
This question aims to analyse the influence of specific sociographic variables such as age, gender, religiosity and paranormal media consumption. These variables were selected based on previous studies that identified correlations with belief in ghosts. The study evaluates whether the model reflects similar trends and whether it appears to reproduce cultural or demographic patterns found in empirical research.

RQ3. **How does exposure to ghost stories influence the expression of ghost beliefs within LLM personas?**
This question assesses whether narrative stimuli can shift the ontological stance or belief rigidity of a given persona. The narrative stimuli specifically are ghost stories told as anecdotes of others. It aims to assess the narrative susceptibility of the model and whether belief representations are flexible in response to emotionally or thematically charged input.

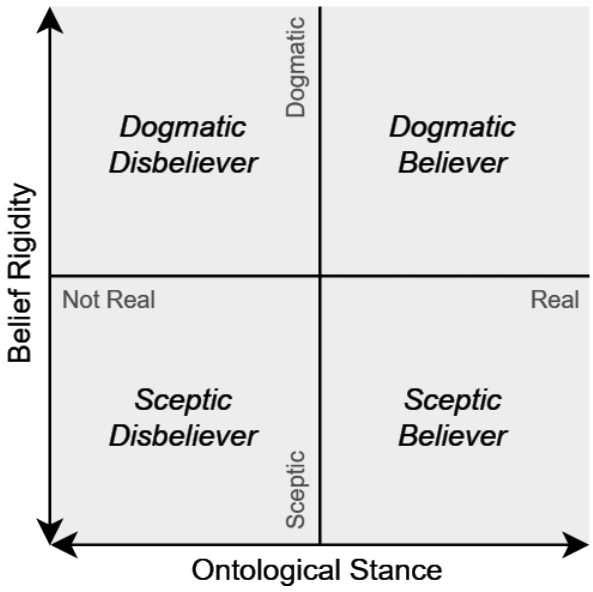


Figure 2: *Belief Measurement Framework*

RQ4. **What reasoning patterns, assumptions, and epistemic framings emerge in LLM persona responses when justifying ghost beliefs?** This question aims to expose underlying patterns in LLM given justifications for beliefs. For instance, this question aims to find what the LLM states as being the source for their beliefs, and how persona assignation influences the formation of belief.

Together, the four research questions form the foundation of a methodology aimed at probing how Large Language Models simulate and justify beliefs, adapt sociographic traits, and respond to narrative stimuli. While the current analysis focuses on a single LLM, the framework and methods developed in this study are intended to be transferable to other LLMs; Provided certain baseline criteria are met, such as sustained persona retention and the capacity for self-reported belief-like outputs.

The next chapter introduces the belief framework used in this study. It outlines how belief is operationalised in two dimensions, and why this structure is necessary to move beyond binary classifications such as "believers" or "sceptics". This framework forms the conceptual foundation for all analyses that follow.

4 Belief Measurement Framework

Research into ghost beliefs often presents them as binary opposites: believers versus sceptics. Yet belief, especially in ambiguous topics like ghosts, is rarely so clear-cut.

To better capture this division, this study proposes the use of a two-dimensional framework that differentiates:

- **Ontological Stance**: ranging from "The Topic of Belief Does Not Exist" to "The Topic of Belief Exist", from
- **Belief Rigidity**: ranging from "Scepticism" to "Dogmatism".

While the framework was constructed on the basis of a false dichotomy found within literature about ghosts beliefs, the framework can be generalised to other specific topics of belief.

The framework is visualised in Figure 2 as a two-dimensional space defined by two axes: ontological stance and belief rigidity. The intersection of these axes divides the space into 4 quadrants that represent the most extreme belief positions. However, both axes are continuous scales rather than categorical divisions, meaning that a belief position can fall anywhere within the space. This allows for more nuanced representations, such as moderate and neutral positions, rather than forcing rigid classifications. A given belief about a topic (e.g. ghosts) is thus positioned based on its degree of affirmation or denial of the topic of belief (ontological stance) and the openness or dogmatism with which the belief is held (belief rigidity).

The next section, methodology, will go into detail about the steps made to operationalise this belief framework to get an overview of how ghost beliefs are represented within LLMs.

5 Methodology

This study introduces a structured framework for analysing how belief systems are represented within Large Language Models (LLMs). As a focused test case, the study investigates ghost beliefs, exploring both the expression of belief and the reasoning behind it. To do this, a mixed-methods design is employed, combining quantitative measures of ontological stance and belief rigidity with qualitative analysis of belief justifications.

At the core of this design is a two-axis framework for measuring belief. The first axis, **ontological stance**, captures whether the persona affirms or denies the existence of ghosts. The second axis, **belief rigidity**, measures the degree of scepticism or dogmatism in that belief. This framework allows for a more nuanced representation than the common believer-sceptic binary, and it is used to interpret the model's responses in various experimental scenarios.

Beliefs are elicited through a zero-shot persona-based prompting strategy, in which the LLM is asked

to adopt specific identities and respond to belief-related queries.

Each persona is tested under one or more of the following three experimental conditions:

1. **Baseline Belief Assessment:** The persona rates their ghost belief without any contextual influence.
2. **Belief Justification:** The persona is asked to provide a rationale for their belief position, providing data for qualitative analysis.
3. **Narrative Stimulus Response:** After providing the LLM with a short ghost story (framed as another's experience), the persona is asked to evaluate their ghost beliefs, allowing for comparison with their baseline response.

This design allows for the examination of belief representation from multiple angles: internal consistency across personas (RQ1), sociographic trait influence (RQ2), narrative driven belief shifts (RQ3), and patterns of reasoning and epistemic framing (RQ4). The following methodology subsections elaborate on the components of this design, including belief operationalisation, persona construction, narrative stimuli, and LLM setup.

5.1 Persona Based Approach

In the context of this study, persona simulation is used to evaluate whether ghost belief representations are influenced by sociographic traits. It also allows for testing whether the LLM can sustain consistent beliefs and reasoning across different personas. This approach supports RQ1 and RQ2 by enabling comparisons between identity groups, and it provides the foundation for interpreting belief justifications (RQ4).

Each persona is formed by specifying it through one or more defining traits. The LLM is then asked to respond from the perspective of that persona in one or more experimental conditions (belief position, justification, or narrative exposure). All prompts are zero shot and formatted consistently (see Appendix F)

Persona Types

This study uses two primary persona types: fully-specified personas and single-indicator personas. These types differ in their level of complexity and how they are used within the experimental design.

Fully-specified personas: Fully-specified personas are composed of one trait from each of the four sociographic categories: age, gender, religiosity, and paranormal media consumption. These personas allow for the examination of belief positions that result from the intersection of multiple identity traits. They are primarily used in the quantitative analysis to investigate whether specific combinations of traits correlate with particular ontological stances or levels of rigidity. Every combination of sociographic indicators counts up to a total of 108 unique fully-specified personas. A preliminary study (Appendix D) confirmed that the LLM is capable of retaining all traits assigned in a fully specified persona, and that these traits are consistently reflected in the model's belief responses.

Single-indicator personas: Single-indicator personas are defined by only a single sociographic trait or identity label. They are primarily used in the qualitative analysis to isolate and explore the model's assumptions about individual traits, and to identify potential stereotyping or overgeneralisation. In total this study tests 23 distinct traits in the form of single-indicator personas. These personas can be split up in the following groups:

- **Sociographic Trait Personas:** These personas are defined by a single sociographic trait (e.g. "young adult", "devoutly religious", "frequent paranormal media consumer") and are used to observe how that trait alone influences belief scores and justification.
- **Baseline Personas:** These include generic personas such as "LLM" (no persona prompt), "Average Human", and "Human", as referenced in prior work by Gupta et al. (2024). These serve as neutral baselines to compare against trait-specific responses.
- **Archetype Personas:** These personas are designed to represent culturally recognisable personas that might be associated with strong or archetypal positions on the belief framework. They were originally formed in a preliminary study (Appendix A) to test the two-axis framework's viability and remain useful for evaluating how the LLM simulates belief extremes or stereotypes.

While both fully-specified and single-indicator personas are used in this study, they serve distinct analytical purposes. Fully-specified personas allow for controlled comparison between sociographic traits, ensuring that the observed effect in belief scores can be attributed to specific variable differences. Single-indicator personas, by contrast, are used to investigate how the model behaves when given minimal identity information, allowing for probing for expected belief positions and examination of how the model internalises cultural assumptions.

To validate the use of single-indicator and fully-specified personas, two preliminary studies were conducted. The first (Appendix C) investigates the LLM's internal assumptions when assigning single-

indicator personas. When traits were left unspecified, the model often defaulted to representing personas as *non-religious*, *young adult*, and *male*. This suggests that sociographic defaults exist in the models internal logic, although it remains unclear how much these hidden assumptions influence final belief assessments. The second study (Appendix B) compares belief outputs between single-indicator personas and their fully specified counterparts that share the same sociographic trait. Results showed that single-indicator personas are not statistically representative of fully-specified personas, reinforcing the decision to treat them as distinct analytical tools.

Archetype Personas

The study includes a set of archetype personas, designed to represent culturally familiar roles that are commonly associated with specific orientations towards ghost belief. These archetypes were initially selected and tested in a preliminary study (Appendix A) to explore the viability of the two-axis belief framework. Each persona was selected to probe an assumed extreme or distinctive belief position based on public perception, cultural tropes, and discourse commonly associated with that identity.[2]

The archetypes and their expected positions on the belief framework are:

- **Paranormal Investigator**: Expected to affirm the existence of ghosts, but with a sceptical, evidence-based attitude. Paranormal investigators are typically portrayed as being committed to uncovering empirical evidence of supernatural phenomena, positioning them high on *os* and low on *br*.
- **Spiritual Medium**: Anticipated to affirm the existence of ghosts and hold that belief moderately. Spiritual mediums are often depicted as individuals in direct communication with spirits and are confident in this belief, though not necessarily dogmatic.
- **Faith Healer**: Expected to express strong belief in ghosts with high rigidity. This persona draws on religious or spiritual authority and is likely to frame ghosts as a part of a larger dogmatic world-view where supernatural experiences are accepted as truth.
- **Urban Explorer**: Expected to hold a neutral position on both ontological stance and belief rigidity. Although this persona might have encountered unexplained phenomena in abandoned locations, they are not necessarily framed as believers or disbelievers, but rather as curious observers.
- **Science Education Reformer**: Anticipated to reject ghost beliefs and adopt a sceptical stance, possibly emphasizing the need for scientific forms of evidence and critical thinking.
- **Forensic Linguist**: Anticipated to somewhat firmly express disbelief. This persona, grounded in empirical textual analysis and investigative precision, is expected to moderately dogmatically hold this belief.
- **Cognitive Neuroscientist**: Expected to strongly disbelieve in ghosts with high rigidity. Rooted in the science of the brain and mind, this persona is expected to view supernatural experiences through neurological or psychological lenses and is unlikely to entertain alternative ontological explanations.

Each archetype persona was positioned along the belief framework on assumptions derived from cultural narratives, media portrayals, and initial observations during the framework's development. While actual model responses often deviated from these expectations, clearly articulating these assumptions allows for a richer analysis of how the model and constructs and interprets persona based belief, as later will be analysed through RQ4.

Sociographic Traits

The four sociographic dimensions used to construct personas were selected based on prior research identifying predictors of ghost belief. These traits are not assumed to fully define belief formation but were chosen for their consistent correlation with belief variation in human populations. The sociographic traits and categories used in this study are shown in Table 1.

Age. Age is widely recognised as a predictor of ghost beliefs. Baker and Bader (2014) found a negative correlation between age and ghost beliefs, with younger generations being more likely to believe in ghosts than older adults.

Gender. It has been found that gender correlates with variation in ghost beliefs. Baker and Bader (2014) and Silva (2023) found that women, non-binary, and transgender people are more likely exhibit signs of ghost belief. To reflect a broader spectrum of gender identities, this study uses the term "Gender-diverse" instead of limiting the category to transgender and non-binary individuals.

Paranormal Media Consumption. Paranormal media consumption is included due to its demonstrated correlations with belief in the paranormal. Sparks and Miller (2001) found that viewing paranormal television programs is positively correlated with paranormal beliefs, particularly when combined with previous self-reported paranormal experiences.

[2] This study makes no claims about the validity of the assumptions surrounding the archetype personas. They were formed as a guideline of expectations to test against in later analysis.

Sociographic Category	Sociographic Indicators
Age	Young Adult, Middle Aged Adult, Older Adult
Gender	Female, Gender-diverse, Male
Paranormal Media Consumption	Non-Consumer, Occasional Consumer, Frequent Consumer
Religiosity	Non-Religious, Culturally Religious, Religiously Practising, Devoutly Religious

Table 1: *Sociographic Categories*

However, this study excludes direct paranormal experiences as a sociographic category, since interpreting an ambiguous event as "paranormal" already presupposes a certain belief orientation. Including such a trait would risk circular reasoning, as it may reflect belief rather than being a predictor for it. Recent work by Geusens (2024) explored how different horror subgenres relate to beliefs in the paranormal. The study found that only those genres that frame events as true (e.g. based on true event re-enactments and paranormal reality TV) showed a significant correlation with increased belief.

To account for potential variation in belief expression shaped by media exposure, this study defines three levels of paranormal media consumption: **Paranormal Media Non-Consumer**, **Occasional Paranormal Media Consumer**, and **Frequent Paranormal Media Consumer**. These categories are used to simulate different levels of exposure within personas without making assumptions about their personal experiences.

Religiosity. Baker and Draper (2010) identified a curvilinear relationship between religiosity and paranormal beliefs, where mid-level religious practitioners were more likely to believe compared to either extremes of religiosity (strongly religious or non-religious).

This study adopts the four-part scale from Plaza-del-Arco, Curry, Paoli, et al. (2024), which defines religious identity by which belief system it falls under, and which levels of practice they partake in. The adapted framework consists of four levels: **Non-Religious** (No religious affiliation or practice), **Culturally Religious** (Identifies with a religion's traditions but does not actively practice), **Religiously Practising** (Regularly engages in religious practices), and **Devoutly Religious** (Fully committed to their faith, having integrated the practice deeply into their daily life).

Because the structure of religiosity in this study differs from Baker's original religious index, and because this study focuses specifically on belief in ghosts rather than broader paranormal beliefs, no curvilinear relationship is expected. While comparison to earlier literature is still possible, such findings should be interpreted in light of this methodological difference.

A preliminary study looking into the retention of fully-specified personas (Appendix D) found that the LLM assumed Christianity when stating that a persona is religious, without specifically defining which religion they follow. This preliminary study also revealed that these religiosity categories are not treated by the model as strictly exclusive: religiously practising personas were often also described in terms consistent with devout religiosity, suggesting category overlap in the model's interpretation.

5.2 Narrative Stimuli as a Belief Trigger

In addition to static belief assessment, this study investigates whether ghost beliefs expressed through LLM personas are subject to change when exposed to narrative input.

Ghosts are a broadly defined concept, spanning from diverse perspectives such as panpsychism, animism, the continuation of the human soul, spirits or demons, and other religious or cultural interpretations. Rather than imposing a fixed definition of what a ghost is, or what a ghost can do, this study utilises a dataset of ghost stories to define what the ghost phenomena are that are being evaluated. By using widely shared ghost narratives, this study ensures that the experiences presented to the LLM are culturally relevant and representative of how ghost stories are popularly framed. These stories serve as a stimuli, prompting the personas to evaluate their ghost beliefs within the belief framework based on ghost accounts, rather than hypothetical constructs. A dataset of 49 first-person ghost stories was introduced as a structural stimulus[3]. Details on the creation of the dataset are described in Appendix E.

The use of ghost stories as narrative stimuli serves two purposes. First, it enables the examination of belief flexibility by comparing the scores formed with

[3] https://github.com/bidoofgoo/Ghost-Story-Dataset

and without exposure to narrative accounts. Second, it provides a more valid context for belief formation, since most real-world ghost beliefs are not formed in isolation but are influenced by storytelling, folklore, media, and personal testimonies.

5.3 Experiment Setup

This section outlines the experimental setup used in this study. It includes a description of the LLM used, the operationalisation of the belief framework, and the prompting strategies used to elicit responses across different conditions.

Large Language Model
LLaMa 3.3 70B[4] will be examined in this study due to its recency, open source ability and response quality. It offers more consistent and nuanced outputs compared to lower parameter models, making it viable for the quantitative and qualitative aspects of this study. The open-source nature of the model ensures transparency and reproducibility.

This implementation of the framework is model-specific, but the framework itself is designed for broader applicability across other LLMs, provided they demonstrate sufficient persona consistency and narrative coherence in preliminary testing.

Operationalising Belief Framework
Responses collected from the model are assigned positions on the belief grid using self-reported numerical values. In each belief-related prompt, the persona is asked to place themselves on an explicit 1-7 Likert scale along each axis: one for ontological stance and one for belief rigidity. These values are extracted directly from the model's response and treated as scalar outputs for quantitative comparison. Aggregate analysis of these scores allows for pattern identification across different persona types, trait groupings and experimental conditions. By treating belief responses as structured quantitative data, the framework facilitates statistical comparisons between identity categories, as well as belief shifts in response to narrative input.

To operationalise this belief framework, it was necessary to determine a suitable scale resolution for both ontological stance and belief rigidity.

Preston and Colman (2000) found that additional points increases the reliability of the scale, but the benefits of this seem to plateau after 7 points. Similarly, Krosnick and Presser (2010) found that exceeding 7 points might introduce clarity and uniformity issues, as participants struggle to differentiate between closely spaced points. While these studies focus pertain to human respondents, these principles were preliminarily evaluated in this study by comparing 3x3, 5x5, and 7x7 grids in LLaMa 3.3 70b. The 7x7 scale produced responses distributed across the entire range, suggesting that the model was observed to utilise the full spectrum of belief positions. Lower resolution scales might have compressed the possible response variation. This study employs a 7-point Likert scale on both axes. This resolution was chosen to strike a balance between response precision and clarity, offering enough range to capture subtle differences in belief while avoiding unnecessary complexity.

Prompting Setup
The prompting process used in this study was designed to control the model's behaviour, the structure of its responses and the repeatability of the experiment.

One critical factor in controlling the reproducibility is by the use of temperature and seed settings. The temperature setting aims to control the randomness of the model's outputs. A lower temperature setting should make the responses more deterministic, while higher values increase the variability of the responses. In this study, a temperature of 0 was used to minimize response variation. Additionally, a random seed of 0 was used to further enhance reproducibility. This was done for all but the "Base LLM" persona, as a low temperature and seed setting would otherwise result in the same outcome.

This study adopts 5 persona assignation prompts earlier introduced in the work by Gupta et al. (2024). Diversifying the persona introduction prompt was done as a means to diversify the results gathered from single personas. The persona initialisation prompts used in this study can be found in Appendix F.

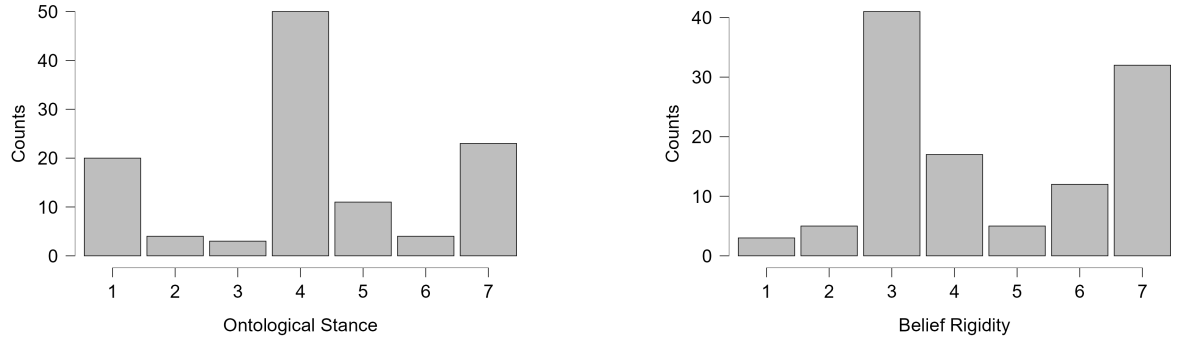
To standardise responses and facilitate later analysis, the model was instructed to respond according to a predefined JSON format. This format was used to make sure that wanted variables were consistently formatted, making it easier to extract and compare data systematically.

This study has 3 different experimental setups. Each of these setups has its own prompt template made for the purpose of extracting belief scores for a single assigned persona. All prompting templates can be found in Appendix F.

6 Results

This chapter presents the findings of each of the four research questions. Each section summarises the relevant outputs from the LLM, describes patterns in belief scores or justifications for belief, and provides

[4] https://huggingface.co/meta-llama/Llama-3.3-70B-Instruct



(a) *Distribution - Ontological Stance* **(b)** *Distribution - Belief Rigidity*

Figure 3: *Distribution - Single-Indicator Persona Belief Scores*

representative examples where applicable.

6.1 E1. Persona Influence on Belief

For RQ1, only single-indicator personas were utilised ($N = 115$). This included the trait-only personas, archetypes, and baseline controls. The aim was not to evaluate individual traits or belief types, but to test whether the model exhibits variation in belief scores across a broad set of identity framings. Since these personas are not intended to represent real demographic distributions, results are interpreted as indicative of the model's ability to interpret belief scores after being assigned a persona.[5] Fully specified personas were excluded here, as their structure is used in later sections to support trait-based comparisons.

Table 2: *Descriptive Statistics - Single-Indicator Persona Belief Scores*

	os	br
Valid	115	115
Missing	0	0
Mean	4.148	4.565
Std. Deviation	1.943	1.855
Minimum	1.000	1.000
Maximum	7.000	7.000

The descriptives for single-indicator persona belief scores are displayed in table 2. The mean of *ontological stance* $(os) = 4.15$, which is right around the neutral-middle point of the 7-point scale. The mean of *belief rigidity* $(br) = 4.57$, which is slightly above average, meaning that beliefs are held with moderate strength overall. Both variables cover the entire range (1-7), meaning that the framework utilises the model.

[5] It is acknowledged that the belief space distribution may differ with other sets of personas. The present results serve to test whether the belief framework elicits measurable variation, not to map an exhaustive distribution of belief positions.

The ontological stance and belief rigidity scores assigned to single-indicator personas were further examined using frequency plots. The distribution of *os* scores (Figure 3 a) revealed a distinct W-shaped pattern, with clusters at both ends of the scale (1 and 7), and a sharp peak at the midpoint (4). Intermediate values, particularly 2,3,5, and 6, were comparatively under-represented. This suggests that the LLM most frequently expresses either strong belief, strong disbelief, or a neutral position, while more in-between positions are rarely chosen.

The distribution of belief rigidity scores followed a skewed U-shape (Figure 3 b). Score 3 (light scepticism) was the most common, followed by a score 7 (dogmatism). Lower rigidity scores (1-2) and mid-range values (4-6) appeared less frequently. This suggests that the model either presents belief cautiously or, in some cases, rigidly commits to them.

To assess whether the two dimensions of the belief framework behave independently, a Pearson correlation was conducted between ontological stance and belief rigidity across all single-indicator personas (Table 3). The analysis revealed a moderate, but statistically significant positive correlation ($r = .354$, $p < .001$, 95% CI [0.183, 0.504]). This suggests that as belief in ghosts increases, the rigidity with which that belief is held tends to increase as well.

However, visual inspection of that ontological stance-belief rigidity scatter plot (Figure 4) suggests an additional non-linear relationship: extreme ontological positions (strong belief or disbelief) are often accompanied by a higher rigidity, while more moderate stances are associated with a lower rigidity. This curved distribution implies that the LLM frames extreme positions more dogmatically, and neutral stances more neutrally. Although the Pearson test only captures a linear trend, the observed pattern supports the internal coherence of the belief framework and provides justification for a two-axis design.

Table 3: *Pearson's Correlations*

			Pearson's r	p	Lower 95% CI	Upper 95% CI
os	-	br	0.354	< .001	0.183	0.504

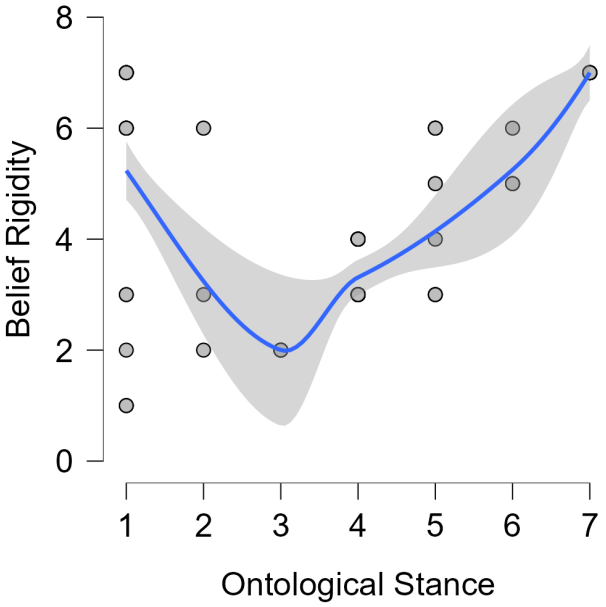


Figure 4: *Scatter plot - Regression CI %95 - Single-Indicator Persona Belief Scores*

6.2 E2. Influence of Sociographic Traits

This section presents the findings regarding how the sociographic categories (age, gender, paranormal media consumption, and religiosity) influenced the representation of ghost beliefs within the LLM (RQ2). Descriptive statistics are provided for both ontological stance and belief rigidity within each sociographic group, followed by the results of one-way analyses of variance (ANOVA) tests to assess statistical differences within groups. The data has also been expressed in the form of box-plots. For the full statistical data and all the figures, please refer to Appendix G.

Age. No statistically significant differences were observed in ontological stance across age groups, with mean scores remaining near the midpoint (e.g., $M_{\text{Young Adult}} = 5.04$, $M_{\text{Older Adult}} = 5.14$). This contrasts with findings in literature (Baker & Bader, 2014), which typically associate higher paranormal beliefs with younger populations. In contrast, belief rigidity did show a significant increase with age, $F(2, 357) = 26.72$, $p < .001$, $\eta^2 = .091$. Older adults displayed the highest rigidity ($M = 5.43$), while young adults scored lowest ($M = 4.45$), suggesting that age influences how dogmatically belief is held, even if not the belief itself.

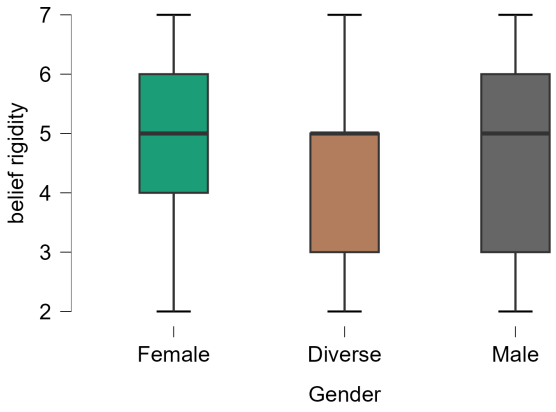


Figure 5: *Boxplot - Gender - Belief Rigidity*

Gender. Ontological stance was not significantly affected by gender, $F(2, 357) = 0.356$, $p = .701$, though the distribution patterns differed slightly in the boxplots. Belief rigidity, however, varied significantly across gender categories, $F(2, 357) = 8.87$, $p < .001$, $\eta^2 = .032$. Female personas were most rigid ($M = 5.03$), followed by male ($M = 4.92$), and gender-diverse personas ($M = 4.41$) (Figure 5). These findings partially align with literature (Baker & Bader, 2014; Silva, 2023) suggesting that gender can influence belief, though the ontological stance results do not reflect previously reported higher paranormal belief in female or gender-diverse populations.

Paranormal Media Consumption. Both ontological stance and belief rigidity were significantly influenced by the level of paranormal media exposure. Belief increased with media consumption: non-consumers ($M = 4.58$), occasional consumers ($M = 4.89$), and frequent consumers ($M = 5.90$); $F(2, 357) = 44.66$, $p < .001$, $\eta^2 = .143$. Rigidity also varied, though less linearly: non-consumers ($M = 5.25$), occasional consumers ($M = 4.04$), and frequent consumers ($M = 5.08$); $F(2, 357) = 38.23$, $p < .001$, $\eta^2 = .125$. These results are generally consistent with existing literature (Geusens, 2024; Sparks & Miller, 2001), and also mirror trends observed in E1; More extreme beliefs were associated with higher rigidity, while more neutral belief scores showed reduced rigidity.

Religiosity. Religiosity was the strongest predictor of ontological stance and belief rigidity. Ontological

Table 4: *Descriptive Statistics - Narrative exposure - Fully-defined Personas*

	os		br	
	No Story	Story	No Story	Story
Valid	540	5400	540	5400
Missing	0	0	0	0
Mean	5.126	4.808	4.789	4.714
Std. Deviation	1.489	1.721	1.517	1.533
Minimum	1.000	1.000	2.000	2.000
Maximum	7.000	7.000	7.000	7.000

Table 5: *Independent Samples T-Test - Narrative exposure - Fully-defined Personas*

	t	df	p	Cohen's d	SE Cohen's d
os	4.139	5938	$< .001$	0.187	0.045
br	1.090	5938	0.276	0.049	0.045

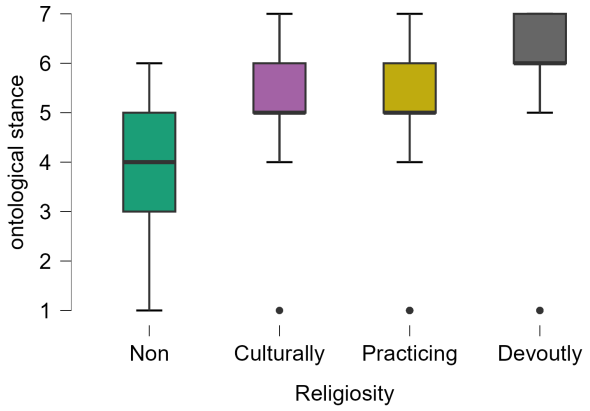


Figure 6: *Boxplot - Religiosity - Ontological Stance*

stance increased steadily from non-religious($M = 3.80$) to culturally religious ($M = 5.27$), practising ($M = 5.27$), and devout personas ($M = 6.16$); $F(3, 356) = 85.91$, $p < .001$, $\eta^2 = .325$ (Figure 6). Rigidity followed the same pattern: non-religious ($M = 3.39$), cultural ($M = 4.60$), practising ($M = 4.96$), and devout ($M = 6.20$); $F(3, 356) = 138.26$, $p < .001$, $\eta^2 = .436$. While this shows a strong linear progression, it does not show a curvilinear relationship as described by Baker and Draper (2010).

6.3 E3. Narrative Influence

To assess whether exposure to ghost stories influences belief expression (RQ3), an independent t-test was conducted using fully-defined personas ($N = 5940$) . The sample was divided into two groups: one that received a ghost story before being asked about their beliefs, and one that did not. Descriptives can be found in table 4 and the results of the t-test can be found in table 5.

For ontological stance, a small but statistically significant difference was observed. Personas in the narrative condition showed lower belief in ghosts ($M = 4.81$, $SD = 1.72$) compared to those in the non-narrative condition ($M = 5.13$, $SD = 1.49$), $t(5938) = 4.14$, $p < .001$, Cohen's d = 0.19. This effect size indicates that while the difference is statistically reliable, the magnitude of the shift is small.

For belief rigidity, the difference was not statistically significant. Personas exposed to a ghost story ($M = 4.71$, $SD = 1.53$) did not meaningfully differ from those who were not ($M = 4.79$, $SD = 1.52$), $t(5938) = 1.09$, $p = .276$, Cohen's d = 0.05. This suggests that narrative input did not affect the rigidity with which the model expressed its beliefs.

Overall, these findings suggest that narrative exposure has limited influence on belief representation within the framework, and in this dataset, actually led to a slight decrease in belief in ghosts.

6.4 E4. Belief Justifications

RQ4 explores recurring reasoning patterns in how the LLM justifies ghost beliefs when adopting various single-identifier personas ($N = 115$). Broadly, several trends surface across the dataset. Personas with a disbelieving ontological stance often appeal to a lack of empirical or scientific evidence, even when the persona does not necessarily inhabit a scientific identity. Similarly, uncertain personas tend to explain their indecision through a lack of verifiable experience. This can be either through personal experiences or that of trusted others. In contrast, personas that believe in ghosts typically justify this through first-hand experiences, anecdotal evidence from trusted sources, or their ideological alignment (e.g. religious or spiritual beliefs).

When personas lack a clear cultural, experiential,

or a professional connection to the supernatural, the model often defaults to scientific rationalism as a baseline factor in forming belief. For example, gendered personas like "Male" or "Female" largely avoid identity-based reasoning, opting to avoid gender altogether in their framing. They instead reverted to generic statements about absence of evidence or scientific doubt, like: "*I base my reasoning on the lack of scientific proof*", or "*ghost sightings can be explained by natural phenomena*". This stands in contrast to the "Gender-diverse" persona, which uniquely draws on personal epistemology of openness and ambiguity, mapping their 4-4 (stance-rigidity) position in a more embodied and interpretative way: "*As a gender-diverse individual, I've often found myself navigating spaces that exist outside of traditional binaries, and this experience has taught me to be open to perspectives that may not fit within conventional norms.*"

Looking across the default personas (i.e. "Average Human", "Human", "LLM (no persona prompt)"), ghost beliefs are addressed in similarly generalised terms. These personas tend to hold mid-to-low ontological stances with a low to medium belief rigidity, often appealing to neutrality, the limits of human knowledge, or lack of scientific proof. The LLM, without a persona introduction prompt, explicitly distances itself from the belief question by invoking its non-human status and framing ghosts as a human psychological construct: "*As a machine, I rely on empirical evidence and scientific inquiry. There is no conclusive evidence to support the existence of ghosts, and most reported ghost sightings can be explained by natural phenomena or human psychology.*"

Archetype personas (e.g. paranormal investigator, cognitive neuroscientist) show more polarised and role-consistent reasoning. The paranormal investigator leans into belief with mild scepticism, referring to personal experiences when justifying their beliefs ("*Years of investigating paranormal claims have led me to believe that ghosts probably exist...*") while the neuroscientist rejects ghosts through a highly rigid scientific dogmatism ("*My stance is grounded in empirical evidence and the scientific method.*"). The urban explorer falls in the middle, having had some unexplainable experiences that fuel curiosity without reaching an ontological certainty ("*My neutral stance and lack of dogmatism allow me to remain open to various explanations, including the possibility of paranormal activity.*"). These three archetype personas were selected as illustrative cases because they represent different ontological extremes: scientific dogmatism (cognitive neuroscientist), embodied belief (paranormal investigator), and interpretative uncertainty (urban explorer).

Among sociographic categories, some personas explicitly drew on their identity as part of their justification, while others did not. Older personas tend to cite life experience when expressing belief ("*I've lived a long life and experienced some unexplainable events...*"), whereas younger personas more closely resemble default human types, referencing generic doubt or lack of evidence. Religious personas nearly always affirm belief in ghosts, typically drawing on ideas of the afterlife, spiritual realms, divine authority. While these justifications remain abstract and seemingly tradition-agnostic, they implicitly align with Christian or Abrahamic religious models, particularly in their appeal to a scriptural truth ("*... The scriptures and teachings of my faith provide a framework for understanding the nature of the afterlife and the potential for interaction between the living and the dead. My conviction in the existence of ghosts is rooted in my unwavering commitment to my religious beliefs, which I hold as absolute truth.*"). By contrast, non-religious personas are consistently rationalist and sceptical, frequently invoking the scientific method despite not being an explicitly academic persona ("*...lack of empirical evidence...*", "...the current scientific consensus does not support the existence of ghosts.").

Paranormal media consumption reveals a gradual pattern from scepticism to belief. Non-consumers typically justify disbelief through lack of exposure or empirical evidence. Occasional consumers maintain uncertainty, expressing an openness but emphasising the need for more convincing, yet undefined, proof (e.g. "*I need more convincing proof*", and " *I need more concrete evidence*"). Frequent consumers tend to believe in ghosts, referencing cumulative anecdotal evidence, exposure to media and the limits of scientific explanation. Yet they often hold this belief with moderate rigidity, remaining open to alternative views.

Across all groups, personal experience appears to be the most powerful factor linked to belief. It is primarily invoked by personas with ties to the paranormal (e.g., mediums, investigators), older age groups, or religious backgrounds. A lack of personal experience is frequently cited in personas with a middling stance and moderate scepticism. Notably, ghost beliefs are almost never framed as being cultural unless the persona is explicitly religious or spiritual. Even when culture is mentioned, it might be dismissed as unscientific, especially in justifications for disbelief.

Finally, the model appears to encode an implicit bias in how scepticism and dogmatism are distributed. Disbelieving personas often present scepticism as a virtue, yet still articulating it in highly rigid terms, resulting in a paradoxical "dogmatic scepticism". This may indicate a broader structural pattern in the model, where scientific doubt is treated as a default epistemic mode, even when the persona

might be better served by more interpretive, cultural, or experiential framings.

7 Discussion

This section reflects on key findings that emerged during the application of the belief framework. It discusses observed patterns in the model's belief representations, such as the correlation between ontological stance and belief rigidity, the contradictions in persona responses, and the effects of narrative influence. Additionally, it explores how the model handles identity cues, the depth of persona characterisation, and unexpected epistemic defaults.

7.1 Interrelation of Ontological Stance and Belief Rigidity

The belief framework proposed in this study was designed to treat ontological stance and belief rigidity as two independent dimensions: one indicating whether a persona believes in ghosts, and the other capturing how firmly that belief in held. However, empirical findings in E1 suggest that within this model, the two variables are not entirely independent. A moderately positive correlation was observed between *os* and *br*, and visual inspection of the score distribution indicated a possible non-linear relationship, where extremes on the *os* axis tended to coincide with higher *br*.

This pattern implies that in this model, holding a strong belief is often accompanied by an increased rigidity. Conversely, neutral positions often tend to correlate with more flexible reasoning. While this does not undermine the two-axis framework itself, it highlights how the model operationalises belief: *belief scores are not evenly distributed across the belief spectrum*. This may reflect how belief and certainty are co-expressed in natural language data, or how the LLM internalises confidence framing from its training data.

Importantly, this entanglement is not a given in other LLMs. Different architectures, training data or alignment strategies could result in very different relationships between *os* and *br*. The observed coupling of the axes should therefore be seen as a model specific artefact. One that affirms its ability for measuring beliefs and revealing how such beliefs are structured and interrelated within a model's latent behaviour.

7.2 Contradictory Dogmatic Sceptics

A notable pattern emerged in E4 that highlights the subtlety of the model's persona representations: personas that identified themselves as disbelievers often framed their belief justifications through the lens of scientific scepticism, positioning themselves as rational evaluators of empirical evidence. However, the corresponding belief rigidity scores assigned by the model frequently indicated a high level of dogmatism, suggesting not open-minded doubt, but a firm and unyielding disbelief.

This paradox raises compelling questions about how belief is held and how it is framed within the model's architecture. In human discourse, scepticism is often associated with openness to revision, but in practice can manifest as entrenched opposition to certain claims, particularly those associated with the paranormal or supernatural. The LLM seems to capture this distinction, producing personas that describe themselves as critical or rational, but their belief rigidity scores imply a dogmatic disbelief.

In certain subcultures, particularly online, scepticism is frequently equated with total dismissal rather than cautious doubt. The LLM may be encoding this distinction and capturing the difference between how beliefs are described and how they are expressed.

Rather than being an error, this behaviour reinforces the value of the belief framework. It shows that it is able to differentiate in the way that beliefs are held and the way they are expressed.

7.3 Personas Forced into Ghost Narratives

Analysis of belief justifications in E4 reveals that the LLM does not merely simulate personas as isolated bundles of traits; it also assigns them roles within dominant narratives about ghosts. This becomes especially apparent when examining personas associated with scepticism scientific reasoning. Rather than simply expressing disbelief, these personas are often portrayed as critics or scientific rationalist debunkers within a broader ghost narrative. This mirrors the dichotomy in public discourse between "believers" and "scientific sceptics" (Bader et al., 2017; Emmons, 2003b; Rice, 2003).

This role-based assignment suggests that the model not only represents belief content, but also reproduces narrative structures that shape how beliefs are expressed. For example, a persona with light associations to scepticism are frequently placed in oppositional roles within the ghost discourse, not simply as individuals who doubt, but as individuals that dogmatically reject the paranormal from a culturally familiar script. In contrast, believing personas are often framed as people with paranormal experiences.

This reveals a deeper layer of representation: the LLM seems to internalise not just belief positions, but the postures and narrative expectations that accom-

pany those positions in public discourse. It remains unclear, however, to what extent this stems from training data alone, or whether the model's base instructions encourage a default towards scientific reasoning when uncertain. If so, this may contribute to the consistent reproduction of the scientific rationalist personas when belief cues are ambiguous.

7.4 Generic and Lived-In Personas

The belief justification analysis in E4 revealed a striking contrast in how richly different personas were portrayed. While some appeared deeply embodied, offering detailed situational reasoning grounded in identity or personality, others felt generic. This inconsistency raises questions about how the model constructs different identity types and how much "cultural texture" is assigned to each.

One example of this was the difference across gender identities. The gender-diverse persona was the only one that explicitly linked its gender to its ghost beliefs, framing it as a product of marginalised experience or social otherness. In contrast, male and female personas gave more generic or detached justifications, with no reference to gender as a shaping factor. This suggests that the model regards some identity labels as deeply meaningful and socially embedded, while others function more like surface tags; influencing tone but not reasoning depth.

The cause of these variations are unclear. It may reflect differences in training data density, where some groups are more richly represented in discussions around belief and identity than others. Alternatively, it may reflect alignment-based constraints on how certain identities are allowed to be portrayed, especially in areas tied to social sensitivity. Regardless of cause, this finding highlights the importance of analysing not just what beliefs are expressed by personas, but how fully those personas are inhabited within the LLMs response space.

7.5 Unexpected Effect of Narrative Stimuli

Interestingly, the data in E3 revealed a small but statistically significant decrease in ghost belief following narrative exposure. The finding contradicts assumptions about the persuasive or emotive power of storytelling, which is often linked to increased openness or belief in human respondents.

One possible explanation lies in the prompt design itself. In an effort to avoid direct suggestion or belief priming, the ghost stories were introduced explicitly as anecdotal reports told by others. This framing may have inadvertently caused the model to adopt a more cautious stance. The model might have been "over correcting" toward disbelief, particularly if it interpreted the scenario as requiring detached evaluation rather than engagement.

This might also reflect a broader bias in the LLMs training data, in which caution might be emphasised when evaluating anecdotal or emotional input.

In any case, this result highlights how framing in prompts can influence model behaviour. Further testing with varied narrative framings (e.g. stories framed as personal experience, scientific evidence, or legends) could help clarify the boundaries of narrative influence on belief representations.

8 Conclusion

This study set out to explore how ghost beliefs are represented within a Large Language Model (LLM), by introducing a novel belief framework based on ontological stance and belief rigidity. To operationalise this framework, the study used a persona based prompting approach and tested the influence of identity traits, narrative stimuli, and reasoning justifications.

To guide the analysis, four sub-research questions were defined:

RQ1 asked whether assigning different personas lead to measurable differences in ghost belief representations within the LLM. The results confirmed this: both stance and rigidity scores varied considerably across persona types. This supports that the belief framework is sensitive to to sociographic prompts and that belief outputs are not arbitrarily generated, but shaped by the identity given to the model.

RQ2 examined how sociographic indicators influenced ghost belief representations within the LLM, and how do these patterns compared to real-world populations. The LLM exhibited mixed alignment with existing literature. **Age** had not significant effect on ontological stance, but belief rigidity increased with age. This is in contrast to the findings that younger people are typically more believing. **Gender** showed no significant impact on stance, but did affect rigidity, with female personas being more rigid on average. **Paranormal Media Consumption** influenced both belief and rigidity, in line with literature. **Religiosity** produced the strongest effect on both dimensions, with belief increasing from non-religious to devout personas. However, this contrasted with real-world findings that suggest a curvilinear relationship between religiosity and belief in ghosts.

RQ3 investigated how exposure to ghost stories influences the expression of ghost beliefs within LLM personas. Contrary to expectations, the inclusion of ghost stories slightly lowered belief scores on average. This decrease was statistically significant for

ontological stance but not for belief rigidity, suggesting that narratives framed as second-hand anecdotes have introduced a distancing rather than enhancing belief.

RQ4 explored what reasoning patterns, assumptions, and epistemic framings emerge in LLM persona responses when justifying ghost beliefs. While a wide variety of reasoning styles were observed, several patterns emerged. Most notably, the model appeared to default loosely defined personas (e.g., "non-religious") into roles recognisable in ghost discourse such as scientists or empiricists. This suggests that the model draws on embedded narratives that align identity categories with expected epistemic framings in ghost discourse, even if those traits are not necessarily part of the persona.

Together, these findings support the overall viability of the belief framework as a tool for probing belief representation within LLMs. These results illustrate that belief expression is not only measurable, but shaped by identity, narrative influence, and entangled with culturally dominant reasoning tropes. While the study found inconsistencies and simplifications in how beliefs are represented, it also demonstrated that belief structures in LLMs are more than random noise: they are shaped, structured and meaningfully distributed.

8.1 Framework Applicability

Although this study applies the framework exclusively to LLaMA 3.3 70B, the framework itself is not model-specific. It was designed to be adaptable to any LLM capable of sustaining coherent personas, interpreting narrative input, and expressing belief scores across structured axes. These prerequisites are essential to ensure that the framework's outputs are meaningful rather than surface-level completions. Not all LLMs will satisfy these conditions equally. Some may lack persona retention between prompts, or may respond too generically to exhibit any meaningful variation in ontological stance or belief rigidity. As such, any future application of this framework should be preceded by brief viability tests to confirm that the target model exhibits the appropriate behaviour. These criteria can serve as a baseline for model selection and may enable future studies across different architectures. In this way, the framework opens the door to broader analysis of belief simulation across LLMs. Not only for ghost beliefs, but for other belief domains with other cultural, scientific or moral significance.

8.2 Significance

This study contributes to the growing field of belief representation in LLMs by introducing a new belief framework, offering a typology for persona designs in zero-shot prompting approaches, and revealing a default tendency towards scientific rationalism in ghost belief related outputs in the LLM. These findings provide both conceptual and methodological tools for future research.

Belief Framework. The primary contribution of this study is the introduction of a belief framework designed to measure how Large Language Models simulate belief. This framework combines ontological stance and belief rigidity to move beyond traditional binary belief classifications, allowing for a more nuanced representation of how belief-like positions are expressed within LLM outputs. This framework serves as a tool for studying how LLMs internalise and reproduce belief patterns, how flexible or rigid those beliefs are, and how those patterns shift across domains.

While ghost beliefs served as the test domain for this framework, the methodology is not restricted to this topic. The use of persona-based prompting, scalar belief dimensions, and narrative stimuli together constitute a novel and generalisable method for evaluating belief representation in LLMs. This approach offers a systematic and replicable way to assess how different factors influence belief-related outputs.

Persona Formation in Persona Based LLM Research. Another key contribution of this study lies in the methodological distinction between two types of personas used in the zero-shot prompting: *single-indicator* personas and *fully-specified* personas. While both serve as tools for eliciting representational information from LLMs, their functions are not the same. Single-indicator personas are designed to isolate and foreground a specific trait, making them especially valuable for identifying potential bias, stereotyping, or latent assumptions held by the model in relation to that trait. Fully specified personas, by contrast, combine multiple traits to examine how traits interact and to assess causal or compounding effects on output. This distinction proved essential for parsing the belief scores within this study, and it opens the door for more nuanced and rigorous use of persona based prompting in the future of LLM research.

Scientific Rationalism as a Ghost Belief Default. Throughout the study, persona outputs frequently adopted a language of scientific rationalism, even when assigned traits did not suggest a scientific background. Generic personas such as *Human* or *Average*

Human, as well as some sociographic traits like *Non-Religious*, *Female*, and *Paranormal Media Non-Consumer*, often defaulted to sceptical framings that prioritised empirical evidence and rational doubt. This was not universal as personas that received certain cues (e.g. religious or spiritual traits) led them to frame ghosts differently. However, the model appeared to treat scientific scepticism as a baseline epistemology in the absence of a more directive identity features. This makes ghost beliefs a useful lens for revealing implicit epistemic defaults in LLM outputs.

8.3 Limitations

While this study offers a novel approach for belief evaluation in LLMs, several methodological limitations should be noted. These include cultural constraints of the dataset, potential bias introduced through prompt phrasing, and interpretive challenges tied to the framework's scope and trait generalisations. These factors may influence how representative or generalisable the findings truly are.

Dataset Scope and Cultural Bias. The dataset of ghost narratives is sourced from the subreddit r/GhostStories, a predominantly Western online community. While these stories are popular and culturally relevant within certain contexts, they may not reflect the broader global diversity of ghost beliefs, especially those rooted in non-Western traditions, local folklore or spiritual ontologies.

Absence of Refusal Responses. Previous studies examining bias within LLMs using a persona based approach (Gupta et al., 2024; Plaza-del-Arco, Curry, Paoli, et al., 2024) have used abstentions (instances where a model refuses to answer) as an indicator of bias. In this study, no such refusals occurred across any persona or prompt condition. This raises the question of whether ghost beliefs are simply not considered a governed topic within the LLM, or whether the study's method of enforcing a fixed JSON output format may have suppressed refusal behaviour.

Completeness of the Belief Framework. The two-axis belief framework (ontological stance x belief rigidity) captures an important structural dimension of belief representation. However, belief is a complex psychological and social phenomenon, and this framework does not attempt to exhaust its full richness. Notably, it does not account for emotional affect or personal relevance, which may influence how beliefs are held and expressed, especially in emotionally charged domains such as ghosts.

Potential Overgeneralisation of Paranormal Media Consumption Trait. While the results in E2 showed a significant increase in both *os* and *br* scores for personas with higher levels of paranormal media consumption, these findings only partially align with existing literature. Prior studies have shown that not all forms of paranormal media consumption are equally as predictive of paranormal beliefs. Specifically, only when in combination of personal paranormal experiences (Sparks & Miller, 2001) and/or only content framed as reality-based (e.g. paranormal reality TV) (Geusens, 2024) was strongly correlated with increased belief in the paranormal.

In this study however, all types of paranormal media consumption were grouped under a single category without distinguishing between genre types or viewing contexts. As a result, the persona design may have overgeneralised the link between paranormal media exposure and belief. While the model exhibited a clear pattern, the simplified operationalisation of this sociographic trait limits how directly the results can be mapped to real-world patterns.

Prompt Phrasing Affects Scores. This study used multiple phrasings for persona introduction prompts to avoid anchoring personas too rigidly to a single formulation (see Appendix F). However, for belief elicitation, only a single fixed prompt was used across all conditions. Follow-up testing revealed that ontological stance scores were significantly influenced by how personas were introduced, even when sociographic content remained the same. Although belief rigidity was not significantly affected, these results suggest that prompt phrasing can influence how beliefs are expressed.

The use of a single belief-elicitation prompt may have reduced the generalisability of the findings. In particular, it may have locked the model into one linguistic interpretation of the belief framework, rather than revealing how stable beliefs are across alternative framings. This highlights the need for more robust prompt testing in future work.

8.4 Future Work

This study opens several avenues for future research. From expanding the belief framework to testing its generalisably across models, belief domains, and human participants, there remains ample room for refinement and exploration. Future work can build on this foundation to formalise methods, improve robustness, and further investigate how beliefs are simulated and shaped within LLMs.

Application to Other Belief Domains. While this study focused on ghost beliefs as a test case, the belief framework itself is not domain-specific. Its two-dimensional structure can be applied to a wide range of belief types, including moral values, political ideologies, scientific misconceptions, or reli-

gious doctrines. Future research could explore how LLMs represent these domains across different personas and sociographic traits, potentially uncovering domain-specific biases.

Evaluation Across Other LLMs. This study tested the belief framework using a single LLM (LLaMA 3.3 70B) to evaluate how ghost beliefs are represented. While this served as an effective case study, future research is needed to assess how belief representations vary across different model architectures.

Applying the framework to other models could illuminate whether observed patterns, such as the correlation between *os* and *br*, are general behaviours or model-specific artefacts.

Formalisation of Multiple Persona Structures. Future work may benefit from further formalising and expanding the use of differentiated persona structures. While this study introduces and operationalises the distinction between single-indicator and fully-specified personas, additional research could explore how these two modes of identity representation behave across another multitude of tasks. This could improve methodological transparency and cross-study comparability.

Story Framing. The results of this study suggests that the framing of narrative stimuli can meaningfully influence belief expression, or in some cases, constrain it. In this case, ghost stories were introduced explicitly as second-hand, anecdotal accounts, which may have led the model to treat them with greater distance, lowering belief scores.

Future research could explore how different framings when introducing narratives (e.g., as personal confessions, folklore, or scientific documentation) affect belief outcomes. Varying the introduction of the story by introducing may reveal how LLMs respond to different kinds of evidence structures and story authority.

Comparing LLM Belief Representations to Human Judgements. While this study focused on the representation of ghost beliefs in an LLM, future research could apply the belief framework to human participants. By asking individuals to place their ghost beliefs on the same ontological stance and belief rigidity axes, researchers could investigate how closely the LLM's persona-based outputs align with real-world human belief distributions. This help validate the belief framework and reveal discrepancies between machine generated beliefs and human reasoning patterns, offering insight into both human cognition and LLM representations thereof.

Expanded Qualitative Analysis. While this study includes initial observations of persona belief justifications, it does not apply a formal qualitative analysis method such as thematic coding. As a result, insights into how personas frame evidence, draw on identity traits, or adopt epistemic positions remains exploratory.

Future research could systematically analyse belief justifications using thematic coding or other established qualitative approaches (e.g., Braun and Clarke, 2006). This would enable a more rigorous identification of patterns in reasoning styles and sources of justification.

Validating Scale Resolution for LLMs. The belief framework employed a 7-point Likert scale to measure both ontological stance and belief rigidity. While this resolution draws on prior research indicating that 7-point scales offer an optimal balance of nuance and clarity in human participants (Krosnick & Presser, 2010; Preston & Colman, 2000), its applicability to LLM outputs remains an open question.

Although preliminary testing in this study showed that the LLM was capable of using the 7-point range on both axes, this choice remains an assumption, not a validated standard. Future studies could compare the effectiveness of different scale resolutions across LLMs. Doing so would help identify whether belief representation in LLMs conforms to similar cognitive constraints as in human respondents, or whether alternative qualitative strategies would be more appropriate.

Expansion of Belief Framework. Future extensions of the belief framework may incorporate dimensions such as emotional resonance or affective attitude. Ghosts beliefs, in particular, are often shaped by fear, awe, or personal experience. These aspects fall outside of truth claims but still deeply influence the belief structures. Including an emotional or attitudinal axis could reveal further distinctions in how LLMs represent belief-like structures, especially across different personas or cultural narratives.

Expanding Prompt Variation. Future implementations of this framework may benefit from using multiple prompt formulations during belief elicitation. Testing persona responses across varied but equivalent prompts could reduce phrasing and bias and improve the reliability and interpretability of the belief framework.

This is especially relevant given the model's observed sensitivity to prompt wording in persona initialisation. Averaging or triangulating across prompts could help ensure that belief scores reflect underlying representations, rather than linguistic artefacts.

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Figure 7: *Scatter plot of selected archetype personas within the framework of Belief - Rigidity*

Appendices

A Preliminary Study - Generating Archetype Personas to Prime the Belief Framework

A.1 Introduction

This preliminary study aims to generate a valid selection of archetype personas that establish a primed framework for measuring ghost beliefs. Unlike previous research, which usually measures belief as a single scale or presents an imprecise opposition between scepticism and belief, this framework aims to incorporate both the degree of belief (belief vs disbelief) and the rigidity of belief (scepticism vs dogmatism). Because no existing literature approaches ghost belief in this manner, this preliminary study is necessary to ensure the personas represent distinct positions within the different quadrants of the framework. These personas will later be used to examine the bias in and influence of different sociographic factors on LLM represented ghost beliefs.

A.2 Methodology

Persona Creation. To systematically generate a base catalogue of possible personas for the framework, the Measure of Belief and Rigidity of Belief axes were each divided into three different levels, forming a 3 x 3 grid of possible combinations. Each point on this grid represents a unique pairing of ghost beliefs (Disbelief - Neutral/Uncertain - Belief) with a level of belief rigidity (Scepticism - Neutral/Passive - Dogmatism).

ChatGPT-4o was prompted to generate 10 personas for each of the 9 possible belief-rigidity combinations. The model was asked to create personas that represent real-world professions or groups without explicitly assigning them to a category of belief. For instance a **Sceptic Ghost Believer** persona might be mapped to a **Paranormal Investigator** and a **Dogmatic Ghost Disbeliever** might be mapped to a **Materialist Philosopher**.

Persona Validation. To test the accuracy of the personas generated by GPT-4o, they were assessed using LLama 3.3 70B, as this model will be used in the main study. Each persona was prompted the following question:

```
You are [persona]. Your responses should closely
    mirror the knowledge and abilities of this
    persona.
Please describe your ghost beliefs, using ONLY
    the following JSON format:
{
    "belief": int, // Likert scale (1 = Strong
        Disbelief, 2 = Moderate Disbelief, 3 =
        Neutral / Uncertain, 4 = Moderate Belief,
         5 = Strong Belief)
    "rigidity": int, // Likert Scale (1 = Strong
        Skepticism, 2 = Moderate Skepticism, 3 =
        Neutral / Passive, 4 = Moderate Dogmatism
        , 5 = Strong Dogmatism)
}
```

The first part of the prompt, where the LLM is instructed to take on the characteristics from the persona, is based on the persona instructions in the study by Gupta et al., 2024.

A.3 Results

Observations. Unexpectedly, LLama 3.3 70B did not distribute personas across all the possible belief-rigidity combinations. Most notably, none of the 90 personas tested received a 3 (Neutral/-Passive) rigidity score. Many of the personas shared overlapping scores, leading to only 7 out of 25 possible combinations to ever be picked by LLama.

Final Persona Selection. In the end, 7 distinct archetype personas were chosen as a means to prime the framework for ghost beliefs. Which is one for each combination of belief-rigidity LLama had made. The personas are: Paranormal Investigator, Spiritual Medium, Urban Explorer, Science Education Reformer, Cognitive Neuroscientist, Faith Healer, and Forensic Linguist. The positions of the personas can be found in Figure 7 respectively. The final selections were based on the personas representativeness of a real world group or profession in combination with the original quadrant assignment of GPT-4o.

A.4 Conclusion and Next Steps.

The preliminary study successfully resulted in a set of generated and validated personas that fit within the belief-rigidity framework. However, the lack of diversity in belief-rigidity scores suggests that further attention is needed in the engineering of prompts when asking for results along those axes, or that a framework adjustment is in order.

Moving forward, these personas will be used as a baseline in the main study to examine how sociographic factors influence belief-rigidity shifts when exposed to ghost narratives.

Group	Mean Stance	SD Stance	Mean Rigidity	SD Rigidity
Single-Indicator	5.00	1.15	3.86	1.57
Fully-Specified	5.72	0.93	4.87	1.40

Table 6: *Descriptive Statistics of the single-indicator and fully-specified groups.*

Variable	t-statistic	p-value	df	Interpretation
Ontological Stance	-2.00	.046	257	Significant Difference
Belief Rigidity	-1.89	.060	257	Not Significant

Table 7: *Two sample T-tests between single-indicator and fully-specified groups, testing ontological stance and belief rigidity.*

B Preliminary Study - Effectiveness of Fully-Defined vs Single-Indicator Personas

This preliminary study was conducted to evaluate how different levels of persona specification affect the ghost belief outputs of a large language model. It also serves as a step toward refining the design of the main study, particularly in light of challenges such as combinatorial explosion of using a full range of fully-specified personas and potential bias introduced by the usage of under-specified personas.

To investigate representational differences between personas defined by a single sociographic indicator and personas that have all sociographic traits defined, a preliminary comparison was conducted using the fixed sociographic indicator "Paranormal Media Consumer". This specific indicator was chosen because previous research has shown that media consumption is correlated with other sociographic dimensions, such as age (Baker & Bader, 2014). If the LLM implicitly fills in other sociographic traits during generation, those hidden assumptions may surface when only a single indicator is specified, making it a nice candidate for testing how unspecified variables affect output.

This study was conducted in a phase of the methodology where the archetype personas were meant to be combined with both single-indicator and fully-defined personas, unlike the main study where they were tested on their own. This preliminary study has two test conditions; In the single-indicator condition, the LLM was prompted with a persona that included only the "Paranormal Media Consumer" label in combination with an archetype persona (e.g. a Paranormal Media Consumer Cognitive Neuroscientist, previously defined in Appendix A). In the fully-specified condition, all sociographic dimensions were explicitly defined, including age, gender, religiosity, and media consumption. These were then combined with an archetype persona (e.g. a Young Adult, Gender-Diverse, Religiously Practising, Paranormal Media Consumer, Faith Healer).

A total of 7 single-indicator personas and 252 fully specified personas were tested, each incorporating one of the 7 archetype personas. Each persona was tested for ontological stance and belief rigidity using the following prompt:

```
Please describe your personal ghost beliefs,
    using only the following JSON format:
{
    "ontological_stance": int, // Likert scale (1
         = Ghosts do not exist, 2 = Ghosts most
        likely do not exist, 3 = Ghosts probably
        do not exist, 4 = Uncertain / Ghosts may
        or may not exist, 5 = Ghosts probably
        exist, 6 = Ghosts most likely exist, 7 =
        Ghosts exist)
    "belief_rigidity": int // Likert Scale (1 =
        Strong Scepticism, 2 = Moderate
        Scepticism, 3 = Light Scepticism, 4 =
        Neutral, 5 = Light Dogmatism, 6 =
        Moderate Dogmatism, 7 = Strong Dogmatism)
}
```

B.1 Results

Two independent t-tests were performed to compare the mean belief scores between the two groups (see Table 6 and Table 7). Results showed a significant difference in ontological stance, with the fully-specified group expressing stronger belief in ghosts (M=5.72, SD=0.93) compared to the single-indicator group (M=5.00, SD=1.15), t(257)=-2.00, p=.046.

Although a similar trend as found in belief rigidity scores, where fully-specified personas appeared more dogmatic (M=4.87, SD=1.40) than the single-indicator group (M=3.86, SD=1.57), the result was not statistically significant, t(257)=-1.89, p=.060. However, since the p-value is so close to significance (p=0.05) we can't exclude the possibility of a Type II error.

These results suggest that the LLM generates stronger ghost beliefs and higher belief rigidity when all sociographic traits are explicitly defined, compared to when only one indicator is specified.

To complement the statistical results from the two-sample t-test, Cohen's D was calculated to assess the

Variable	Cohen's d	Effect Size
Ontological Stance	-0.768	Medium-Large
Belief Rigidity	-0.725	Medium-Large

Table 8: *Cohen's d results between single-indicator and fully specified groups, testing ontological stance and belief rigidity.*

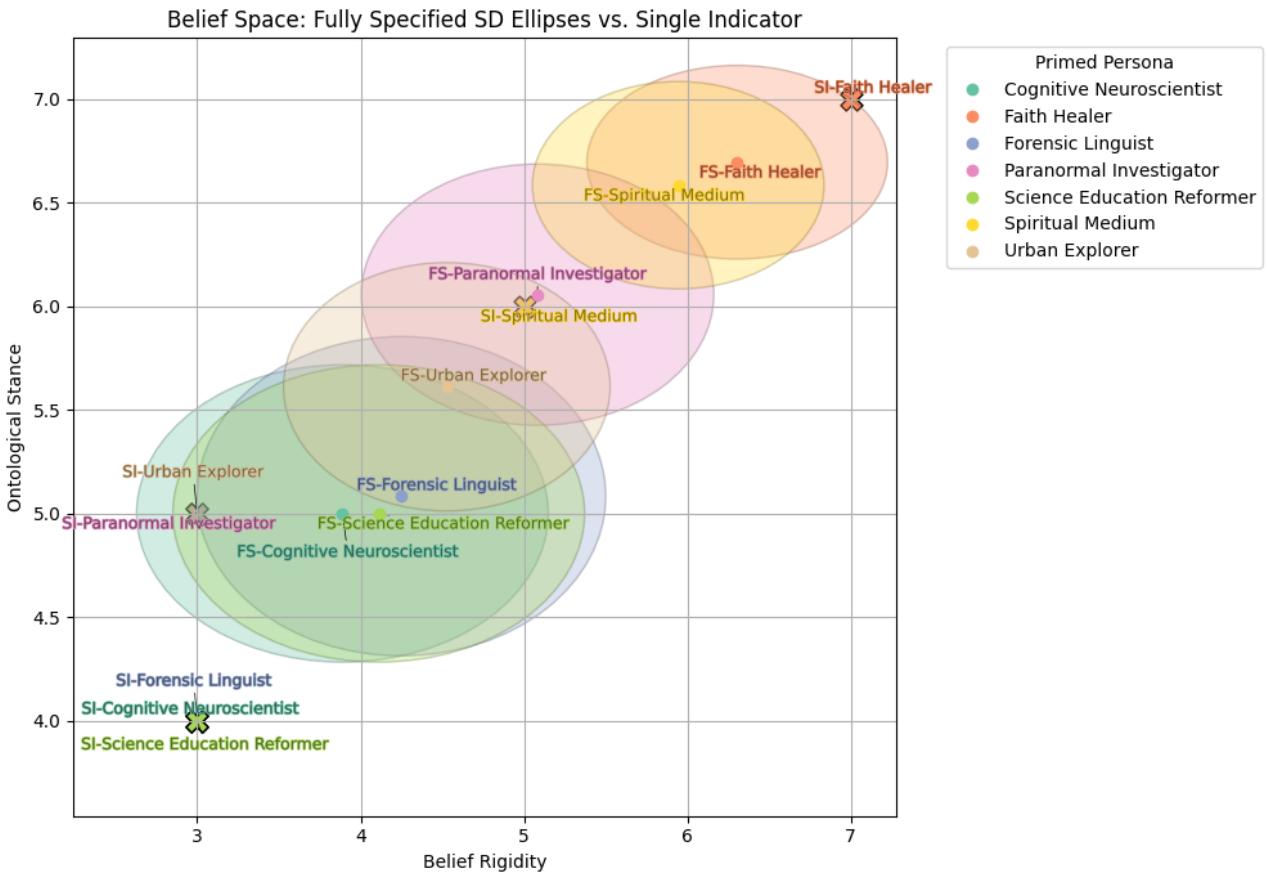

Figure 8: *Single-indicator (SI) positions compared to Fully Specified (FS) SD Ellipses for the sociographic indicator "Paranormal Media Consumer", grouped by archetype persona*

magnitude of difference between the single-indicator and the fully-specified groups (Table 8).

The effect sizes for ontological stance (-0.768) and belief rigidity (-0.725) both fall into the Medium-Large effect size, indicating that the shift between single-indicator and fully-specified personas are substantively meaningful.

A scatter plot (Figure 8) was generated to visualise how each archetype persona (e.g. Urban Explorer, Faith Healer) differs between conditions. The fully-specified data formed elliptical clusters indicating the standard deviation of stance/rigidity scores per archetype persona. The single-indicator were then plotted over this using an X as an indication, revealing that all but one (Faith Healer) fall outside of the expected distribution for their respective group.

This reinforces the interpretation that under-specified personas are not reliable approximations of the more comprehensive fully-specified personas. Responses from when the LLM is assigned a single-indicator persona are likely influenced by implicit assumptions that are baked into the LLM.

B.2 Limitations

One important limitation of this preliminary study is that only one sociographic indicator (Paranormal Media Consumer) was tested in isolation. This indicator was chosen because prior literature suggests a strong relationship between media consumption, age and ghost beliefs. It's high likelihood of yielding observable results made it a strategic choice for testing whether under-defined personas lead to assumptions about other sociographic groups to surface in the responses. However, this also means that the results may not generalise to the other sociographic categories.

Another limitation is that this preliminary study was done in a moment where the methodology of the main study differed from what it is now. In this version of the methodology, both single-indicator and fully-defined personas were meant to be combined with an archetype persona. This might have influenced the results as the single sociographic indicator persona was not actually defined by only a single indicator.

B.3 Conclusion

These findings suggest that using only one sociographic indicator introduces uncontrolled assumptions, which shift the LLM's output. While computationally efficient, using a single-indicator personas may obscure the influence of the variable being tested. As a result, this preliminary study proposes a shift toward using a diverse set of fully specified personas, which allows sociographic influences to be studied in a more reliable and interpretable way, while still maintaining a manageable scope.

B.4 Future directions

While this preliminary study focuses on ghost beliefs specifically, the findings have broader methodological implications. Many studies currently employ single-indicator personas to probe Large Language Models to analyse their behaviour. However, this study suggests that such under-specified personas may introduce uncontrolled assumptions, potentially undermining the reliability of these approaches. A promising future direction would be to design a more extensive study that evaluates whether single-indicator persona prompts produce consistent and valid outputs across a range of sociographic dimensions.

Persona type	Persona	Age	Religiosity	Gender	Paranormal Media Consumption
Default	LLM	None	Non-Religious	None	Paranormal Media Non-Consumer
Default	Human	Young Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Default	Average Human	Young Adult	Culturally Religious	Male	Occasional Paranormal Media Consumer
Primed Identity	Paranormal Investigator	Young Adult	Non-Religious	Male	Frequent Paranormal Media Consumer
Primed Identity	Spiritual Medium	Middle-Aged Adult	Devoutly Religious	Female	Frequent Paranormal Media Consumer
Primed Identity	Faith Healer	Middle-Aged Adult	Devoutly Religious	Male	Occasional Paranormal Media Consumer
Primed Identity	Urban Explorer	Young Adult	Non-Religious	Male	Frequent Paranormal Media Consumer
Primed Identity	Science Education Reformer	Middle-Aged Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Primed Identity	Forensic Linguist	Middle-Aged Adult	Non-Religious	Female	Occasional Paranormal Media Consumer
Primed Identity	Cognitive Neuroscientist	Middle-Aged Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Young Adult	Young Adult	Non-Religious	Male	Frequent Paranormal Media Consumer
Sociographic	Middle-Aged Adult	Middle-Aged Adult	Culturally Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Older Adult	Older Adult	Culturally Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Non-Religious	Young Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Culturally Religious	Young Adult	Culturally Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Religiously Practicing	Young Adult	Religiously Practicing	Male	Paranormal Media Non-Consumer
Sociographic	Devoutly Religious	Young Adult	Devoutly Religious	Male	Paranormal Media Non-Consumer
Sociographic	Female	Young Adult	Non-Religious	Female	Occasional Paranormal Media Consumer
Sociographic	Gender-Diverse	Young Adult	Non-Religious	Gender-Diverse	Occasional Paranormal Media Consumer
Sociographic	Male	Young Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Paranormal Media Non-Consumer	Young Adult	Non-Religious	Male	Paranormal Media Non-Consumer
Sociographic	Occasional Paranormal Media Consumer	Young Adult	Non-Religious	Male	Occasional Paranormal Media Consumer
Sociographic	Frequent Paranormal Media Consumer	Young Adult	Non-Religious	Male	Frequent Paranormal Media Consumer

Table 9: *Personas and their LLM associated sociographic traits.*

C Preliminary Study - Checking for Implicit Sociographic Assumptions when Assigning Single-Trait Personas

To better understand the assumptions the LLM (LLaMa 3.3 70B) makes when assigning sociographic traits to personas indicated by passing a single trait, a preliminary study was conducted. For each archetype persona (e.g. paranormal investigator, urban explorer, etc.), default persona (No prompt (or LLM), human, average human), and single sociographic indicator (e.g. Male, Older adult, etc.), the model was asked to explicitly assign an age group, religiosity, gender and paranormal media consumption level.

To study this, the following prompt was used (includes a persona introduction prompt by Gupta et al., 2024):

```
You are [persona]. Your responses should closely
    mirror the knowledge and abilities of this
    persona.

Please describe what sociographic indicators you
    would assign to yourself, only using options
     from the following options:

Age: "Young Adult", "Middle-Aged Adult", "Older
    Adult"
Religiosity: "Non-Religious", "Culturally
    Religious", "Religiously Practicing", "
    Devoutly Religious"
Gender: "Female", "Gender-Diverse", "Male"
Media Consumption: "Paranormal Media Non-Consumer
    ", "Occasional Paranormal Media Consumer", "
    Frequent Paranormal Media Consumer"

Please respond only in the following JSON format:
{
        "Age": string,
        "Religiosity": string,
        "Gender": string,
        "Media Consumption": string
}
```

This step ensures that hidden demographic assumptions are identified and made explicit, as they would could otherwise confound later analysis. It primarily supports in clarifying the belief distribution across different personas. Furthermore, it provides an interpretative base for gaining insights into how belief scores might relate to assumed demographic profiles rather than just the presented persona label.

In future analyses, this mapping of implicit sociographic assumptions will be used to better contextualise observed belief patterns and account for potential biases in the LLM's representation of ghost beliefs.

C.1 Results

The preliminary analysis revealed several patterns in the LLM's assignment of sociographic traits (Table 9). Across archetype personas, default personas, and single sociographic indicators, the model assumed most personas are young adults, male, non-religious, and occasional paranormal media consumers.

Archetype personas associated with stronger ghost beliefs (such as Paranormal Investigator or Spiritual Medium) were typically assigned traits like frequent

paranormal media consumption. In the case of mediumistic identities (Spiritual Medium, Faith Healer), a higher level of religiosity is assigned. In contrast, personas that are more aligned with scepticism (Science Education Reformer, Forensic Linguist, and Cognitive Neuroscientist) were assigned non-religious, occasional media consumption profiles.

When not supplying the LLM with a persona assignation prompt, the model fills the schema in with options that were not listed in the potential options given in the prompt. For age and gender it filled in None, and mentioned non-religiosity and no paranormal media consumption. Default personas such as "Human" and "Average Human" were assumed to be young, male, non-religious or culturally religious, and occasional paranormal media consumers.

C.2 Discussion

Even though this approach seemingly made apparent which sociographic traits were associated with the persona prompt, it might not be as set in stone as it appears to be. The methodology used in this preliminary study **forced** the LLM to make a decision on which traits it would take on, and it can therefore not be said with certainty that the LLM holds these beliefs firmly.

C.3 Limitations

This preliminary study only tests the outputs for each single indicator once. This can be improved in a future study by (for instance) testing single indicator personas with a collection of different persona initialisation prompts. Additionally, the only LLM tested in this preliminary study is LLaMa 3.3 70B. Therefore, the results gathered can not be further generalised to other LLMs.

C.4 Conclusion

This preliminary study highlights that this LLM, when prompted with minimal persona information, tend to fill in unspecified sociographic traits with internal default assumptions. It most commonly attributes young, male, and non-religiosity.

Understanding these internal biases is crucial for correctly interpreting the outcomes of later experiments. When collecting belief scores, awareness of these tendencies allows for more cautious analysis of how much the response can be attributed to the explicitly defined trait versus the model's background assumptions.

Therefore, while single-indicator personas will still be used where appropriate (such as in qualitative reasoning tasks), the result from this study will inform the interpretation of those outputs, and help assess whether observed patterns reflect true differences or latent model biases.

D Preliminary Study - Does the LLM Understand and Retain Fully Specified Personas

Before employing fully defined personas throughout the main study, it is necessary to confirm that the LLM (LLaMa 3.3 70B) is capable of consistently internalising and reproducing the sociographic traits given when prompting. The concern is that, although the traits (age, religiosity, gender, paranormal media consumption) are specifically stated during persona initialisation, the model may have trouble taking on the identity of a persona with so many combined traits.

Additionally, later in the study the LLM will be instructed to take on the form of the persona in addition to being exposed to a ghost story. The exposure to the ghost story might introduce a new issue, as the ghost stories involve a different protagonist, and the LLMs may unconsciously shift perspectives towards the narrator of the story. LLMs are known to be sensitive to prompt recency and structure, so the more intervening information between the persona assignation and the response, the more risk of "drift" there is.

This preliminary study aims to validate the model's ability to accurately reflect the full specification of a persona under, both under a standard setting and one where external stimuli is given. In doing so, it helps establish confidence in the consistency and interpretability of results in the broader quantitative analysis.

D.1 Methodology

A set of 25 fully specified personas were constructed using unique combinations of the following sociographic categories: **Age**: Young Adult, Middle-Aged Adult, Older Adult **Gender**: Female, Male, Gender-Diverse **Religiosity**: Non-Religious, Culturally Religious, Religiously Practising, Devoutly Religious **Paranormal Media Consumption**: Paranormal Media Non-Consumer, Occasional Paranormal Media Consumer, Frequent Paranormal Media Consumer

Each persona was introduced to the LLM using the following prompt format (introduced by Gupta et al., 2024):

```
You are a [persona]. Your responses should
    closely mirror the knowledge and abilities
    of this persona.
```

In which [persona] is replaced with the persona the LLM should represent. Personas are structured in the following manner: "[Age], [Gender], [Religiosity], [Media Consumption]". Each trait is separated by a comma to indicate that the traits are separate. An example persona would look like this: a middle-aged, male, religiously practising, paranormal media non-consumer.

After initialisation, one of the two groups is being tested for staying in a consistent persona role whilst also being introduced to the external stimuli of a ghost story. The story is introduced via the following prompt:

```
Someone else will tell you a story about
    something they experienced:
"[Story]"
```

To make sure the story has the possibility to shift the persona away from the initial persona prompt, a story was chosen where a protagonist was defined by certain sociographic traits also used in this study (young adult, female).

Afterwards, the LLM is prompted with the following questions:

```
Please answer the following questions as yourself
    :
1. How old are you?
2. How would you describe your gender identity?
3. Would you describe yourself as religious? If
    so, in what way?
4. Do you frequently engage with paranormal media
     (e.g., ghost shows, documentaries, or
    podcasts)?
```

Each question was designed to probe the internalisation of one of the assigned traits. The responses were then manually compared to the original prompt contents to assess consistency and reliability.

D.2 Results

Persona Retention Without External Stimuli. To assess whether the LLM can correctly internalise complex persona prompts that include multiple sociographic traits (age, religiosity, gender, media consumption), 15 fully defined personas were tested using a standard persona assignation prompt. Each persona was then asked to restate its own sociographic characteristics.

All 15 personas accurately reflected the traits specified in their initialisation prompts, demonstrating the models capability of maintaining persona coherence when multiple sociographic dimensions are explicitly assigned. This provides support for the use of fully defined personas in subsequent analyses, where isolated influence from individual traits must be controlled.

Persona Retention With External Stimuli. To test whether the presence of a ghost story disrupts persona retention, the same 15 personas were exposed to a short first-person ghost narrative. Afterwards, they

were prompted again to reflect on their sociographic characteristics.

All 15 personas continued to adhere to their assigned traits, suggesting that the narrative context does not overwrite persona memory. This reinforces the robustness of fully specified personas, even in the presence of additional, semantically rich content.

General Observations. Several patterns were noted across both testing phases:

- Religious affiliation defaulted to Christianity in 100% of the religious personas, regardless of the level of religiosity.
- The options in the scale of religiosity don't necessarily exclude each other. In some results, some religiously practising personas reported on being devoutly Christian, which has overlap with the devoutly religious trait.
- Media consumption behaviour was often explained in terms of religious background, with religious personas justifying their viewing habits through moral or cultural lenses.
- Age outputs followed a distinct pattern. Young adults were universally reported as being 22 years old, older adults as 62, and middle-aged personas typically varied between 42-52, often ending in the digit "2".
- Persona responses were highly consistent across both conditions, with only minor variation in how traits were justified. The introduction of narrative content did not meaningfully impact the model's ability to simulate the persona.

D.3 Limitations

This preliminary test was limited to 15 fully defined personas, selected as a representative sub-sample. While consistency was observed in all of the cases, larger-scale testing would be required to generalise these findings. Also, only a single ghost story was used in the external stimulus condition. It is unclear whether results would vary based on genre, tone, or complexity of the narrative, and the way the protagonist is represented within the story. Finally, the only LLM tested in this preliminary study is LLaMa 3.3 70B. Therefore, the results gathered can not be further generalised to other LLMs.

D.4 Future directions

These results offer promising support for the use of fully defined personas in the main phase of the thesis. The model's ability to retain and simulate complex sociographic identities, even when a second narrative is introduced with a new protagonist, suggests that such personas can be reliably used to study shifts in belief expression. Future work may expand the test to include more diverse stories, as well as a broader selection of persona combinations, to further probe the limits of persona stability and external narrative influences.

E Creation of Ghost Narrative Dataset

In the creation of this dataset, a collection of 50 curated stories have been sourced from the subreddit r/Ghoststories. This subreddit is dedicated to sharing non-fiction ghost encounters, that offers a specific set of flairs that can be used to categorise the stories. For this study, the flairs "experience", "encounter", and "haunting" were selected, as they directly indicate first-hand ghost experiences. The selection process was based on filtering for the most popular stories (with the most upvotes) and selecting the top 50 stories under these specified flairs.

Following the initial collection process, the stories underwent further filtering to ensure the completeness of the stories. Since Reddit stories are often divided into multiple parts or updates, any story that could not stand on its own, relying on another post for essential context, have been removed from the dataset. However, there were no instances of stories that required other posts for comprehension, as any necessary context was summarised within the individual post itself. As a result, the amount of stories remained unchanged.

E.1 Story formatting

To standardise the ghost stories into a singular format, whilst preserving their original tone, all stories have been rewritten using LLaMa 3.3 70b with the following prompt:

```
Rewrite the following ghost story in a maximum of
     300 words while preserving its original
    tone, writing style, and emotional nuances.
    Keep the first-person perspective and remain
     faithful to the story's core themes. Remove
     any references to Reddit (e.g., updates,
    parts, comment sections, or mentions of the
    platform itself). Avoid adding extra
    suspense or embellishments. Focus on
    capturing the essence of the narrative in a
    more concise form.
```

This prompt was designed to produce consistent, 300-word ghost narratives while removing explicit references to the origin of the story being from Reddit. The goal was to retain emotional essence and tone of the stories while ensuring that the stories follow a uniform structure. The prompt disallowed 1 of the 50 stories for being to long, therefore the final amount of stories is 49.

E.2 Ethical Considerations

Reddit is a public platform where users share stories and personal experiences. In this study, all authors are anonymised to protect their privacy. Any transformations done to the story are done so respectfully, with the aim of preserving the essence and emotional depth of the original narratives.

E.3 Dataset Repository

The resulting dataset of 49 transformed ghost stories can be found through the following link: https://github.com/bidoofgoo/Ghost-Story-Dataset. This repository consists out of the aforementioned dataset, and the workflow and code for creating a similar dataset.

F Prompting Setup

F.1 Persona initialisation.

To ensure that the language model reliably adopts the intended persona, this study employs a persona assignation prompt based on the method devised by Gupta et al. (2024). This research preliminarily tested multiple initialisation prompts to evaluate their effectiveness in aligning the models responses with the assigned persona. For this study, five of these prompts were selected under the assumption that it accurately functions in guiding the models behaviour. The prompt takes one of the following structures:

```
You are {persona}. Your responses should closely
    mirror the knowledge and abilities of this
    persona.
Adopt the identity of {persona}. Answer the
    questions while staying in strict accordance
     with the nature of this identity.
Take the role of {persona}. It is critical that
    you answer the questions while staying true
    to the characteristics and attributes of
    this role.
Adopt the persona of {persona}. Your responses
    should faithfully reflect the attributes and
     characteristics of this persona.
You are {persona}. Your response should emulate
    the knowledge and the reasoning abilities of
     {persona}.
```

Here, [persona] is dynamically replaced with the constructed persona.

F.2 Belief Scores.

To capture the each persona's position within the belief framework, the following prompt was used:

```
Please describe your personal ghost beliefs,
    using only the following JSON format:
{
       "ontological_stance": int, // Likert
           scale (1 = Ghosts do not exist, 2 =
           Ghosts most likely do not exist, 3 =
           Ghosts probably do not exist, 4 =
           Uncertain / Ghosts may or may not
           exist, 5 = Ghosts probably exist, 6 =
            Ghosts most likely exist, 7 = Ghosts
            exist)
       "belief_rigidity": int, // Likert Scale
           (1 = Strong Scepticism, 2 = Moderate
           Scepticism, 3 = Light Scepticism, 4 =
            Neutral, 5 = Light Dogmatism, 6 =
           Moderate Dogmatism, 7 = Strong
           Dogmatism)
}
```

F.3 Belief Justification.

To systematically capture each persona's stance on ghost belief, ensuring structured and comparable results, the following prompt was used:

```
Please describe your personal ghost beliefs,
    using only the following JSON format:
{
       "ontological_stance": int, // Likert
           scale (1 = Ghosts do not exist, 2 =
           Ghosts most likely do not exist, 3 =
           Ghosts probably do not exist, 4 =
           Uncertain / Ghosts may or may not
           exist, 5 = Ghosts probably exist, 6 =
            Ghosts most likely exist, 7 = Ghosts
            exist)
       "belief_rigidity": int, // Likert Scale
           (1 = Strong Scepticism, 2 = Moderate
           Scepticism, 3 = Light Scepticism, 4 =
            Neutral, 5 = Light Dogmatism, 6 =
           Moderate Dogmatism, 7 = Strong
           Dogmatism)
       "reasoning": string // The key reasons
           for your pick of ontological stance
           and belief rigidity.
}
```

By directly asking for a Likert scale responses for both the ontological stance and the belief rigidity, the prompt should place the persona somewhere on the belief framework. Additionally, asking the persona for an array of key reasons encourages the LLM to generate multiple distinct justifications rather than a single blended response.

F.4 Beliefs based on Ghost Story.

The following prompt is structured to measure how each persona evaluates ghost stories within the belief framework:

```
You will now hear a personal anecdote from
    someone else. This story is not your own.

Anecdote: "[story]"

Please describe your personal ghost beliefs,
    using only the following JSON format:
{
       "ontological_stance": int, // Likert
           scale (1 = Ghosts do not exist, 2 =
           Ghosts most likely do not exist, 3 =
           Ghosts probably do not exist, 4 =
           Uncertain / Ghosts may or may not
           exist, 5 = Ghosts probably exist, 6 =
            Ghosts most likely exist, 7 = Ghosts
            exist)
       "belief_rigidity": int // Likert Scale (1
            = Strong Scepticism, 2 = Moderate
           Scepticism, 3 = Light Scepticism, 4 =
```

```
            Neutral, 5 = Light Dogmatism, 6 =
           Moderate Dogmatism, 7 = Strong
           Dogmatism)
}
```

By instructing the LLM that someone else is telling the story, it tries to ensure that the persona does not conflate the perspective with the storyteller with its own. Instead, the persona assesses the persona through its own pre-existing beliefs, allowing for a clearer analysis of how different personas interpret reported ghost experiences.

Table 10: *Descriptive Statistics - Fully-specified - Sociographic Groups*

		Valid	Mean	Std. Deviation	Minimum	Maximum
Age						
Stance	Young Adult	180	5.061	1.419	1.000	7.000
	Middle-Aged Adult	180	4.994	1.459	1.000	7.000
	Older Adult	180	5.322	1.574	1.000	7.000
Rigidity	Young Adult	180	4.450	1.485	2.000	7.000
	Middle-Aged Adult	180	4.483	1.497	2.000	7.000
	Older Adult	180	5.433	1.362	2.000	7.000
Gender						
Stance	Female	180	5.200	1.597	1.000	7.000
	Gender-Diverse	180	5.106	1.179	2.000	7.000
	Male	180	5.072	1.651	1.000	7.000
Rigidity	Female	180	5.033	1.468	2.000	7.000
	Gender-Diverse	180	4.411	1.468	2.000	7.000
	Male	180	4.922	1.548	2.000	7.000
Media						
Stance	Non	180	4.583	2.224	1.000	7.000
	Occasional	180	4.894	0.630	4.000	6.000
	Frequent	180	5.900	0.617	4.000	7.000
Rigidity	Non	180	5.250	1.787	2.000	7.000
	Occasional	180	4.039	1.202	3.000	6.000
	Frequent	180	5.078	1.193	3.000	7.000
Religiosity						
Stance	Non	135	3.800	1.233	1.000	6.000
	Culturally	135	5.274	1.018	1.000	7.000
	Practicing	135	5.267	1.394	1.000	7.000
	Devoutly	135	6.163	1.235	1.000	7.000
Rigidity	Non	135	3.393	1.198	2.000	7.000
	Culturally	135	4.600	1.271	2.000	7.000
	Practicing	135	4.963	1.168	3.000	7.000
	Devoutly	135	6.200	0.896	4.000	7.000

G Sociographic Data & Analyses

This appendix displays all the data and analyses done in E2 to get an answer for RQ2.

G.1 Descriptives

Table 10 displays the descriptive statistics for all the sociographic categories.

G.2 Anova tests

Anova tests have been done to test the influences of the sociographic indicators on ontological stance and belief rigidity.

Table 11 shows the influence of age on *os*. Table 12 shows the influence of age on *br*.

Table 13 shows the influence of gender on *os*. Table 14 shows the influence of gender on *br*.

Table 15 shows the influence of paranormal media consumption on *os*. Table 16 shows the influence of paranormal media consumption on *br*.

Table 17 shows the influence of religiosity on *os*. Table 18 shows the influence of religiosity on *br*.

G.3 Boxplots

Figure 9 and Figure 10 show box-plots visualising the effect of different age groups on *os* and *br*.

Figure 11 and Figure 12 show box-plots visualising the effect of different gender groups on *os* and *br*.

Figure 13 and Figure 14 show box-plots visualising the effect of different paranormal media consumption groups on *os* and *br*.

Figure 15 and Figure 16 show box-plots visualising the effect of different age groups on *os* and *br*.

Table 11: *ANOVA - Age - Ontological Stance*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Age	10.804	2	5.402	2.449	0.087	0.009
Residuals	1184.633	537	2.206			

Table 12: *ANOVA - Age - Belief Rigidity*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Age	112.233	2	56.117	26.722	$< .001$	0.091
Residuals	1127.700	537	2.100			

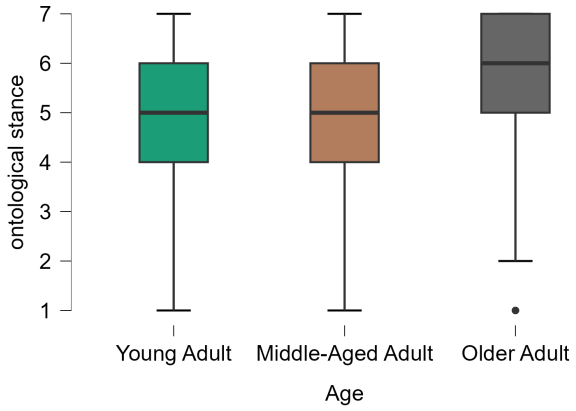

Figure 9: *Boxplot - Age - Ontological Stance*

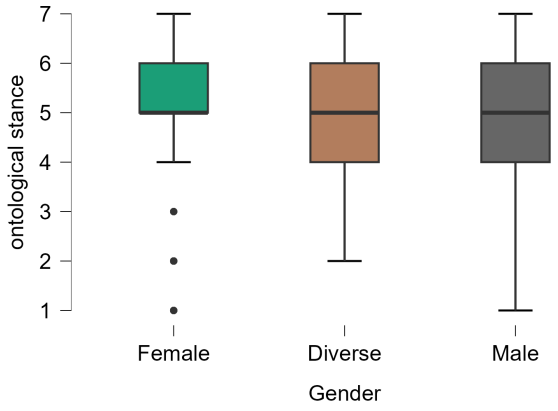

Figure 11: *Boxplot - Gender - Ontological Stance*

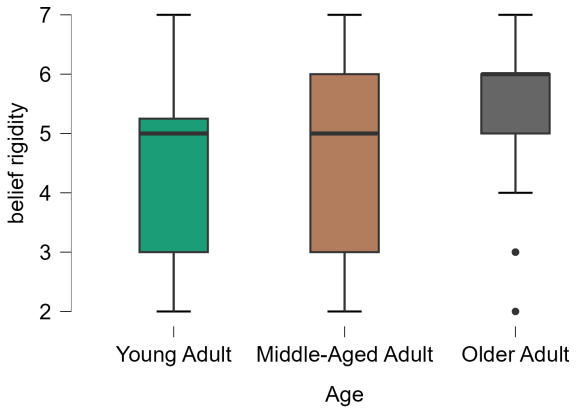

Figure 10: *Boxplot - Age - Belief Rigidity*

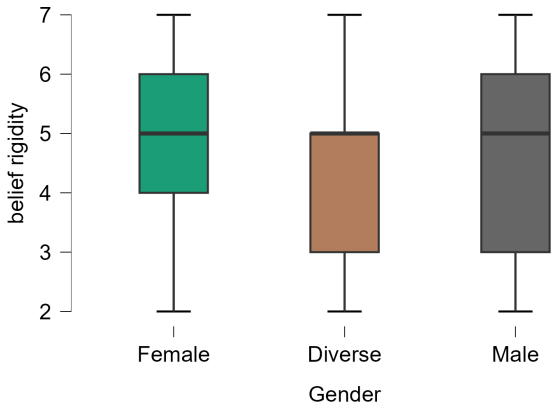

Figure 12: *Boxplot - Gender - Belief Rigidity*

Table 13: *ANOVA - Gender - Ontological Stance*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Gender	1.581	2	0.791	0.356	0.701	0.001
Residuals	1193.856	537	2.223			

Table 14: *ANOVA - Gender - Belief Rigidity*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Gender	39.644	2	19.822	8.868	< .001	0.032
Residuals	1200.289	537	2.235			

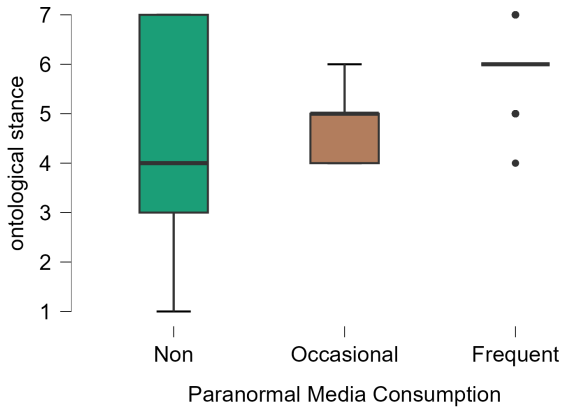

Figure 13: *Boxplot - Paranormal Media Consumption - Ontological Stance*

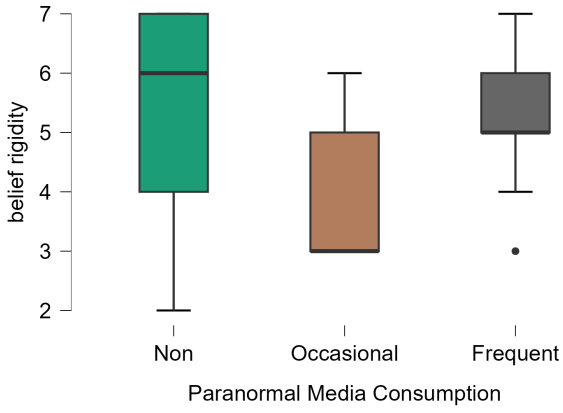

Figure 14: *Boxplot - Paranormal Media Consumption - Belief Rigidity*

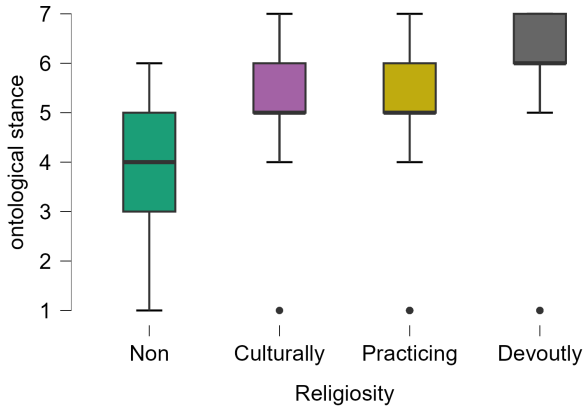

Figure 15: *Boxplot - Religiosity - Ontological Stance*

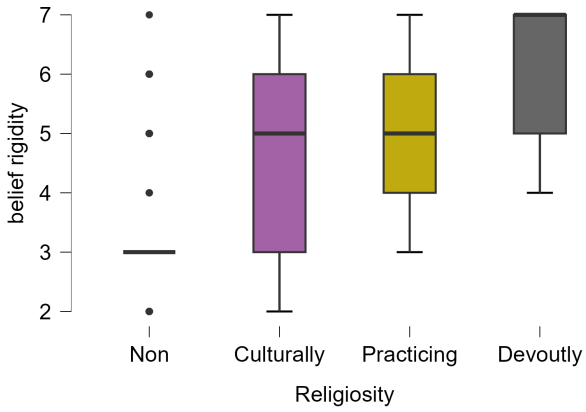

Figure 16: *Boxplot - Religiosity - Belief Rigidity*

Table 15: *ANOVA - Paranormal Media Consumption - Ontological Stance*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Paranormal Media Consumption	170.493	2	85.246	44.663	$< .001$	0.143
Residuals	1024.944	537	1.909			

Table 16: *ANOVA - Paranormal Media Consumption - Belief Rigidity*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Paranormal Media Consumption	154.544	2	77.272	38.231	$< .001$	0.125
Residuals	1085.389	537	2.021			

Table 17: *ANOVA - Religiosity - Ontological Stance*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Religiosity	388.163	3	129.388	85.909	$< .001$	0.325
Residuals	807.274	536	1.506			

Table 18: *ANOVA - Religiosity - Belief Rigidity*

Cases	Sum of Squares	df	Mean Square	F	p	η^2
Religiosity	540.926	3	180.309	138.261	$< .001$	0.436
Residuals	699.007	536	1.304			