BELIEF IN SCIENCE AND ‘SUPERNATURAL’ EXPLANATIONS IN SCIENCE-ORIENTED INDIVIDUALS

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Beyond Scientific Worldviews

Belief in Science and ‘Supernatural’ Explanations in Science-Oriented Individuals

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ACADEMIC DISSERTATION

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Abstract

Previous work in the study of religion indicates that although science and supernatural belief (including religious belief) are often seen as contradictory, people across various cultures apply both scientific and supernatural explanations for the same events. Furthermore, some individuals integrate scientific and supernatural accounts into a singular explanation – for example, by referring to God’s design in human evolution. In the cognitive science of religion (CSR), applying both causal models is referred to as ‘explanatory coexistence’. Although there is extensive work on supernatural beliefs in different cultures, the research has been characterised by two shortcomings. First, ‘supernatural’ explanations have mainly been operationalised as beliefs perceived as supernatural in the Western context (such as religious beliefs). Second, few studies have investigated the relationship between belief in science and the supernatural in individuals who hold science in high regard, as people with ‘scientific worldviews’ are generally expected to endorse few, if any, supernatural beliefs.

This doctoral dissertation investigates the supernatural beliefs of science-oriented individuals (people who hold science in high regard). More specifically, the dissertation aims to answer the following research questions: Do science-oriented individuals also hold supernatural beliefs? If yes, what kind of supernatural beliefs do science-oriented individuals hold? What is the relationship between belief in science and supernatural belief in science-oriented individuals? In the dissertation, ‘supernatural’ refers to beliefs that blend cross-culturally common core knowledge about the ontological properties of entities and processes, such as a stone (a physical entity) that knows things (a mental agent). Thus, the scope of the investigation includes not only the beliefs that have been traditionally labelled supernatural (such as belief in God’s design in evolution) but also the beliefs that are not necessarily perceived as supernatural (for instance, evolution following the ‘natural plan’).

The dissertation comprises four research articles written between 2020 and 2023. The data was collected in two online studies. Study 1 investigated the worldview beliefs of non-theistic individuals in ten countries (n = 996), and it was conducted for a research project on secular worldviews led by Dr Valerie van Mulukom (Coventry University). Study 2 examined the worldview beliefs of both religious believers and non-believers in the Finnish context (n = 387). The data of both studies contained structured and open-ended responses, where science-oriented individuals described their meaningful beliefs and answers to questions of fundamental concern. The analysis utilised a mixed method approach, and insight was derived through both theory-driven and data-driven analyses.

The findings indicated that some science-oriented individuals hold i) religious or other traditional supernatural beliefs and/or ii) secular supernatural beliefs that do not contain religious connotations. The latter included belief in purpose in difficult life events and agency in natural processes, such as the Gaia-like conception of nature as a self-regulating creature. Many of those who tackled questions of fundamental concern with supernatural belief also integrated supernatural causation with science. This was mainly done by describing the supernatural agency as the ultimate cause (the why) and a scientific
mechanism as the proximate cause (the how). In addition, some integrated supernatural and scientific accounts by appealing to their perceived similarity (immortality of the soul based on thermodynamics).

Still, supernatural belief and belief in science were mainly applied as separate sense-making strategies. In line with prior research, belief in science entailed less religious belief. However, the relationship between secular supernatural beliefs and belief in science was weak to non-existent. The results indicate that, to some extent, the previous findings on the negative relationship between belief in the supernatural and science have likely been influenced by cultural expectations of science and religion as contradictory, whereas there may be little (if any) conflict between science endorsement and supernatural views per se. Moreover, a comparison of the prominent belief in science scale and a new religion-neutral measure indicated that measuring belief in science as competing with religious faith may have contributed to the conflict between belief in science and religion in prior studies.

Despite the occurrence of supernatural beliefs in both samples, the overall results point towards the primary importance of non-supernatural secular beliefs (and more particularly belief in science) for individuals who hold science in high regard. Altogether, the findings shed light on the diversity of science-oriented worldviews. The dissertation increases knowledge on the contemporary understandings of science, their relationship with supernatural belief, and how both are used to tackle the conundrums of human existence, such as mortality.
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My deepest gratitude goes to my supervisors and other mentors who have helped me along the way. I started my doctoral research with Dr Elisa Järnefelt and Professor Terhi Utriainen. I learned important skills from you both. Already during my undergraduate years, Terhi would not let me get away with sloppy text but required writing to be concise. Improving my writing skills proved to be extremely useful, not only for research but also for writing funding applications. Elisa, on the other hand, helped me develop a more critical stance towards research. During her course on experimental methods in the study of religion, Elisa handed out ‘real’ research articles (at the time, this was not common in undergraduate studies) and asked us to find potential methodological flaws and discrepancies in the research we read. At first, I did not find any. After trying hard enough, I could not stop. I started to see published research in a new light. It is nearly never perfect, and the beauty is that anyone, despite their academic ‘rank’ or prestige (or lack thereof), can help make it better with their contribution – to then let others improve upon their work. In terms of developing research designs, Elisa also ‘practised what she preached’. Your meticulous work has inspired me to do my best.

During most of my doctoral studies, my research was primarily supervised by Dr Teemu Taira. Teemu’s sharp comments on my work made me pay more attention to some of my research solutions and their underlying assumptions. Although Teemu is known for his critical approach, I dare say there is one thing Teemu has not been critical about: that is, me (or his other supervisees) taking a critical stance on his views. This, to me, has been important. It indicates an academic environment where PhD candidates are considered ‘equal’ in the sense that they can truly speak their minds.
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Thankfully, life has not merely comprised of research. I have also had time for other adventures, and I wish to thank the people who have shared them with me. These people include Mikko Sillfors, a dear friend and colleague who also commented on several of the thesis articles, and other long-time friends and trustees, such as Maija Hopsu, Rania Taina, Antti Martiskainen, and Lauri Hukkanen. In recent years, I have also been lucky enough to make new friends who have believed in my ability to finish ‘The Difficult Text’. Thank you Annika Metso, Elisa Muraja, Félix Barros, and Görkem Yücesoy, who also proofread the summary chapter.¹ One of the groups that provided me moments to remember was my choir,

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¹ Some alterations were made to the summary after the proofreading.
Metsoforte. If you are looking for a choir that gives a sense of community and
family, Metsoforte might just be right for you. I have also been supported by my

Patience could also be brought up in relation to my siblings – I know I have tried
theirs at times. Discussions with my brother, in particular, have refined my
‘väittelytaidot’.² I also wish to thank my sister, who might just be the wittiest person
I know. The person who encouraged me towards academia the most may have been
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get you employed’. At least you have been right so far.

Lastly, I am greatly indebted to the two particularly strong women in my life, my
mother and my grandmother. Both encouraged my curiosity and enthusiasm for
reading when I was a child. It astounds me that my grandma (an avid reader) only
had some years of mobile schooling, whereas I, her granddaughter, have had the
opportunity to attend university teaching and research conferences. The lives of
Finns have surely changed a great deal in the past century. Still, some things remain
very similar. Research extends beyond the being of an individual, yet for an
individual like me, the most important thing is other people: particularly the ones I
have mentioned here. Thank you.

In Helsinki, Finland, 13th of August 2023,

Roosa Haimila

² Finnish for ‘debating skills’, literally ‘defence skills’.
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<th>Description</th>
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<tbody>
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<td>counterintuitive</td>
</tr>
<tr>
<td>CSR</td>
<td>cognitive science of religion</td>
</tr>
<tr>
<td>ELCF</td>
<td>Evangelical Lutheran Church of Finland</td>
</tr>
<tr>
<td>MCK</td>
<td>mixing core knowledge</td>
</tr>
<tr>
<td>PSMS</td>
<td>paranormal, ‘superstitious’, magical, and supernatural</td>
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<td>SOW</td>
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cf.  | confer  

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1 Introduction

Most people in the world believe in something ‘supernatural’. Some of the beliefs widely endorsed include belief in God, the soul, and a universal spirit or a life force (Bullivant et al., 2019; Gallup, 2017; Haerpfier et al., 2021; Pew Research Center, 2018). Although supernatural belief is often associated with religion, it is also entrenched in secular cultures of belief. In a recent study across six countries, even non-theists (who did not believe in God) often believed in the existence of other kinds of supernatural beings or phenomena (Bullivant et al., 2019; see also Järnefelt et al., 2018).

The endured prevalence of supernatural belief might appear surprising in relation to some academic and lay accounts about science. In the past centuries, it was common to propose that as science progresses, religious belief and other ‘superstitions’ will subside in human populations and be replaced with ‘rational’ scientific knowledge. Indeed, some expected a ‘scientific world view’ to reign the contemporary societies (Lewis, 2007, p. 209; Evans & Evans, 2008). Such accounts have at times been referred to as the narrative, or even the myth, of Enlightenment (Tregenza, 2014, p. 174), and they have been largely criticised by scholars from different fields. Many are familiar with the sociological criticism underlining the continued importance of religious belief for contemporary societies in many regions of the world (Berger, 1999). However, the ‘victory’ of science over supernatural belief has also been called into question by cognitive scientists (Legare et al., 2012). Research in fields such as developmental and cognitive psychology and the cognitive science of religion has shown that few people can maintain scientific views of the world. Research in these fields indicates that people’s beliefs about reality are influenced at least by i) cognitive factors, such as the propensity towards ‘folk theories’ about physical and biological kinds,

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3 In the study of religion, ‘secular’ commonly refers to something that is not subordinate to religion. The term ‘secular’ thus contains phenomena that are not religious or not primarily defined in relation to religion (Lee, 2015).
4 The study was conducted with statistically representative samples from six countries: Brazil, Japan, China, Denmark, United Kingdom, and the United States. Respondents were asked about their belief in phenomena/beings such as a ‘universal spirit of a life force’, karma, an afterlife, ‘supernatural beings’, and ‘underlying forces of good and evil’ (Bullivant et al., 2019, p. 15). In all the countries surveyed, a minority of both non-theists (who did not believe in God) and agnostics (who thought we cannot know whether God exists) rejected the existence of all supernatural phenomena included in the study, leading Bullivant and his colleagues (2019) to conclude that even among ‘unbelievers’ it is rare to uphold a fully ontologically naturalist worldview.
ii) motivational reasoning, and iii) cultural learning, for instance, what cultural authorities and other people we trust believe in (Kelemen & Rosset, 2009; Norenzayan & Hansen, 2006; Shtulman, 2015; Turpin, 2022; Willard & Cingl, 2017). People who hold science in high regard, such as scientists, do not seem to be immune to the human tendencies underlying beliefs (De Cruz & De Smedt, 2007). For instance, even biology students prefer agentic and purpose-driven explanations for natural phenomena, such as evolution. These align with the human tendency towards teleological reasoning but go against the Darwinian (non-teleological) view of evolution (Brumby, 1984; Gregory, 2009). Similarly, findings about American scientists' nature beliefs indicate that although scientists are more sceptical of natural phenomena as purposeful than non-scientists, many still endorse belief in nature as a Gaia-like entity that self-regulates to serve its interest (Kelemen et al., 2013; cf. Pew Research Center, 2015). In light of these and similar findings, some have gone so far as to say that many scientific accounts are difficult to learn and can even be 'unnatural' for humans (McCauley, 2011, p. 7; Blancke et al., 2012; Shtulman, 2015). In other words, it seems unlikely for individuals to achieve or maintain a ‘scientific worldview’ – a view of the world based on scientific knowledge (Niiniluoto, 1984) that is often perceived as devoid of supernatural belief (Koski, 2016; Vidal, 2008). Research indicates that people who hold science in high regard are likely to endorse a wide variety of beliefs, including lay interpretations of scientific theories. In this dissertation, I thus argue that instead of discussing ‘a scientific worldview’, it is generally more accurate to refer to ‘science-oriented worldviews’ – a term that refers to sets of beliefs about the world that include identification with science but does not make assumptions on the possible (other) content of these beliefs.5

Importantly, science-oriented worldviews may also contain supernatural beliefs. Similar to general populations, some individuals who likely hold science in high regard (like scientists and medical staff) endorse supernatural beliefs about phenomena such as death and the origins of life. For instance, some American scientists believe that biological life has evolved in a process guided by a supreme being (Pew Research Center, 2015), and belief in an afterlife seems to be common among medical staff in the United States (Walker, 2000). Thus, although many scholars conceptualise belief in science and supernatural phenomena as ‘rival belief systems’ (Aghababaei, 2016, p. 735), it is unclear whether this approach is empirically justified. Research in developmental psychology and the cognitive science of religion indicates that scientific knowledge often coexists with other strategies for sense-making, including supernatural belief (Legare & Shtulman, 2015).

5 To my knowledge, this is a novel term, although some scholars have discussed ‘science-oriented’ discourses (Koski, 2016, p. 23) or ‘orientation towards science’ more generally (Johnson et al., 2015, p. 106).
2018; Shtulman & Lombrozo, 2016). Furthermore, some findings suggest that people can rely on both scientific and supernatural (including religious) sources to tackle existential questions, for instance, about purpose and suffering in life (Jackson et al., 2020). On the other hand, another line of research in the psychology of religion proposes that confidence in science entails less supernatural belief (e.g. Farias et al., 2013; Irwin et al., 2015). According to this body of work, belief in science and the supernatural might still conflict despite the occasional ‘coexistence’ (Preston & Epley, 2009; Preston et al., 2013; Rutjens et al., 2018). As contemporary individuals who hold science in high regard have mainly been expected to hold scientific views of the world, research on their religious and other supernatural beliefs has been relatively scarce. Thus, we know surprisingly little about how science-oriented individuals’ possible supernatural beliefs relate to their belief in science, especially outside the Anglosphere (however, see Ecklund et al., 2016; Mansour, 2011). Although religiosity has been on the decline in most regions of the world in the last decades (Inglehart, 2021), it seems safe to say that religious (and other supernatural) beliefs as forces affecting global politics and decision-making are not disappearing – at least any time soon (Casanova, 2007). The same applies to the authority of science in contemporary societies: the vast majority of the world’s population trusts scientists and the ability of science to provide a better future (Haerpfer et al., 2021; Wellcome, 2018). As confidence in science is shared across different regions around the globe, the authority of science has even been referred to as a ‘world culture’ (Qadir & Syväterä, 2021, p. 272).

Thus, instead of assuming that science and religious (and other) supernatural belief are contradictory and mutually exclusive, it seems more beneficial for our understanding of contemporary cultures to investigate how these coexist. Much of prior research on how people apply both supernatural and scientific accounts has been conducted in contexts where an ample amount of religious (or religious-like) belief is expected and, again, less among scientific experts or other individuals who could be expected to lean on science in particular (e.g. Astuti & Harris, 2008; Busch et al., 2017; Gutiérrez et al., 2020; Legare & Gelman, 2008; Watson-Jones et al., 2015; but see e.g. Evans et al., 2009; Raman & Winer, 2004). Still, if we aim to understand how scientific accounts interact with supernatural beliefs, we should also uncover the beliefs of individuals who are especially attuned to science and its contents. Do such individuals also hold supernatural beliefs, and if so, what do these beliefs look like? Are science-oriented supernatural beliefs similar to those generally investigated in study of religion, or do they somehow reflect the science-oriented context (e.g. the cultural expectation of science and religion as opposing)? What is the relationship between belief in science and supernatural phenomena in individuals who hold science in high regard? In this doctoral dissertation, I aim to answer these questions by investigating the supernatural belief and belief in science of science-oriented
individuals from ten countries, with a focus on the beliefs of Finns recruited through pro-science organisations. On a global scale, Finland is one of the nations where people are the most likely to have strong faith in science (Wellcome, 2018). Similar to the Anglosphere, many Finns perceive a conflict between religious and scientific views of the world (ibid.; Science Barometer, 2019). Still, unlike Americans, most contemporary Finns are reluctant to identify as religious (Haerpfer et al., 2021), and even many non-religious Finns are interested in supernatural phenomena (ISSP, 2018). Thus, Finland offers an intriguing cultural context for investigating the possible diversity of supernatural beliefs and their relationship with science. Next, I will further introduce the research framework of the dissertation.
2 Prior research and theoretical framework

2.1 Locating the dissertation in the field(s) of research

Scholars of religion have long been intrigued by the variety of beliefs about gods and spirits that people hold in different cultures – and why these seem to occur across the world, even in places that are geographically and culturally distant (see e.g. Eliade, 1987; Evans-Pritchard, 1937). One relatively recent sub-discipline in the study of religion that has focused on the cross-cultural ubiquity of supernatural beliefs is the cognitive science of religion (CSR, also referred to as the cognitive and evolutionary sciences of religion, CESR). Ever since the 1990s, scholars in this field have tried to answer questions such as: Why do people in different cultures hold religious beliefs, such as belief in God and spirits? What underlies the human tendency to ritual practice? Why are certain kinds of supernatural beliefs widespread and not others? (Barrett, 2011; White, 2021). An overarching aim of the cognitive science of religion has been to explain religious phenomena by integrating humanistic and interpretative approaches to the science of human belief and behaviour.6 The cognitive science of religion has thus been a multidisciplinary research endeavour, and prevalent work has applied theories and methods from fields such as cognitive science, evolutionary, cognitive and social psychology, anthropology, archaeology, behavioural ecology, and sociology (Barrett, 2011; Lawson, 2017; White, 2021).

Ever since the emergence of the field, scholars in the cognitive science of religion have proposed that the cross-cultural prevalence of supernatural beliefs indicates that there is something appealing in these beliefs. Thus, cognitive scientists of religion have suggested that supernatural beliefs are tempting to humans in regard to their structure. One such suggestion asserts that supernatural beliefs commonly appeal to the human tendency to perceive intentional agency and design in our surroundings – a trait that has most likely been adaptive (Lawson, 2017; McCauley, 2018; White, 2021). Thus, supernatural beliefs come effortlessly to humans and are easy to remember, which enhances their cultural

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6 Despite this, many individual studies in CSR do not aim to answer why questions. Instead, much of research contributes to the knowledge on religion-related beliefs and practices by investigating how humans process information and how the predictions from the why theories relate to the empirical findings on different groups of individuals and cultures, thus advancing the answers of the field to the why questions.
transmission (Scott & Barrett, 2022).7 Furthermore, many supernatural beliefs were proposed to contain strategic information, for instance, about gods or spirits that know about social transgressions (Boyer, 2001). The suggestions on supernatural beliefs aligning with our early-developing tendencies in information processing (and thus coming easily to humans) have been referred to as the hypothesis on ‘born believers’ or the ‘intuitive belief hypothesis’ (Barrett, 2007, p. 8; Farias et al., 2017, p. 1). Such approaches mainly focus on the content and structural properties of beliefs, which, according to these accounts, help explain why supernatural beliefs are more tempting than many other kinds of views, such as scientific knowledge (McCauley, 2011; cf. ‘content biases’ in White, 2021, p. 70).

Recent research in the cognitive science of religion and neighbouring disciplines has also discussed supernatural beliefs as less ‘special’ compared to other beliefs. These lines of research have emphasised similarities between supernatural and other kinds of beliefs (Boudry & Coyne, 2016; Coleman et al., 2019; Coleman & Arrowood, 2015). In this body of work, religious belief is often seen as a result of cultural learning (Gervais & Najle, 2015), similar to secular beliefs (Mauritsen & van Mulukom, 2023). This approach has been supported by results indicating that people’s belief in God might mainly be determined by how the people we have loved and trusted approach religiosity (Gervais et al., 2021; Turpin, 2022). Thus, cognitive scientists of religion have increasingly focused on how social cognition might explain supernatural belief. These approaches place less importance on the content of beliefs and instead focus on the influence of context on the credibility of beliefs (see ‘context biases’ in White, 2021, p. 70).

Many current scholars have integrated the ‘born believers’ and the cultural learning approaches by suggesting that the human ability to entertain supernatural beliefs is enabled by certain cognitive mechanisms, such as the tendency to perceive agency and purpose, but the credibility and the content of beliefs are also determined by the social context (Mauritsen & van Mulukom, 2023). The current dissertation adheres to this approach: supernatural beliefs are seen as a result of cognitive mechanisms that i) bias humans towards certain kinds of beliefs (e.g. belief in design in nature) and ii) predispose us to learn from our social surroundings and, more often than not, conform to it – for instance, if others around us believe in God, this would make it more likely for us to believe in design by ‘God’.

In line with some of the work on cultural learning, there seems to be no particular reason to expect that our cognitive mechanisms only influence

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7 Some have proposed that in addition to often appealing to agency and design, supernatural beliefs also contain elements that defy our everyday expectations (for instance, an agent walking through walls, see Boyer, 2001; Scott & Barrett, 2022). I will elaborate on this notion in section 2.2.2.
supernatural beliefs. In fact, it seems likely that other (non-supernatural) views of
the world also i) are affected by intuitive biases and ii) are culturally learned and
transmitted (Mauritsen & van Mulukom, 2023; Shtulman, 2013). This can be
illustrated by common beliefs about the evolution of species presented in the
introduction. Scholars have suggested that cognitive inclinations underlie the
robustness of need-based views of evolution, as the tendency towards teleological
reasoning supports the belief that evolutionary changes occur to serve the needs
of an organism (Blancke et al., 2012; Gregory, 2009). As people attend formal
schooling, they learn about the theory of evolution and its mechanisms, such as
natural selection, yet their views about science are also affected by intuitive
reasoning (Shtulman, 2017).

In this dissertation, I approach both our views about science and
supernatural phenomena as beliefs that result from an interplay of cognition and
culture. Both are enabled by the mechanisms present in the minds of most
(neurotypical) individuals, influenced by one’s social surroundings and further
shaped by intuitive biases. However, although views about science and the
supernatural can both be conceptualised as beliefs, I argue that they are different
kinds of beliefs. Next, I will define and describe the key concepts of the
dissertation.

2.2 Key concepts: what is ‘belief’?

According to prominent definitions applied in psychology and cognitive science,
beliefs are ideas about reality that are assumed to be true. Beliefs are thus
conceptualised as convictions about the ‘real’ state of events (Connors & Halligan,
2015; Sommer et al., 2022). Although typically seen as unquestioned and
enduring, beliefs can differ in the level of conviction and certainty in which they
are deemed as true, and people’s evaluations of the veracity of their beliefs can vary
across different contexts (Coleman et al., 2018; Connors & Halligan, 2015;
Sommer et al., 2022). Moreover, current definitions of belief do not require that
people are consciously aware of them – instead, many ‘beliefs’ remain outside
one’s reflective reasoning (Connors & Halligan, 2015; Sommer et al., 2022). Some
cognitive scientists have differentiated between ‘intuitive’ and ‘reflective’ beliefs
(Trémolière & Lespiau, 2022, p. 172). In these accounts, intuitive beliefs refer to
automatic, cross-culturally common inferences about entities and events that
easily come to mind (somewhat similar to folk theories, see Shtulman (2017) and
core knowledge, see Spelke & Kinzler (2007)). For instance, humans readily expect

8 Furthermore, belief in evolutionary changes as need-based seems to also be associated with a
tendency to apply essentialist reasoning, see Shtulman (2006).
that a rock (a solid object) cannot pass through a wall (another solid object). Although we might not pay conscious attention to this inference, any object passing through (a sturdy) wall would likely elicit surprise. Reflective beliefs, on the other hand, require conscious, deliberative processing and are the beliefs that can be articulated. Reflective beliefs are not distinct from intuitive ones, as intuitive processing underlies and influences reflective beliefs (Trémolière & Lespiau, 2022).

In addition to belief as an idea that is deemed true, current work in the psychology and cognitive science of religion has also discussed belief as a functional process. Many have underlined the importance of beliefs for structuring one’s reality and locating oneself in a wider, meaningful context (Connors & Halligan, 2015; Sommer et al., 2022). In the cognitive science of religion and neighbouring disciplines, such functions have been referred to as the worldview components (Koltko-Rivera, 2004; Taves, 2022) or simply the psychological functions of beliefs (Farias, 2013; Rutjens & Preston, 2020). Common worldview components or functions of beliefs include providing a theory on what is true, a sense of meaning, guidance on what is right and wrong, and an account of ‘where we come from and where are we going’ (Taves et al., 2018, p. 3; Pyszczynski et al., 2015; Taves, 2022; Vidal, 2008). From this perspective, beliefs or sets of beliefs are not equal in importance, as some beliefs might provide for these functions better than others. Importantly, scholars in the study of religion have long suggested that religious beliefs exist to answer questions of fundamental concern – many have suspected that secular beliefs, like belief in the ‘hard, cold objectivity of science’, cannot equally serve such an existential function (Park & McNamara, 2006, p. 71; Tillich, 2011).

2.2.1 What is ‘belief in science’?

In contrast to religious belief as a particularly efficient antidote for fundamental concern, some have argued that people also turn to secular beliefs for solace – as individuals who lack belief in God cannot find comfort in supernatural belief, secular beliefs provide them with similar psychological functions as religion. In the psychology of religion, this suggestion is known as the belief replacement

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9 Intuitive and reflective beliefs can be discussed in relation to dual process theories that differentiate between automatic/intuitive (Type 1) and reflective (Type 2) information processing. However, the discussion on intuitive and reflective beliefs represents a somewhat different theoretical model that does not fully converge with dual processing theories (which also cannot be conflated into a single theory, see Trémolière & Lespiau, 2022).

10 In the study of religion, the suggestion that religious belief provides a particularly efficient antidote for fundamental concern has been called the religious comfort hypothesis (for an overview, see Sibley & Bulbulia, 2012).
hypothesis (Farias, 2013; Jasinskaja-Lahti & Jetten, 2019). Some candidates for secular beliefs that may serve similar worldview functions as religiosity have included humanism, nationalism, and belief in science (Coleman et al., 2019; Farias, 2013; Smith, 1994). Of these, belief in science has been the most widely investigated secular belief system (e.g. Farias et al., 2013; Rutjens et al., 2010; Rutjens & Preston, 2020; Stavrova et al., 2016; Tracy et al., 2011).

As scientists of religion have mainly been interested in belief in science that might function similarly to religion, the concept ‘belief in science’ has often been operationalised as scientism. For instance, the most prominent article on the concept in the science of religion refers to ‘belief in science’ as an attitude in which science is perceived ‘as a superior, even exclusive, guide to reality, and as possessing a unique and central value’ (Farias et al., 2013, p. 1211). Such belief in science is expected to involve ‘the categorical rejection of anything supernatural’, including religious belief (ibid.). This working definition is not surprising in relation to its origins: in their work, Farias et al. (2013) clearly state that their concept of ‘belief in science’ is based on notions of scientism that approach belief in science as a more or less dogmatic belief that generally excludes religiosity. This conception of ‘belief in science’ has been applied by many scholars in the science of religion, as they have used the Belief in Science Scale developed by Farias et al. (2013; see e.g. Aghababaei, 2016; Dagnall et al., 2019; Irwin et al., 2015; Saide et al., 2021; Williams et al., 2022). It should be noted that the operationalisation of belief in science in the Belief in Science Scale focuses on certain aspects of scientism, mainly the superior epistemological value of science compared to other belief systems, such as religions. Although this notion of epistemological superiority is generally considered as one potential form of scientism in the philosophical literature (Burch, 2016; Stenmark, 2001), it has also been suggested that scientism constitutes the so-called expansion of science to other domains, such as the domain of morality (science providing answers to what is right and wrong) and meaning (science providing a sense of meaning; Stenmark, 2001).

Interestingly, philosophers’ suggestions on what constitutes scientism overlap with literature on what is a worldview. In study of religion, Ann Taves (2018) has defined worldviews and worldview beliefs as ones that answer the ‘big questions’, such as the following: 1) What exists? (ontology) 2) How do we know what is true? (epistemology) 3) What is right and wrong? (axiology) 4) What actions should we take? (praxeology) 5) Where do we come from and where are we

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11 At times, fields such as the cognitive science of religion, psychology of religion and social psychology of religion have been jointly referred to as science of religion. For the sake of readability, I will also use this term when discussing features of prior work in these in fields in particular (instead of referring to study of religion at large).
going? (cosmology; see Taves et al., 2018; Droogers, 2014; Koltko-Rivera, 2004; Vidal, 2008). Scholars have noted the importance of the worldview framework in research of secular belief systems in particular (Taves, 2018). Furthermore, some have called upon integrating these approaches in study of religion to other work on how secular and religious beliefs answer the big questions, such as the terror management theory in social psychology (Arrowood et al., 2018). According to the terror management theory, humans aspire to exceed the finitude of their existence by relying on a cultural worldview. That is, humans have an inherent need for a theory of reality that provides 1) a sense of meaning and purpose, 2) standards for right and wrong actions, and 3) a way to avoid total annihilation in death, either through literal immortality (e.g. belief in afterlife) or symbolic immortality (contributing to something that exists after one’s own biological death; Darrell & Pyszczynski, 2016; Dechesne et al., 2003; Greenberg et al., 1986; Pyszczynski et al., 2015). Scholars of nonreligion have noted that belief in science may function as a worldview, or a worldview belief, for individuals who do not believe in God (Coleman et al., 2019; Farias, 2013). In fact, the role of science in a non-religious sense of meaning has been reported in a variety of studies (Aghababaei et al., 2016; Coleman & Arrowood, 2015; Lee, 2015). However, considering the widespread nature of science-based education and other authority of scientific institutions around the world (Qadir & Syväärä, 2021; Wellcome, 2018), it seems likely that also religious individuals rely on science in their beliefs and worldviews.

To summarise, much of prior work in the study of religion has approached ‘belief in science’ as belief in the epistemological superiority of science that has been expected to exclude religious and other supernatural belief. Studies that have shed preliminary light on the importance of science for other worldview functions, such as a sense of meaning, have generally focused on non-theistic and/or non-religious individuals, leaving open the question of whether finding science important for one’s answers to the ‘big questions’ extends to religious believers or not.

In this dissertation, I apply ‘belief in science’ in accordance with the earlier description of the meaning and functions of ‘belief’. In other words, I refer to belief in science as a belief or a set of beliefs perceived as justified in its value in attaining the ‘truth’ and one that provides answers to the big questions, for instance, by providing a sense of meaning or purpose. In this dissertation, and similar to much of prior research, ‘science’ is used as an emic concept (e.g. Farias et al., 2013; Lindeman et al., 2019). In other words, I mainly investigate how individuals believe in what is viewed as science by themselves and the cultural contexts included in the studies of this dissertation. It should be noted that applying ‘science’ as an emic concept poses some challenges, as the meaning of the term ‘science’ varies across cultures. Philosophers of science have noted that in the Anglophone, ‘science’ generally refers to the natural sciences, whereas in Finland,
the equivalent for the term ‘science’ commonly also comprises other research conducted at universities and research institutions (Kiikeri & Ylikoski, 2004). Another important notion is that unlike much of previous research in the psychology of religion, this dissertation does not assume that belief in science excludes religious or other supernatural beliefs.

2.2.2 Belief in the supernatural

Traditionally, ‘supernatural’ has been defined in relation to science. Originating from Latin, the prefix ‘super’ refers to something being ‘above’ or beyond. Most commonly, ‘supernatural’ has referred to phenomena that extend beyond or violate the laws of nature and, thus, are considered scientifically impossible or outside the scope of the scientific method (e.g. Flanagan, 2008; Tobacyk & Milford, 1983; Watts et al., 2020; for reviews, see Exline & Wilt, 2023; Lindeman & Svedholm, 2012). There are several reasons to criticise defining the supernatural in this manner. First, it is in practice difficult to distinguish what is in accordance with the current scientific knowledge of the world. Furthermore, what exactly can be scientifically investigated is dependent on technology and research methods (Svedholm, 2013) and cultural conceptions of the limits of science. For instance, it was once common to presume that uncovering the processes underlying morality is not in the scope of science, but they are nowadays studied in moral psychology and neuroscience. Still, most importantly, it seems warranted to ask: How relevant is it for the science of religion whether a belief aligns with the current conception of what is ‘scientific’? If a belief would be deemed ‘supernatural’ today but scientific tomorrow (due to a pending scientific discovery, for instance), would this alter the cognitive and motivational processes underlying the belief in people’s reasoning, and if so, to what extent? Instead of defining supernatural based on cultural (mainly Western) conceptions of science, it seems warranted that the cognitive science of religion in particular would apply a definition rooted in human cognition.

One such approach has been to define supernatural belief (and religious belief in particular) as counterintuitive (CI). This approach was previously prominent among scholars of the cognitive science of religion who were intrigued by the cross-cultural prevalence of religious beliefs and interested in their transmission. These scholars argued that humans might be prone to remembering and transmitting supernatural beliefs in particular, as they are surprising and attention-grabbing. Building on developmental psychology, scholars such as Boyer (1996) and Pyysiäinen (2002) suggested that religious beliefs about supernatural agents have these properties as they go against humans’ intuitive expectations about entities and processes. Humans generally hold differing expectations for phenomena based on whether they are categorised as spatial, physical, living,
animate or psychological. For instance, a rock (a physical entity) is expected to be solid but not to move on its own (animate entity) or have intentions and desires (a psychological entity; Scott & Barrett, 2022; cf. also Spelke & Kinzler, 2007). A belief about an entity that violates these expectations (e.g. a rock that listens to people’s prayers) would then be counterintuitive. This line of work in the cognitive science of religion has claimed that the common denominator of supernatural beliefs is thus their ‘counterintuitiveness’, which can increase the memorability and inferential power of beliefs (Scott & Barrett, 2022). However, both scholars in the cognitive science of religion and in cognitive psychology have criticised research on supernatural beliefs as counterintuitive (Boyer, 2001; Lindeman & Svedholm, 2012; Purzycki, 2013; Purzycki & Willard, 2016). Crucially, conceptualising supernatural beliefs as ‘counterintuitive’ would underplay one of the essential propositions in the cognitive science of religion: that some supernatural beliefs come easily to humans not because they are surprising, but rather because they actually align with our intuitive expectations about the world (Bering, 2002; Järnefelt et al., 2015; Kelemen, 2004; McCauley, 2018). For instance, studies on perceiving design in nature indicate that when humans are asked to respond under cognitive load (that is, when it is more difficult to rely on reflective, deliberate reasoning) they are more prone to reason that natural kinds, such as hurricanes, animals, and humans, have been purposefully created by some being. These and similar findings indicate that perceiving nature as designed and/or purposeful might be intuitive for humans (e.g. Järnefelt, 2013; Järnefelt et al., 2018; Kelemen et al., 2013; Kelemen & Rosset, 2009).

In line with this view, cognitive psychologists have since suggested a definition of supernatural beliefs as ones that violate the expectations humans have of entities and processes based on their ontological categories (‘ontological core knowledge’) without making reference to the intuitive/counterintuitive nature of these beliefs (Lindeman & Svedholm, 2012; cf. also Lindeman & Aarnio, 2007). Moreover, whereas the cognitive science of religion has mainly discussed ‘supernatural’ and ‘religious’ beliefs (Purzycki & Willard, 2016), this later definition further integrates work on supernatural beliefs into other related concepts. In psychology and neighbouring disciplines, the term ‘supernatural’ has often been used interchangeably with concepts such as ‘paranormal’, ‘extraordinary’, ‘magical’, and ‘superstitious’ (Drinkwater et al., 2020; Lindeman & Svedholm, 2012; see e.g. Bouvet & Bonnefon, 2015; Lindeman & Aarnio, 2007; Randall & Desrosiers, 1980; Stone et al., 2018). Although these concepts have had somewhat differing connotations, their use has lacked conceptual clarity (Svedholm, 2013). In their systematic review, Lindeman and Svedholm (2012) reported considerable overlap in the application of the concepts of paranormal, supernatural, magical and superstitious. More specifically, the common denominator of their content seemed to be ‘core knowledge confusions’, that is,
violations of cross-culturally occurring expectations of entities and processes based on their ontological category. Thus, Lindeman and Svedholm (2012) suggested that the terms paranormal, supernatural, magical, and superstitious are not only overlapping but constitute a singular group of beliefs – at least from a cognitive perspective. This approach has been adopted by several research endeavours in the psychology, cognitive science, and sociology of religion that either define ‘supernatural’ as core knowledge confusions (Lindeman et al., 2019) or refer to ‘PSMS beliefs’ (paranormal, supernatural, magical, and superstitious beliefs) as an umbrella term for supernatural and similar beliefs (Herbert & Bullock, 2020, p. 7, 2022).

Defining supernatural beliefs as core knowledge confusions is well suited for investigating supernatural belief in cultural contexts that are less religious. A long line of findings indicates that also non-religious individuals have a propensity towards certain kinds of supernatural reasoning and, to a certain extent, hold explicit supernatural beliefs (see Introduction; Bering, 2002; Järnefelt et al., 2015). These include belief in meaningful life events as ‘meant to be’ and ultimate justice, for instance, through karma (Bullivant et al., 2019; Heywood & Bering, 2014), belief in design and agency in nature (Järnefelt et al., 2018), and a dualistic belief in mental states without a physical body (Bering, 2002). Such beliefs are not necessarily expressed with traditional supernatural terms, as beliefs considered religious or ‘spiritual’ at times run counter to non-religious identities (see Caldwell-Harris et al., 2011, p. 670). Instead of traditional supernatural belief, people in more secular contexts might also make use of other vocabularies that better align with their social surroundings. For instance, Koski (2016, p. 23) has reported that in a ‘science-oriented’ discourse, experiences of previous lives can be interpreted in the framework of quantum physics.

In this dissertation, I approach ‘supernatural beliefs’ as beliefs that blend ontological core knowledge. These include beliefs traditionally discussed as supernatural (and often associated with religiosity) in the Western context, such as belief in God, karma, and an afterlife. Moreover, supernatural beliefs also comprise beliefs that resemble traditional supernatural beliefs in their structure yet operate with vocabulary that is commonly not perceived as religion-related. I refer to these as secular supernatural beliefs (on ‘secular’ as something not subordinate to religion, see Lee (2015)).

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12 I also use the term ‘more secular’ supernatural beliefs, as supernatural beliefs might be considered secular to a differing extent (see article III).
2.3 Research on the relationship between belief in science and the supernatural

Similar to many other fields, scholars in the science of religion have often expected that belief in science and the supernatural are mutually exclusive or competing. Psychologists in particular have discussed science and supernatural belief as incompatible (Rutjens, Sutton, et al., 2018; Shtulman, 2015) or even proposed that supernatural faith is ‘in direct conflict’ with allegiance to science (Farias, 2013, p. 5).

The expectation that belief in science is conflicting or competing with religious and other supernatural belief is not unfounded. Scholars have suggested an ‘automatic’ conflict between religious and scientific accounts, as undermining the credibility of scientific explanations increases positive evaluations of religious belief, and vice versa (Preston & Epley, 2009, p. 238; Preston et al., 2013). Furthermore, several studies have reported that supernatural belief is negatively associated with scientific understanding (Lindeman & Svedholm-Häkkinen, 2016; Majima, 2015; McPhetres & Zuckerman, 2018; Wilson, 2018; but see Järnefelt et al., 2018; Johnson et al., 2015). For instance, studies on American samples have reported that those who believe in the existence of God and/or soul are on average less knowledgeable about the biological processes underlying the evolution of species (Shtulman & Calabi, 2012). Moreover, many have noted that scientists – individuals who likely believe in science and are knowledgeable of scientific theories – are less inclined to believe in God or other supernatural beings than the general population (Beit-Hallahmi, 2006; Stirrat & Cornwell, 2013).

In line with these results, studies in the psychology of religion that have measured ‘belief in science’ have reported that belief in science is negatively associated with religiosity or religious belief (Farias & Newheiser, 2019) with at least moderate effect size (Farias et al., 2013; Irwin et al., 2015; Rutjens, Sutton, et al., 2018; Saide et al., 2021; but see Williams et al., 1989). However, as ‘belief in science’ has been operationalised as scientism that excludes religious belief (see section 2.2.1), the Belief in Science Scale used in these studies explicitly posits ‘science’ and ‘religion’ as competing alternatives (Farias et al., 2013, p. 1211). This is problematic, as portraying science and religion as exclusive alternatives might influence how religious believers score on the scale. These kinds of issues are not

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13 In addition to the studies mentioned above, Williams et al. (2022) reported a moderate negative correlation between ‘paranormal belief’ and the Belief in Science Scale in a sample of UK adults. However, it should be noted that they used the Revised Paranormal Belief Scale (RPBS), which measures religious belief and other beliefs that have traditionally been perceived as supernatural, such as belief in spiritualism and witchcraft (Tobacyk, 2004).

14 It should be noted that Saide et al. (2021) applied an 8-item version of the Belief in Science Scale that did not include the item that explicitly posits science and religion as competing. Still, I
limited to the Belief in Science Scale, as several other measures of science attitudes have also assumed a conflict between endorsement of science and supernatural belief (see e.g. Hayes & Tariq, 2000; Rutjens, Sutton, et al., 2018).  

Some findings indicate that it might be premature to assume a conflict between belief in science and supernatural belief. Studies generally support the finding that endorsement of science is negatively associated with religious belief in the Western countries, but in many other regions, the relationship between belief in science and religious belief does not follow this pattern (Bullivant et al., 2019; Ecklund et al., 2016; McPhetres et al., 2021; see also Aghababaei, 2016; cf. Chan, 2018). For instance, in some regions scientists are more likely to be religious than the general population (Ecklund et al., 2016). Thus, there seems to be no inherent conflict between ‘science and religion’ or belief in science and supernatural phenomena. Many people believe in something supernatural, such as purpose in nature, and still hold science in high regard or even practice science. Instead of solely relying on scientific knowledge or supernatural belief, some people apply both. In developmental psychology and the cognitive science of religion, invoking more than one explanatory framework is referred to as ‘explanatory coexistence’, ‘explanatory pluralism’, or simply ‘the coexistence model’ (Legare et al., 2012, p. 783; Legare & Shtulman, 2018, p. 415; White, 2021, p. 123). Several types of explanations can ‘coexist’, such as formal and informal accounts of events. Particularly, work in the cognitive science of religion has focused on the coexistence of supernatural and natural explanations. Studies have reported this kind of explanatory coexistence across diverse cultural settings. Research has been conducted in countries such as the United States, Spain, Mexico, South Africa, Vanuatu, Serbia, and China (Astuti & Harris, 2008; Brent et al., 1996; Evans et al., 2009; Gutiérrez et al., 2020; Harris & Giménez, 2005; Jerotijević, 2015; Legare & Gelman, 2008; Watson-Jones et al., 2015).

Previous work on explanatory coexistence has proposed three different ways in which natural and supernatural explanations are commonly ‘reconciled’. The first is called synthetic reasoning, where both supernatural and natural

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would argue that as the measure operationalises belief in science as superior compared to other belief systems (including religion), excluding the item does not make the scale neutral towards religion.

For instance, by portraying belief in science as an alternative to ‘faith’ (Hayes & Tariq, 2000; Rutjens, Sutton, et al., 2018). The expectation that belief in science and supernatural belief are competing has also influenced measures of supernatural belief. Some studies have measured supernatural belief by asking individuals about their belief in science (in addition to their belief in extraordinary phenomena), as it has been expected that belief in science automatically indicates a lack of supernatural belief (Williams et al., 1989; see Randall & Desrosiers, 1980).

As one example, one of the pioneers in the cognitive science of religion, Justin Barrett, has suggested that some of the findings in the science of religion likely indicate a (non-human) intelligent designer (Atkinson, 2020).
explanations are invoked but their interaction is not specified (e.g. belief in earthquake destruction as a result of both inadequate infrastructure and an act of God). The second mode of coexistence is target-dependent reasoning, as supernatural and natural causes are more coordinated but applied to different parts of the phenomenon (e.g. biological death of the body and afterlife of the soul). Third, supernatural and natural causes are reconciled with integrated reasoning that merges supernatural and natural causation into a single explanation. One example of an integrated account is belief in intelligent design (ID) in evolution (Haimila, 2016; Legare et al., 2012; Legare & Shtulman, 2018; Legare & Visala, 2011; Watson-Jones et al., 2015). It has been proposed that humans are especially likely to turn to supernatural causation in addition to natural explanations when making sense of topics that may elicit fundamental concern, such as the origins of life, death, and human suffering (Legare et al., 2012; Legare & Shtulman, 2018; see Haimila, 2016; Jerotijević, 2015).

Similar to much of psychological research, prominent work on explanatory coexistence has approached the supernatural as phenomena that are unscientific (outside the scope of scientific enquiry or natural laws), with a focus on causes and practices that are often seen as religious or supernatural in the Western context (Legare et al., 2012; Legare & Shtulman, 2018; Legare & Visala, 2011; Pnevmatikos & Georgiadou, 2019). Moreover, the same applies to most of other prior work on the relationship between science endorsement and supernatural belief. Previous research on the relationship between belief in science and the supernatural has mainly investigated the association between science and religious or other traditional PSMS beliefs – the beliefs that have been commonly perceived as ‘supernatural’ in the Western countries (e.g. Aghababaei, 2016; Ecklund et al., 2016; Irwin et al., 2015; McPhetres & Zuckerman, 2018; Preston & Epley, 2009; Preston et al., 2013, but see Järnefelt et al., 2018; Kelemen & Rosset, 2009; cf. Lindeman & Svedholm-Hääkkinen, 2016). This is noteworthy, as it might be difficult to uncover the extent to which the findings might be accounted for by cultural identities and local expectations on the relationship between science and religion.17 Defining supernatural belief based on the structure of beliefs would help

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17 For instance, the findings that priming scientific explanations as strong decreased the appeal of religious explanations (and vice versa) in American samples (Preston & Epley, 2009; Preston et al., 2013) are at times interpreted as evidence of the incompatibility of scientific and religious explanations (e.g. Rutjens et al. 2018). The results do indicate competition between science and religious belief, but it is unclear whether this was due to both serving the same functions and competing over the same explanatory space (Rutjens et al., 2018; Preston & Epley, 2009) or due to a culturally constructed conflict between ‘science’ and ‘religion’, leading Americans to react as if there was a conflict between scientific and religious explanations. If the latter is the case, then the results should not replicate in cultures where science and religion are not generally perceived as conflicting frameworks.
investigate whether science-oriented individuals hold similar supernatural beliefs as other populations, but ones that might differ in their terminology from traditional religious belief. These supernatural beliefs might also differ from traditional religious beliefs in their relationship with belief in science, as ‘science’ is seen to conflict with ‘religion’ in particular (Evans & Evans, 2008).

\[\text{\textsuperscript{18}}\text{ It should be noted that although prominent literature on the explanatory coexistence model defines supernatural as something outside the scope of natural laws (in relation to science) and as phenomena that are traditionally conceptualised as supernatural, several studies have also investigated more secular supernatural beliefs, such as immanent justice beliefs more generally (Jerotijević, 2015; cf. Raman & Winer, 2004) or teleological nature beliefs (Kelemen & Rosset, 2009).} \]
3 Aims of the dissertation

To summarise, prior research on science-oriented individuals' religious and other supernatural beliefs and their relationship with belief in science has been scarce. Furthermore, studies have generally contained one or both of the following limitations: 1) the study design has assumed that belief in science and supernatural belief are competing, or 2) supernatural belief has been operationalised as religious or other 'traditional' supernatural belief, such as belief in God, the soul, or an afterlife. So far, studies have not (to my knowledge) aimed to investigate whether science-oriented individuals hold other supernatural beliefs that might reflect the contemporary cultural surroundings of a 'science-believer', and whether such more secular beliefs are related to belief in science in similar ways as religious belief.

The dissertation aims to fill these gaps by answering the following research questions:

1) Do science-oriented individuals hold ‘supernatural’ beliefs (beliefs that blend ontological core knowledge)? If yes, what kind of supernatural beliefs do science-oriented individuals hold?  
2) What is the relationship between belief in science and supernatural belief in science-oriented individuals?

More specifically, the following sub-questions on different kinds of supernatural beliefs were investigated:

1a) Do science-oriented individuals hold ‘traditional’ supernatural beliefs, such as belief in the soul, the afterlife, karma, or a higher power?  
1b) Do they also hold more secular supernatural beliefs that might not use ‘traditional’ supernatural vocabulary?

Regarding the relationship between belief in science and supernatural belief, the following sub-questions were examined:

19 Despite previous research indicating that some science-oriented individuals also hold supernatural beliefs, I did not want to assume that they do; I thus began by asking whether the individuals in the dissertation data believe in supernatural phenomena, before proceeding to ask about the content of the beliefs and their relationship with belief in science.
2a) Does belief in science entail less supernatural belief in science-oriented individuals?
2b) Are belief in science and the supernatural separate or integrated sense-making strategies for phenomena?

Based on previous research, it was expected that some science-oriented individuals also hold supernatural beliefs. Moreover, I expected that the supernatural beliefs of individuals who hold science in high regard would mainly be secular in their vocabulary. In other words, I predicted that science-oriented individuals would i) endorse religious and other ‘traditional’ supernatural belief less than secular supernatural beliefs (in a structured measure), and that ii) they would less likely apply religious and other traditional supernatural beliefs than secular supernatural beliefs (in open-ended responses).

Regarding the relationship between belief in science and the supernatural, I predicted that belief in science would entail less supernatural belief, when belief in science is measured with a scale that posits ‘science’ as superior to ‘religion’. Furthermore, I expected that there might be no association between belief in science and supernatural belief in science-oriented individuals, when belief in science is investigated with a measure that is neutral towards religion. In other words, I presumed that belief in science does not necessarily entail decreased supernatural belief, but there might be such an association if prompted by the research design. Furthermore, I expected that supernatural beliefs that do not contain religious terminology would not entail less belief in science.

Finally, I expected that some science-oriented individuals who hold supernatural beliefs would also integrate them with ‘scientific’ accounts of the world. Thus, I started out with the prediction that people who hold science in high regard would not only use ‘science’ and supernatural belief as separate sense-making strategies (e.g. for different phenomena or in a target-dependent manner) but also merge their supernatural beliefs into their belief in science with integrated reasoning. In other words, I expected that the results on explanatory coexistence of supernatural and scientific explanations would be the most significant ones for this research question. However, the dissertation was since complemented with data-driven articles that also contribute to its response to the research question. Next, I will introduce the articles included in the dissertation and describe how they answer the research questions.

Article I is a joint publication that aimed to investigate the content of non-theistic worldview beliefs in ten countries. It reports the results of a research project on secular worldviews under the ‘Understanding Unbelief’ research programme led by Dr Valerie van Mulukom (Coventry University). More specifically, we asked which beliefs non-theistic individuals (individuals who do
not believe in God) find especially meaningful.\textsuperscript{20} One worldview belief was mentioned more frequently than others: a ‘scientific worldview’. Considering the primary importance of belief in science for the participants compared to other beliefs, the sample is here considered ‘science-oriented’ (see Introduction). In the article, we also investigated non-theistic participants’ supernatural beliefs and discussed the relationship between belief in science and the supernatural in light of the findings. The beliefs measured comprised ‘traditional’ supernatural beliefs, such as belief in karma and a higher power. The results of article I contribute to answering research question 1a) (Do science-oriented individuals hold ‘traditional’ supernatural beliefs?) and, in particular, research question 2 (How are supernatural beliefs related to belief in science in science-oriented individuals?). For the joint article, I collected and coded the data for Finland and contributed to interpreting the overall results in relation to the previous work.\textsuperscript{21}

In article II, I extend the scope of the research to religious believers. Here, supernatural beliefs were also measured as ones that utilise secular vocabulary. The article investigated the possible relationship of belief in science with supernatural belief in science-oriented Finnish religious believers and non-believers. Thus, findings help answer research question 2a) (Does belief in science entail less supernatural belief in science-oriented individuals?) and research questions 1a-b) (Do science-oriented individuals hold ‘traditional’ supernatural beliefs? Do they also hold secular supernatural beliefs?) in the Finnish context.

Article III further elaborates on the responses to all research questions with a theory-driven study on open-ended data on science-oriented Finns’ views about the origins of life, death and suffering – domains that have previously been suggested to elicit explanatory coexistence (see section 2.3 on prior research). The article explored whether Finns would invoke supernatural causality when explaining these phenomena in their own words, and what kinds of supernatural explanations they referred to. The article also reported the extent to which and how supernatural explanations were integrated with belief in science.

While preparing for the analysis of article III, I noticed that science-oriented death beliefs in particular were more diverse than might be expected

\textsuperscript{20} In this dissertation, the terms ‘non-theistic individuals’ and ‘non-theists’ refer to individuals who do not believe in God. In addition, individuals who do not believe in God are at times referred to as ‘non-believers’ (when preceded by the term ‘religious believers’). In the use of these terms, we follow Lee (2015, p. 204) who has defined non-theism as a stance ‘other than theist’. In Lee’s work, the absence of God belief is also referred to as ‘atheism’ (Lee, 2015). However, in this summary chapter, I have chosen not to refer to individuals who simply lack belief in God as ‘atheists’, as in many cultural contexts included in the studies, ‘atheist’ also implies a negative attitude towards religion – something that was generally not prevalent in non-theistic individuals in the data (see article I). Furthermore, individuals who do not believe in God are also occasionally referred to as ‘unbelievers’ (see e.g. Bullivant et al., 2019).

\textsuperscript{21} Based on my contribution, I was the third author (3/13).
based on previous work. Thus, the theory-driven research designs of articles II-III were complemented with a data-driven analysis of science-oriented death beliefs reported in article IV. The findings of article IV shed further light into the relationship between belief in science and supernatural causation in science-oriented Finns’ beliefs about death and thus help to specify the answers to research questions 2a-b (Does belief in science entail less supernatural belief in science-oriented individuals? Are belief in science and the supernatural separate or integrated sense-making strategies for phenomena?)
4 Data and methods

The data of the dissertation was collected in two online self-report questionnaires (henceforth: study 1 and study 2). In total, the data comprises responses from 1383 individuals in ten countries. The data of study 1 (article I) was collected in the following countries: Australia (AUS), Brazil (BRA), Canada (CAN), Czech Republic (CZE), Denmark (DNK), Finland (FIN), the United Kingdom (GBR), the Netherlands (NLD), Türkiye (TUR), and the United States (USA). The data of study 2 (articles II-IV) was collected in Finland. The datasets of both studies were gathered through purposive sampling (Hibberts et al., 2012). Study 1 targeted non-religious non-theists, who were recruited through secular organisations in the included countries. Study 2, on the other hand, targeted science-oriented Finns whom I expected to comprise both religious believers and non-believers. The participants of study 2 were recruited through Finnish organisations that promote science and research. Therefore, it should be noted that the samples were not representative and the findings should not be generalised to wider populations (see section 6.2.1). Next, I will briefly describe the cultural contexts of both studies.

4.1 Cultural contexts

4.1.1 Study 1: Setting the stage for the cross-cultural sample

The countries that were included as sites of research in study 1 were primarily chosen (by the first author of article I) based on international expertise in the psychology of nonreligion at the time, as all the authors were experts on atheism in one or more of the countries. The participants were recruited mainly through secular organisations and relevant online platforms (see section 4.2.1). Despite a focus on the included countries and secular organisations, the recruitment resulted in a sample that was larger and more versatile than those of previous studies on non-theists’ meaningful beliefs in their own words (see for instance Keller et al., 2018; Pasquale, 2009). In addition to recruiting participants from the
United States and Europe (as most prior work), the sample comprised non-theistic individuals from Brazil (South America), Türkiye (located both in Europe and Asia), and Australia.

The countries included in the data collection exhibited variety in terms of history and socioeconomic background. They also differed in the extent to which being non-religious and not believing in God was regular – or out of the ordinary (see table 1). In Brazil and Türkiye, an overwhelming majority of the population believed in God. On the other hand, only one in four believed in God in the Czech Republic, a nation that emerged from under Communist rule in 1993 (see table 1). In terms of religious affiliation, a majority of the population did not belong to any religious denomination in the Czech Republic, the Netherlands, Australia, and the United Kingdom (Haerpfer et al., 2021). Of the remaining countries, many were predominantly Protestant (Denmark and Finland) or Catholic and Protestant (United States, Canada and Brazil), with the largest proportion of Catholics in Brazil. In Türkiye, an overwhelming majority of the population was Muslim (Haerpfer et al., 2021).

It should be noted that all countries included in the data collection with the exception of Türkiye (and to some extent, the Czech Republic) were predominantly Christian in their cultural backdrop, and most can also be conceptualised as Western countries. Thus, it might not be surprising that in most of the countries, many perceived conflict between ‘science and religion’ – a conception that is common in the Western context but less endorsed in many other parts of the world (such as East and South Asia and Sub-Saharan Africa, see Ecklund et al., 2016; Wellcome, 2018). Some have suggested that the conflict narrative might be especially prevalent in the United States (McPhetres et al., 2021). Interestingly, statistics on the frequency of perceived conflict between ‘science’ and ‘religion’ among religious individuals also indicate a strong presence of the conflict narrative in Finland in particular (see table 1).

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22 The included countries also differ in the extent to which it is common to self-identify as an atheist. However, I did not include this in table 1, as, to my knowledge, there are no comparable data on atheist identity across the countries. The World Values Survey should contain data on self-identifying as ‘An atheist’ for all countries. However, the WVS uses data from the European Values Study for Europe. In the EVS, the exact wording of the corresponding option for ‘an atheist’ is ‘a convinced atheist’ (italics added; see EVS, 2022). Therefore, self-identifying as an atheist is likely more common in the European countries than presented in the WVS. In fact, according to the WVS, 9% of Finns identify as an atheist (Haerpfer et al., 2021), whereas in another survey, the figure was 19% (Church Research Institute, 2015).
Table 1. Figures describing the cultural contexts of study 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>AUS</th>
<th>BRA</th>
<th>CAN</th>
<th>CZE</th>
<th>DNK</th>
<th>FIN</th>
<th>GBR</th>
<th>NLD</th>
<th>TUR</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>GINI coefficient¹</td>
<td>34.3</td>
<td>53.9</td>
<td>32.5</td>
<td>25.0</td>
<td>28.2</td>
<td>27.3</td>
<td>33.7</td>
<td>28.1</td>
<td>41.9</td>
<td>41.4</td>
</tr>
<tr>
<td>A religious person²</td>
<td>37%</td>
<td>72%</td>
<td>36%</td>
<td>32%</td>
<td>54%</td>
<td>49%</td>
<td>32%</td>
<td>42%</td>
<td>66%</td>
<td>58%</td>
</tr>
<tr>
<td>Not a religious person²</td>
<td>43%</td>
<td>23%</td>
<td>45%</td>
<td>46%</td>
<td>34%</td>
<td>39%</td>
<td>46%</td>
<td>44%</td>
<td>25%</td>
<td>33%</td>
</tr>
<tr>
<td>Belief in God²</td>
<td>56%</td>
<td>96%</td>
<td>59%</td>
<td>28%</td>
<td>50%</td>
<td>54%</td>
<td>48%</td>
<td>41%</td>
<td>95%</td>
<td>81%</td>
</tr>
<tr>
<td>Belief in life after death³</td>
<td>54%</td>
<td>57%</td>
<td>57%</td>
<td>28%</td>
<td>40%</td>
<td>36%</td>
<td>46%</td>
<td>39%</td>
<td>92%</td>
<td>68%</td>
</tr>
<tr>
<td>Trust in science: high⁴</td>
<td>54%</td>
<td>20%</td>
<td>54%</td>
<td>35%</td>
<td>60%</td>
<td>60%</td>
<td>53%</td>
<td>52%</td>
<td>43%</td>
<td>51%</td>
</tr>
<tr>
<td>Trust in government: high⁵</td>
<td>7%</td>
<td>3%</td>
<td>15%</td>
<td>12%</td>
<td>16%</td>
<td>16%</td>
<td>12%</td>
<td>20%</td>
<td>30%</td>
<td>9%</td>
</tr>
<tr>
<td>Perceived conflict between science and religion (among the religious)⁶</td>
<td>50%</td>
<td>46%</td>
<td>43%</td>
<td>12%</td>
<td>27%</td>
<td>60%</td>
<td>44%</td>
<td>53%</td>
<td>32%</td>
<td>59%</td>
</tr>
</tbody>
</table>

Note. ¹ In 2018. World Bank Open Data, 2023. ² ‘Independently of whether you go to church or not, would you say you are… A religious person; Not a religious person. World Values Survey (2017–2022, see Haerpfer et al., 2021). ³ ‘In which of the following things do you believe, if you believe in any?’ ‘God’; ‘Life after death’. World Values Survey (2017–2022, see Haerpfer et al., 2021). ⁴ ‘In general, would you say that you trust science a lot, some, not much, or not at all?’ National percentages for the option ‘A lot’. Wellcome, 2018, appendix D. ⁵ ‘How about the national government in this country? Do you trust them a lot, some, not much, or not at all?’ National percentages for the option ‘A lot’. Wellcome, 2018, appendix D. ⁶ ‘(If respondent identifies with a religion) Has science ever disagreed with the teachings of your religion?’ National percentages for the option ‘Yes’. Wellcome, 2018, appendix D.

In most of the cultures included in the data collection, people were prone to trust science. At the time of our data collection, people were the most likely to have strong confidence in science in the Nordic countries, and Finns fared the highest in their trust in science (Wellcome, 2018; see table 1). Across all countries, people were more inclined to trust science than, for instance, their government, indicating the authority of science in the included cultural contexts (Wellcome, 2018; cf. also Qadir & Syväri, 2021). The authority of science is also reflected in that in most of the countries included, it was common for religious individuals to self-report that they would trust ‘science’ over the doctrines of their religion (Wellcome, 2018, appendix D). For example, 68% of religious Finns surveyed in 2018 who, at one point or another, had perceived conflict between science and religion, stated that when ‘science disagrees’ with their religion, they would believe science over the teachings of their religion (Wellcome, 2018, appendix D, D9959). Next, I will further describe the cultural context of Finland as a site of research on belief in science and the supernatural.
4.1.2 Study 2: Finland as a site of research

Finland is a nation located in Northern Europe, and it is generally conceptualised as a Nordic country along with Sweden, Norway, Denmark, and Iceland. Geographically, Finland is one of the largest countries in Europe, yet relatively small in its population count with approximately 5.5 million inhabitants. During its history, the area of current Finland has been colonised by two of its large neighbours: the Kingdom of Sweden and the former Russian Empire. After declaring independence in 1917, Finland was divided by a civil war. This was followed by two wars against the Soviet Union in the 1930s and 1940s. Following the war times, Finland was a relatively poor country, and in the 1950s the educational level was low compared to other Western European nations (Hjerppe, 2023). The post-war economic boom was followed by crucial improvements to social care, including a public healthcare system and free education at all levels. By the end of the 1980s, Finland was equally wealthy to countries such as Sweden and Australia (as measured with GDP per capita) and had become one of the most equal nations in income distribution (Hjerppe, 2023; OECD, 2023b). At the time of my data collection, Finland was a highly industrialised country with one of the most educated populations in the world (OECD, 2023a).

In terms of religion, there are two denominations that can be called ‘state churches’ or ‘state-preferred churches’ based on their position in the legislation: the Evangelical Lutheran Church of Finland and the Finnish Orthodox Church (Kühle et al., 2018, p. 87; Kääriäinen, 2011). A majority of Finns are members of the Evangelical Lutheran Church (65%), and only a small minority belongs to the Orthodox Church or other religious communities (ELCF, 2018; Ketola et al., 2023). In the past century, being ‘Christian’ has been strongly entangled with the Finnish cultural identity. One factor underlying the Finnish cultural Christianity might include the wars against the communist (atheist) Soviet Union. Another constitutes the small number of immigrants compared to countries such as Sweden (Kääriäinen, 2011; Taira et al., 2023). In Finland, Christianity has been associated with the ‘in-group’ – Finnish background, customs and traditions (Pauha & Jasinskaja-Lahti, 2013; Taira, 2015).

However, the membership rates of the Lutheran Church have steadily declined in the last decades (Taira et al., 2023). Similarly, Finns’ belief in God has generally followed a downward trend since the mid-seventies (Ketola et al., 2018). Currently, approximately one in two Finns believe in God. Belief in God is still more important for Finns than, for instance, a religious promise of immortality, as only one in three Finns believe in ‘life after death’ (see table 1, Haerpfer et al., 2021).

Although Finns are somewhat divided in their religious belief (or lack thereof), they commonly share some other views. Similar to other Nordic countries, people in Finland generally trust other people and the public
institutions of their country (Haerpfer et al., 2021; Science Barometer, 2019). An overwhelming majority of Finns also have at least a ‘fairly high’ level of confidence in science (85%; Science Barometer, 2022, p. 7). In fact, Finns trust ‘science and research’ more than many other institutions, such as the national justice system (Science Barometer, 2019; 2022). Trust in science is shared across demographic groups. For instance, although Finnish men are more interested in science than women, people of different genders are somewhat equally likely to have confidence in science. The demographic variables of most significance seem to be educational background and political orientation, as higher educated Finns have stronger trust in science, and the supporters of the right-wing nationalist party fare lower in their trust in science than the supporters of other parties (Science Barometer, 2022). Yet, even the voters of the right-wing Finns Party rate higher in their confidence in science (71%) than the populations of many other countries in total (Haerpfer et al., 2021; Science Barometer, 2022). In fact, on a global scale, Finland ranks as one of the top nations in general trust in science, following countries such as Uzbekistan, Norway, and Spain (Wellcome, 2018).

But what does ‘science’ actually mean in the Finnish context, and how is ‘science’ perceived in relation to religious and other supernatural belief? As mentioned in section 2.2.1, the Finnish word for science (‘tiede’) is generally considered to be wider in scope than the common English translation, as, in addition to the natural sciences, it has been suggested to comprise social sciences and the humanities (Kiikeri & Ylikoski, 2004, p. 16). The Finnish term therefore resembles the closest equivalents of ‘science’ in many other European languages, such as ‘vetenskap’ in Swedish or ‘wissenschaft’ in German (Hansson, 2015, p. 15). However, to my knowledge, previous work noting this difference between the Anglo-American and Finnish terms has mainly stated it as a ‘fact’ and not relied on empirical research (see Kiikeri & Ylikoski, 2004; cf. also Hansson, 2015).

In general, many Finns perceive tension between science and religion. In 2018, a majority of religious Finns agreed that science has disagreed with their religion, more so than, for instance, religious individuals in the United States (Wellcome, 2018, appendix D, see table 1). On the other hand, at the time of my data collection, ‘only’ 42% of Finns overall agreed that a ‘worldview based on science’ is in conflict with ‘religion’ (Science Barometer, 2019, p. 82). This difference might seem puzzling, yet it aligns with one of the Finnish public discourses on science and religion: that a ‘scientific worldview’ in particular does not contradict religious belief (see e.g. Enqvist, 2014; Finnish National Church Council, 2019). This narrative is related to the conceptualisation of ‘worldview’ in some European cultures and languages such as Finnish and German. In Finnish, the term ‘worldview’ can be translated into two different concepts: ‘maailmankuva’
('Weltbild' in German) and 'maailmankatsomus' (in German 'Weltanschauung'). In terms of the 'big questions', the first is depicted as one's view of the world containing ontology (What is?) and, to some extent, epistemology (How do we know what is true?). The latter is seen as a wider concept that also contains the dimensions of axiology (What is right and wrong?) and praxeology (What actions should we take?) (see section 2.2.1). According to the Finns referring to this narrative, a ‘scientific worldview’ thus does not necessarily collide with religious belief, as science primarily answers the question of ‘What is?’, whereas religion may act as a source of moral values (Finnish National Church Council, 2019) or other worldview content that science, according to these accounts, cannot provide (Enqvist, 2014; Niiniluoto, 1984). This or similar conceptualisations of a scientific worldview have been endorsed by several Finnish celebrities and institutions, such as the Evangelical Lutheran Church and some inaugurated Finnish researchers (see e.g. National Church Council; Niiniluoto, 1984; Enqvist, 2014). However, in Finland many also think that a ‘scientific worldview’, or a worldview based on science, excludes supernatural belief (Koski, 2016, p. 11). For instance, the nation’s most well-known non-religious organisation, The Union of Freethinkers of Finland, lists advancing a worldview based on science as one of its aims. The union furthermore conceptualises religious belief as unscientific and rejects belief in a supernatural purpose or an afterlife (The Union of Freethinkers of Finland, 2023). Moreover, many of the researchers who have proposed that a scientific worldview does not exclude religious belief are themselves openly non-religious (see e.g. Enqvist, 2014; Niiniluoto, 1984), which might, in the end, increase the likelihood of Finns associating scientific expertise with a lack of (religious) supernatural belief.

### 4.2 Data collection and participants

#### 4.2.1 Study 1

We collected the data in the summer of 2018 in the included countries using the Qualtrics online survey platform. The invitation to participate was disseminated through online platforms, such as Reddit, Twitter, and social media groups and email lists of secular organisations (see Appendices). As an incentive, the participants could take part in raffles for a gift card and receive a report on the findings following the publication of the results. The participants first answered pre-screening questions about belief in God and religiosity, followed by open-

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23 On these concepts beyond the Finnish context, see Naugle (2002).
ended and structured questions about beliefs and their psychological functions. At the end of the questionnaire, the participants were asked to provide background information (gender, age, self-reported spirituality, nationality, and country of residence). As we targeted non-religious non-believers (in God), the participants who identified as ‘Religious’ or responded that they believed in God at the beginning of the study were automatically directed to the last page of the questionnaire and informed that they did not meet the sample criteria. In the recruitment, we aimed for 100 participants from each country with a 50/50 gender ratio, and both goals were established in most countries. Altogether, the sample consisted of 996 non-religious non-theistic individuals, who were diverse in their age ($M = 44.34$, $SD = 14.76$, range 15–87 years) and on average highly educated ($M = 17.26$, $SD = 3.68$ years of education). Most identified as ‘atheists’ but some described themselves as having ‘no religion’ or being ‘agnostic’ or ‘spiritual but not religious’. Furthermore, some (albeit very few) described themselves with some other secular identity. The self-reported spirituality of the participants was very low ($M = 0.84$, $SD = 1.37$, on a scale of 0–6).

4.2.2 Study 2

Study 2 collected online self-report data from Finnish participants who comprised both religious believers and non-believers. The data collection took place between December 2019 and February 2020, and it was conducted using the LimeSurvey platform. The participants were recruited through pro-science organisations, such as universities, other research institutions, and the social media (e.g. Facebook and Twitter) of organisations that popularise or promote research in Finland (for a complete list, see Appendices). The social media recruitment was conducted in the last phase of data collection and only lasted two days – yet it yielded approximately half of the responses. The study was advertised as research on worldviews that ‘hold science in high regard’ or ‘value science’. Similar to study 1, the respondents could participate in a raffle for a gift card and request a report on the results. To ensure that participants were paying attention to responding, the final sample consisted of participants who answered the instructional manipulation check correctly. Altogether, 387 Finns were included in the sample. The participants’ median age was 31–40 years (range across groups: 18–30, 31–40, 41–50, 51–65, and over 65 years) and most were women (52%, men 44%, other/I don’t want to say 4%). The respondents were highly educated (years of education $M = 19.6$, $SD = 4.6$), and half had worked in research organisations (natural sciences 24%, humanities 14%, social sciences 9%, and other research fields 4%). Most participants were not affiliated with any religious community (70%).
4.3 Measures and method of analysis

The papers of the dissertation analysed two kinds of self-reports: 1) responses to structured measures, and 2) open-ended data. The structured data was collected to ensure responses about certain beliefs of interest and to enable comparisons to prior research. Open-ended data, on the other hand, was expected to enable novel insight into the research topics. Next, I will introduce the structured measures, the open-ended questions, and the selected method of analysis for each open-ended question (see also Appendices). The questions will be presented in thematical order that aligns with the order of articles in the dissertation.

4.3.1 Measures and analysis method of study 1

Meaningful worldviews

To investigate which views of the world non-religious non-theists consider particularly meaningful, the participants of study 1 were presented the following introduction and open-ended question:

There has been a global increase in individuals who hold no religious affiliation or have no religious beliefs, and a concurrent increase in secular organisations and secular rituals (e.g., humanist weddings and funerals). We are interested in understanding better what forms of ‘non-religious belief’ entail. While non-believers do not hold religious beliefs, they may still have distinct secular views, for example moral or ethical beliefs or views. Moreover, such secular worldviews may provide non-religious individuals with sources of meaning which are important to explain the world and which may also function as coping mechanisms.

If you do not believe in God, what worldviews, beliefs, or understandings of the world do you hold? Please list the worldviews, beliefs, or understandings of the world that are particularly meaningful to you.

In the analysis, we aimed for a data-driven account of the meaningful worldview beliefs of non-theists in different countries. To achieve this, each collaborator coded the data of their respective country with a bottom-up approach, creating categories for recurring themes in the responses during the coding process. The resulting data-driven coding templates were then integrated into a final coding
template by the first and second authors of article I. The coding template was used for all samples during the second and final coding rounds, to quantify the open-ended responses consistently across countries. The consistency of the coding procedures was ensured with a reliability coding on all countries conducted by the second author of the article (Cohen’s kappa range: 0.83–0.94). Finally, any disagreements in coding between the second author and the original coder of the country’s dataset were resolved in collaboration, resulting in the final coding of the responses that was used in the analyses of article I.

**Structured belief measure**

In addition to the open-ended responses on meaningful views of the world, article I investigated the meaningful beliefs of non-religious non-theists with a structured belief measure. The participants were asked: ‘Which of the following worldviews/understandings of the world/beliefs do you hold? A belief in or a worldview or understanding of the world that primarily relies on’ followed by 26 items. The items measured belief in concepts that were expected to be relevant for non-theistic worldviews based on pilot studies and the authors’ expertise, including belief in ‘science’, ‘evolution’, ‘nature’, ‘logic/reason’, ‘common sense’, ‘humanity/human ability’, ‘human goodness/love’, ‘positive thinking’, and ‘enjoyment/seize the day attitude’. Furthermore, the measure investigated belief in phenomena that are often perceived as supernatural in the Western context (belief in ‘karma’, ‘fate’, ‘soul’, ‘universal consciousness/awareness’, ‘spiritual realm/beings’, ‘a creator’, ‘a higher power’, ‘afterlife’, and ‘reincarnation’). The participants were asked to choose one of the following options for each item: ‘I definitely do not hold this belief/view’ (−2), ‘I do not hold this belief/view’ (−1), ‘Neutral’ (0), ‘I hold this belief/view’ (1) and ‘I definitely hold this belief/view’ (2). The belief measure was presented after the open-ended question on meaningful worldviews. The full measure is introduced in article I.

**4.3.2 Measures and analysis method of study 2**

**Belief in science**

In study 2, belief in science was measured with two scales: the Belief in Science Scale by Farias et al. (2013) that operationalises belief in science as superior to other belief systems, including religion (see section 2.3), and a new science-oriented worldview measure that operationalises belief in science as a worldview belief (see section 2.2.1).
Belief in Science Scale (Farias et al., 2013; article I)

The scale contains 10 items on science as superior to other belief systems in value and as a means of knowledge acquisition (e.g. ‘Science provides us with a better understanding of the universe than does religion’). Additionally, the scale contains items on faith in the ability of science (e.g. ‘All the tasks human beings face are soluble by science’) and an item on generally holding science and scientific authorities in high regard (e.g. ‘Scientists and science should be given more respect in modern society’). The items were translated to Finnish, and the translations were tested in a small pilot study. As in prior studies, the internal consistency of the Belief in Science Scale was high (Cronbach’s α = .90; Dagnall et al., 2019).

Science-oriented worldview measure (Articles II and III)

A measure for a ‘science-oriented worldview’ was developed to investigate science as a meaningful worldview with a religion-neutral measure. The measure consisted of subscales for the following worldview components: 1) a sense of meaning, 2) standards for assessing human behaviour, 3) hope of literal immortality, and 4) symbolic immortality through science (see section 2.2.1; for details on the scale formation, see article II). The items were rated on a scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree). Measured with Cronbach’s alpha, the internal consistency of the overall measure was high (α = .89), whereas the consistency of the subscales ranged from acceptable to high (α = .75 for the literal immortality subscale, other subscales α > .84).

Items on a sense of meaning were formulated following George and Park’s (2017) conceptualisation of existential meaning in life. Standards for assessing human behavior, on the other hand, were interpreted similarly to Vidal’s (2008) suggestions on the worldview components of axiology (What is good and bad?) and praxeology (What actions we should take? See also Taves, 2018). As it seems that belief in indefinite life extension (ILE) can serve a similar worldview function as afterlife belief (Lifshin et al., 2018), literal immortality through science was operationalised as 1) hope of surviving death (traditional literal immortality), and 2) hope of avoiding death with scientific means. The final worldview component, symbolic immortality, was measured with items on a sense of belonging to something larger and more significant than oneself (Dechesne et al., 2003), and in reference to prior work, an item on awe from science was also included (cf. Caldwell-Harris et al., 2011; Gottlieb et al., 2018).

The items were mainly based on the open-ended responses of the pilot study. The symbolic immortality subscale was followed by an open-ended question on which communities/larger entitities the participants felt connected to through science (for the participants who reported experiencing such a connection through
science). Finally, the participants answered an open-ended question on ‘What kind of science’ they thought of while answering the measure (‘Could you tell us briefly what kind of science you thought of while answering the questions?’), as it was expected that the Finnish connotation for the word ‘science’ might differ from the term’s connotation in Anglo-American contexts (see section 4.1.2). The responses to both open-ended questions were analysed with data-driven coding templates.

Supernatural belief

Participants’ supernatural beliefs were examined with a structured measure focusing on supernatural agency and purpose, a structured question about belief in God, and with open-ended questions about domains of fundamental concern (death, suffering, and the origins of life; see Legare et al., 2012; Legare & Shtulman, 2018).

Supernatural Agency and Purpose Belief Measure (articles II-III)

As I embarked on investigating science-oriented Finns’ beliefs that mix ontological core knowledge with a structured measure, I noticed that none of the previously existing scales seemed to fit the task. Prior measures had focused on beliefs commonly perceived as religious or spiritual, had investigated a specific subcategory of PSMS beliefs (i.e. magical beliefs about nutrition), or contained some items on more secular PSMS beliefs yet measured a wider category of supernatural and non-supernatural beliefs (such as ‘scientifically unsubstantiated’ beliefs, see e.g. Irwin & Marks, 2013, p. 133; Jong et al., 2013; Lindeman et al., 2000; Stone et al., 2018; Tobacyk, 2004). Thus, I developed a new measure of supernatural beliefs, with a focus on supernatural agency and purpose beliefs in the Finnish context (Article II).

For formulating the measure, participants were asked to rate various beliefs on a scale of 1 to 5 (1 = strongly disagree, 5 = strongly agree). These included beliefs that in Finland are generally interpreted as religious or religion-related, such as ‘Humans have a soul’ and ‘I believe in fate’. The items also comprised more secular beliefs that embed agency or purpose into natural phenomena. These included ones that blend core knowledge as they entail agency separate from a physical body (e.g. ‘Humans have free will that is independent of the body’). Furthermore, secular items on non-human purpose in life events were included (e.g. ‘Everything happens for a purpose’) along with items tapping into a karma-like mechanism of ultimate justice (e.g. ‘People eventually get what they deserve’ and ‘The world is a fair place’). Finally, the secular belief items measured conceptions about agency and purposeful ‘actions’ in nature (e.g. ‘Nature maintains a balance by self-regulating’). Following Lindeman and Svedholm (2012, p. 249), such beliefs blend
core knowledge based on two features: purpose in ‘random events’, and, as for the nature items, embedding agency or goal-directed behaviour into beliefs about non-mental entities. The items were based on qualitative research on supernatural belief in Finland (Haimila, 2016) and previous measures of supernatural belief, although some items from prior scales were slightly modified to fit the Finnish context (e.g. Davis et al., 2011; Järnefelt et al., 2018; Lipkus, 1991; Stanovich, 1989).

In addition to the items on beliefs that blend core knowledge, the participants were asked to rate four filler items (e.g. ‘Everything in the world can be reduced to matter/energy’; ‘Humans have evolved from other, prior species of animals’). The filler items were meant to ensure that the items would concern beliefs about nature and humans without an explicit focus on supernatural belief (as perceiving the measure as ‘religion-related’ might influence the responses, see Caldwell-Harris et al., 2011). Lastly, two quality check items were included that were non-supernatural in their wordings, yet otherwise identical to two of the supernatural belief items. These were meant to ensure that the supernatural belief items were endorsed due to the agency or purpose they contained and not their appeal as metaphors or their other content. For instance, the participants first rated their endorsement of the item ‘All humans consist of the same matter (for instance, [synonym for matter]/energy, stardust)’, followed by the supernatural belief item ‘All humans are made of the same material (for instance, matter/energy, stardust)’.

The final measure applied in the analysis contained 19 supernatural belief items (for more details on the scale development and the full measure, see article I and Appendices). The internal consistency of the supernatural belief items was high (Cronbach’s $\alpha = .89$).

Open-ended questions about origins, death and suffering (articles III-IV)

To further investigate the supernatural beliefs of science-oriented Finns, the participants of study 2 were presented with seven open-ended questions related to death, suffering, and the origins of life. The questions were based on previous research on topics that likely elicit supernatural reasoning (Legare et al., 2012).

In addition, the measure contained one item on nature as a ‘living creature’. This item embedded the properties of a singular biological (living) entity to ‘nature’ as a whole. The item was based on prior research on vitalistic Gaia beliefs that describe the earth or nature as being ‘alive’ (see Järnefelt et al., 2018, p. 19; Kelemen et al., 2013).

Italics added. I chose the items based on the pilot survey feedback on the items — or lack of thereof. The items that were paired with a control item raised the least comments objecting to the purpose embedded in the items, which, in my view, pointed towards a need for a control item.
and some of the questions were derived from prior studies (Evans et al., 2009). The participants were asked three questions about the origins of life, one investigating origins in general (‘How do you think the universe came to exist?’) and two questions on human origins (‘We ask you to describe how both chimpanzees and humans could arise from the same kind of ancestor’ and ‘What kinds of views do you hold regarding the origins of our consciousness?’). The participants also answered two questions about suffering (‘Why do bad things (e.g. a serious illness) happen more to some people than others?’, ‘Why do you think there is suffering in our lives?’). Finally, two death-related questions were included (‘What do you think happens to us (humans) after death?’, followed by a non-mandatory question on the finite/infinite nature of the existence of an individual human, to ensure more detailed responses (for all questions and their prompts, see article III).

The open-ended responses were analysed with a theory-driven coding template that was based on the definition of supernatural applied in this dissertation (see section 2.2.2). The template contained categories for non-supernatural and supernatural attributions, the latter operationalised as views that blended ontological core knowledge. The supernatural views were also categorised (coded) based on their terminology. More specifically, we coded instances of supernatural explanations that in Finland might be perceived as religion-related (religious and traditionally spiritual explanations). In addition, supernatural explanations that applied science-related terminology (e.g. evolution, quantum mechanics) were coded into a separate category to investigate whether supernatural causality was integrated with science. Lastly, to also include other possible views that blend core knowledge, we formed a category for supernatural explanations that merely used a secular vocabulary but did not refer to science (‘other’ explanations).

In addition to the theory-driven analysis of all responses, we conducted a separate data-driven investigation of death beliefs (article IV). For the analysis, we formulated a coding template with categories on i) cessation beliefs (what ends in death), continuation beliefs (what continues after death), and further categories for death-related attitudes and science-related terminology (e.g. atom, genetics). Most of the categories were based on recurrences in the data. Additionally, we had separate categories for religion-related terms and more secular terms to track the significance of both in death beliefs (e.g. continuity of soul, continuity of mind/consciousness).

In both articles, the main categories were rated on a scale of 0–2, to take into account the hesitant wordings of some participants (0 = the response does not fit the category criteria, 1 = the response fits the criteria but uses hesitant wording, 2 = the response fits the criteria). The responses were coded without demographic information on the participants. The coding templates were developed together
with master’s students who also helped with the reliability analysis (for further
details on the development of the templates and the reliability analysis, see articles
III-IV. For the templates and the coding instructions, see Appendices).

Belief in God

The participants’ belief in God was measured with the question: ‘Do you believe in
God?’ The participants could choose one of the following options: ‘Yes’, ‘No’, and
‘I cannot say’ (‘En osaa sanoa’ in Finnish, which could also be translated ‘I do not
know’).

4.4 Research ethics and open science

Both studies included in this dissertation have undergone ethical review prior to
data collection. The research design of study 1 was reviewed by the ethical review
board at Coventry University, and the research design of study 2 was reviewed by
the Research Ethics Committee in the Humanities and Social and Behavioural
Sciences at University of Helsinki. In 2018, in between the data collection of
studies 1 and 2, the European Union enacted the General Data Protection
Regulation (GDPR). To ensure that the implementation of study 2 followed the
GDPR and the renewed Finnish privacy laws, the University of Helsinki legal team
and data support were consulted before data collection. The dataset of study 2 was
collected as sensitive data with the GDPR-compliant LimeSurvey platform.

To advance open science, the datasets of both studies have been archived. The
data of study 1 (reported in article I) can be accessed in Open Science
Framework. The dataset of study 2 has been archived in the Finnish Social Science
Data Archive. To ensure open access to the research, the preprints of all articles
included in the dissertation can be accessed in the PsyArXiv preprint service
(article I) or the Open Science Framework (articles II-IV).

26 Full link to study 1 data reported in article I: https://osf.io/bkpgf. The archived dataset of
study 2 contains the structured data. Full link to study 2 dataset:
https://services.fsd.tuni.fi/catalogue/FSD3526
5 Results

5.1 Primary results of the articles

Article I reported findings from the first study, which investigated the meaningful beliefs of non-religious individuals who do not believe in God. The primary finding was that despite cultural differences, there was a considerable overlap in the ‘particularly meaningful’ beliefs in non-theists from different countries. Most importantly, belief in science or a ‘scientific worldview’ was the most widely endorsed belief among non-theistic participants. Non-theists also emphasised the importance of belief in humanism, critical scepticism, natural laws, and the moral values of equality and kindness across countries. Based on an explorative analysis on the open-ended responses, we extracted three common worldview types: a ‘scientific sceptic’ worldview, a left-wing humanist worldview, and an environmental caring worldview type. Similarly, the analysis of the structured belief measure items indicated a tendency to endorse science and humanism in all countries. On the other hand, few non-theists relied on ‘traditional’ supernatural beliefs, such as belief in a higher power or karma. Further analyses indicated that belief in science was negatively associated with supernatural belief.

Articles II-IV reported findings from the second study, which collected data from science-oriented Finnish individuals. The dataset contained responses from both religious believers and non-believers who follow research institutions or other organisations that promote science and research.

Article II investigated the relationship between supernatural belief and belief in science as meaningful for one’s worldview. I found that non-theists were more likely to state that belief in science provides them a sense of meaning, moral standards, and symbolic immortality than theists. However, the differences between religious believers and non-believers were small. Many God-believers also endorsed the significance of science for meaning in life, moral decision-making and symbolic immortality (operationalised as a connection to something bigger than oneself and a sense of awe through science). Secular supernatural beliefs (e.g. belief in purposeful evolution) were less associated with science attitudes than religious belief.

The article also reported findings on what constitutes ‘science’ in the Finnish context, as philosophers have suggested that the Finnish term for science is broader in meaning than the English equivalent (Kiikeri & Ylikoski, 2004). The
findings show that although most participants considered ‘science’ comprising at least the natural sciences, many also thought of humanities and social sciences, especially in their reflections on how science enables connection to something more meaningful than ourselves, such as humanity as a whole.

In article III, we examined how science-oriented Finns answer existential questions about death, suffering, and origins. Would science-oriented Finns also invoke supernatural explanations for these phenomena, as many people do in other cultural contexts? The findings show that science-oriented Finns primarily attributed death, suffering, and the origins of life to natural processes, and a minority relied on supernatural belief in their reflections. Supernatural explanations were most frequently used to explain why there is suffering and what happens to humans after death. Many of the supernatural beliefs did not contain religious terminology (e.g. suffering as a mechanism of balance). However, religious and other ‘traditional’ supernatural explanations were used almost as frequently as the supernatural explanations that applied a secular vocabulary. Nearly all individuals who believed in the supernatural also used natural (non-supernatural) explanations, and we described the different modes of explanatory coexistence in science-oriented worldviews.

Article IV complemented the prior theory-driven publications with a data-driven analysis of science-oriented death beliefs. The findings show that Finns who hold science in high regard generally believed in a ‘secular death’ and did not endorse belief in an afterlife (as also indicated by article III).²⁷ However, some of the non-supernatural beliefs still entailed continuity after death. Many science-oriented Finns described how they or their loved ones can ‘live on’ in memories, other legacy, or in the circulation of nature. Multivariate analyses indicated that non-supernatural continuity beliefs were mainly endorsed by non-theists, while religious believers relied on traditional afterlife beliefs. Based on the findings, we suggested that in contrast to prior assumptions, non-supernatural death beliefs do not merely portray death as ‘the end’ but contain versatile strategies for exceeding mortality, similar to religious beliefs.

Above, I have described the overall results of each article. In the next sections, I present how the findings contribute to answering the research questions of the dissertation: Do science-oriented individuals also hold ‘supernatural’ beliefs (beliefs that blend ontological core knowledge)? If yes, what kind of supernatural beliefs do science-oriented individuals hold? What is the relationship between belief in science and supernatural belief in science-oriented individuals?

5.2 Do science-oriented individuals hold ‘supernatural’ beliefs?

The results of all articles indicated that some individuals hold supernatural beliefs even in pro-science samples. However, the overall endorsement of supernatural beliefs was fairly low. This was the case especially in study 1 which reported the endorsement of traditional supernatural beliefs, such as belief in an afterlife and a higher power, in non-religious non-theists in different countries (article I). On a scale of −2 (I definitely do not hold this belief/view) to 2 (I definitely hold this belief/view), the average endorsement of supernatural beliefs was very low ($M = -1.43$, $SD = 0.63$) in the overall cross-cultural sample. The trend was observable in samples collected from all the countries, as the average endorsement of supernatural beliefs ranged from −1.61 (Australia) to −1.12 (Türkiye).

Similar to study 1, few participants endorsed traditional supernatural beliefs in study 2 that investigated the beliefs of science-oriented Finns. Only a small minority endorsed belief in God (14%) or reported that they are unsure whether God exists (17%). The vast majority did not believe in God (69%). Similarly, most did not endorse the religious items of the Supernatural Agency and Purpose Measure ($Mdn \leq 2$, when 1 = fully disagree and 5 = fully agree) or the overall scale ($Mdn = 2$; see Appendices, article III).

In article III, we investigated whether science-oriented Finns invoke supernatural causality in their own words when asked about phenomena that might elicit fundamental concern (death, suffering, and the origins of life, see Legare et al., 2012). Approximately one in four (28%) relied on supernatural belief in their responses. Similar patterns of results were found in a data-driven analysis of science-oriented Finns’ death beliefs, in particular (article IV). A minority believed in an immortal soul (8%) or other kinds of supernatural afterlife (religious or New Age beliefs 14%, other afterlife 4%). The analyses of open-ended responses thus also indicate that although some science-oriented individuals hold supernatural beliefs, relatively few do so. Some science-oriented Finns appealed to supernatural explanations without fully endorsing the belief, for instance, by stating that the universe ‘could have been created’ by God (P1572). If such uncertain or hesitant supernatural accounts were included, it could be said that approximately one in three (36%) invoked supernatural causality in their explanations for origins, death and suffering.

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28 Note that in article I, these beliefs are referred to as ‘more spiritual’ beliefs and ‘spiritual’ beliefs.
29 See the supplementary material of article I. The low endorsement of supernatural beliefs in article I is not surprising, considering that most participants identified as ‘atheists’ (52–85% in the country samples) and only few as ‘spiritual but not religious’ (1–14%).
5.3 What kinds of supernatural beliefs do science-oriented individuals hold?

As mentioned in section 3, I expected that science-oriented individuals would less likely endorse supernatural beliefs that contain religious or other expressions often deemed as ‘supernatural’ (e.g. belief in God or a spirit) compared to supernatural explanations that use a more secular vocabulary. This expectation was supported by the average endorsement of items in the Belief in Supernatural Agency and Purpose Measure (article III, supplemental material). The descriptive statistics of the measure indicate that religious and other traditionally supernatural beliefs were endorsed the least (e.g. ones that referred to ‘God’ or the world as ‘created’, \( Mdn = 1 \) on a scale of 1–5), with the exception of belief in ‘soul’ (\( Mdn = 2 \)). The results also show that science-oriented Finns were most likely to agree with beliefs that entailed vitalism or intrinsic or external agency in nature (\( Mdn \) range 3–4), such as the belief that ‘Nature is a living creature’, ‘Nature maintains a balance by self-regulating’ and that ‘All humans are made of the same material (for instance, matter/energy, stardust).’

However, when science-oriented individuals were asked to explain death, suffering and origins in their own words, they were somewhat equally likely to attribute traditionally supernatural and more secular supernatural causality (articles III-IV). Somewhat similar to the ‘self-regulation’ in the structured items, one recurrent theme in the secular supernatural beliefs was suffering as a mechanism of some kind of balance (article III).

Although science-oriented Finns most frequently used secular vocabulary in their supernatural accounts (‘other’ beliefs altogether endorsed by 21% of the participants, firm believers 16%), only slightly fewer participants endorsed religious or other ‘traditional’ supernatural explanations (20%, 15% firm believers). Moreover, the individuals who applied religious and ‘traditional’ supernatural beliefs comprised more than half of the participants who at some point inferred supernatural causation.

This raised the question of the extent to which supernatural beliefs that operate with secular vocabulary are endorsed by religious believers and non-

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30 Note that the latter item was preceded by a non-supernatural but otherwise identical control item ‘All humans consist of the same matter (for instance, [synonym for matter]/energy, stardust)’ to ensure that participants would not endorse humans as ‘made’ of the same ‘material’ due to identifying with the item’s non-supernatural parts.

31 Some of the recurring lines of thought can be seen in the response of the participant who wrote that ‘[s]uffering is associated with the circulation of life. For example, illnesses decrease the amount [of humans] and help maintain a balance in the world. Suffering is also a part of life and its qualia; to attain something good, there must be another side’ (P998).
believers, or whether those who hold religious beliefs (such as belief in God) are also more prone to believe in secular supernatural phenomena. In article III, we found evidence for the latter option. Even supernatural beliefs that used secular vocabulary were more likely mentioned by God-believers. The findings thus indicate that secular supernatural beliefs extend to non-religious answers to fundamental questions but are still associated with religious belief, albeit with a small effect size ($\eta^2 = .07-.08$).

Finally, the answer to the question ‘What kinds of supernatural beliefs do science-oriented individuals hold?’ can be elaborated with data-driven findings (articles III-IV). During the coding, we noticed that many science-oriented individuals deemed some of their views inconclusive. The results of articles III-IV indicated that the uncertainty was prominent in supernatural explanations in particular, compared to views about natural causes. This tendency was the most evident in the responses on what happens after death. Similarly, when asked about death, science-oriented Finns were also more likely to describe a sense of inner conflict than in their explanations of other phenomena (origins of life and suffering). For instance, some stated that they would like to believe in an afterlife but cannot, as their wishes conflict with their ‘reason’ (articles III-IV). A sense of inner conflict was connected to traditional supernatural belief, as those who were unsure of their belief in God were more likely to experience conflict than other belief in God groups. Thus, it seems that among science-oriented Finns, supernatural belief (or leaning towards it) is often characterised by hesitancy and/or a sense of inner conflict.

5.4 What is the relationship between belief in science and supernatural belief?

In this section, I will introduce the results on the relationship between belief in science and belief in the supernatural in science-oriented individuals. First, I will aim to answer the question ‘Does belief in science entail less supernatural belief?’ This will be done by describing the general trends of the relationship between belief in science and supernatural belief in the dissertation articles. Finally, I aim to answer the question ‘Are belief in science and the supernatural separate or integrated sense-making strategies for phenomena?’ In this section, I will describe a) whether science-oriented individuals tend to rely on belief in science, belief in the supernatural, or both in their answers to fundamental questions, and b) how individuals who do apply both science and supernatural belief relate scientific knowledge with supernatural causality (i.e. are belief in science and the supernatural applied as separate or integrated explanations).
5.4.1 Does belief in science entail less supernatural belief?

The results showed that a greater belief in science is related to less religious and other ‘traditional’ supernatural faith. In article I, a factor analysis on the structured belief measure items indicated a tendency for the non-theists who hold traditional supernatural beliefs to value belief in ‘science’ and ‘evolution’ less than other non-theistic individuals. Analysis of the non-theists’ open-ended responses yielded similar results. To investigate the relationship between different worldview types extracted from the open-ended responses (a scientific sceptic, a humanist, and an environmental worldview) and the structured belief measure, the correlations between the structured belief sets and the worldview types were examined. The results showed that the ‘scientific sceptic’ worldview was negatively associated with beliefs commonly perceived as supernatural, such as belief in a higher power, karma, reincarnation, soul and life after death. However, the negative relationship was weak in effect size ($r = -.20$, $p < .01$).

Similar to article I, the findings of article II also indicated that belief in science is related to less ‘traditional’ supernatural belief. To examine whether belief in science entails less supernatural belief, I investigated the relationships between two kinds of ‘belief in science’ and ‘supernatural belief’. Belief in science was approached as 1) belief in science as scientism that competes with religion (the Belief in Science Scale), and 2) belief in science as a worldview, operationalised with the Science-Oriented Worldview Measure. Belief in the supernatural, on the other hand, was approached as 1) religious belief, and 2) belief in supernatural agency and purpose more generally (the Belief in Supernatural Agency and Purpose Measure). In a sample of science-oriented Finns, stronger belief in science entailed less religious belief. The relationship was strong in effect size when belief in science was operationalised with the Belief in Science Scale (Kruskal-Wallis $H(2) = 102.717$, $p < .001$, $\eta^2 = .26$). When belief in science was approached as the ability of science to provide for worldview functions (without positing science and religion as competing), belief in science still entailed less religious belief but with a fairly small effect ($H(2) = 26.941$, $p < .001$, $\eta^2 = .06$). The results indicated that also God-believers reported deriving a sense of meaning and symbolic immortality from science, and, to a certain extent, asserted the importance of science for moral decision-making, albeit less than non-theistic individuals.32

Similar to the relationship between belief in science and religious belief, the results on the relation between belief in science and supernatural belief more generally seemed to depend on how ‘belief in science’ is operationalised. Scientism that competes with religion (Belief in Science Scale) was strongly negatively

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32 However, neither the religious believers nor non-believers gained a sense of literal immortality through science (see article II).
associated with the Belief in Supernatural Agency Measure ($r_s = -0.43, p < .001$), while the association between the Science-Oriented Worldview Measure and the Belief in Supernatural Agency Measure was weak ($r_s = -0.21, p < .001$).

Furthermore, the results on whether belief in science entails less supernatural belief also depend on what kind of ‘supernatural’ was measured. Article II shows that the Belief in Supernatural Agency Measure items that contain religious wordings (‘God’, ‘created’, ‘life after death’) were more associated with belief in science than the more secular supernatural beliefs (regardless of how belief in science is measured). Some of the more secular supernatural beliefs were not significantly associated with belief in science. These included some beliefs that were only endorsed by few science-oriented Finns, for instance, belief in the world as a fair place, belief in a free will independent of the body, and belief that the world was created by an agent such as an AI. However, some of the beliefs that did not seem to conflict with science belief were more widely endorsed. These included belief in humans as ‘made’ from the same ‘material’ such as stardust, vitalistic nature belief (‘Nature is a living creature’) and belief in intrinsic agency in nature, such as the belief in a goal-directed evolution of species (article III, supplemental material, see Appendices).

5.4.2 Are belief in science and the supernatural separate or integrated sense-making strategies?

Somewhat unsurprisingly, an overwhelming majority of science-oriented Finns (99%) relied on natural causes in their open-ended answers to questions about death, suffering and origins (article III). Thus, most turned to non-supernatural beliefs in questions of fundamental concern. This finding was elaborated in the data-driven analysis of death beliefs (article IV). The findings showed that science-oriented Finns mainly discussed death as ‘the end’, often referring to biological cessation. Still, the majority (53%) also mentioned some kind of continuity after death. A minority believed in a supernatural afterlife – instead, the participants mostly believed in symbolic continuity after death (see section 2.2.1). This was mainly attained through social bonds (e.g. living on in memories) or through belief in science (e.g. living on in the circulation of nature through the decomposition of the body). As one respondent put it:

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33 It is interesting that certain beliefs that could be expected to be seen as ‘religious’ (e.g., belief in ‘fate’ or the ‘soul’) were less associated with belief in science than other beliefs that are traditionally religious or supernatural (e.g. items about ‘God’). It seems that for some reason, belief in fate or soul are perceived as less conflicting with science than belief in ‘God’, nature as ‘created’, or ‘life after death’.
After we die, our bodies return back \textit{palaan takaisin} to the circulation of nature. In this way, there will always be something left of us, even if there is no consciousness that could experience this [existence]. We are also tied to each other through other people. When a person dies and their conscious self flames out, they keep on living in the memories and thoughts of those who knew them (P1846).

A principal component analysis indicated that the supernatural afterlife beliefs and symbolic continuity beliefs constituted separate response patterns. That is, some individuals attained a sense of continuity through their secular beliefs, such as belief in science (continuity in nature) while others relied on afterlife belief, for instance, belief in an immortal soul. The result on continuity through science and supernatural afterlife as mainly separate sense-making strategies for death was further supported by an analysis on how death beliefs were associated with religious belief. Traditional afterlife beliefs were mainly endorsed by God-believers, whereas symbolic continuity (including continuity in natural laws) was mainly mentioned by non-theists. The data-driven analysis thus indicated that science-oriented individuals seemed to have somewhat separate religious and secular sense-making strategies in the domain of death (article IV).

However, supernatural death beliefs also ‘coexisted’ with belief in science, as some individuals applied both explanatory frameworks for the same phenomenon. In the principal component analysis of the response patterns, supernatural afterlife beliefs clustered together with belief in biological decay of the body after death (article IV). In other words, the same individuals applied belief in science and the supernatural in a target-dependent manner: supernatural belief explained mental processes while scientific explanations accounted for the physical ones. In addition to death beliefs, such a dualistic approach was also used to explain the origins of life, and humans in particular (article III). Some science-oriented Finns described human origins with target-dependent reasoning, attributing the origins of the body to evolution and exerting divine intervention to the origins of consciousness or the soul.

In some other beliefs, the relationship between supernatural and scientific mechanisms was not explicitly laid out or coordinated but rather remained unclear. For instance, several science-oriented Finns explained the (proposed) inequality of suffering by referring to scientific factors (such as genetics) and the supernatural mechanism of karma. However, these accounts generally did not
specify how the two causes interact and were thus conceptualised as *synthetic reasoning* (article III). 34

Although target-dependent and synthetic explanations invoked both belief in science and the supernatural, belief in science and the supernatural could still be perceived as somewhat separate, as they explained different parts of the phenomenon (in target-dependent reasoning) or their interaction was not specified (in synthetic reasoning). However, science-oriented participants also *integrated* supernatural belief with science by placing a scientific cause and supernatural explanation in a singular explanation (for the same target). Integrated explanations were used by a minority (14% overall, 10% with assured wordings) but by many of those participants who invoked supernatural explanations (36% overall, 28% with assured wordings). That is to say, integrated reasoning was a relatively common way to relate supernatural belief and belief in science among the science-oriented Finns who believed in supernatural phenomena.

Supernatural explanations were most frequently integrated with science in the domain of origins (8%). For example, some proposed that the beauty and the complexity of the universe indicate an ‘intelligent designer’ behind the Big Bang (P1723). In addition to belief in Big Bang as designed, some science-oriented Finns described an intrinsic agency in evolution or suspected that the evolution of species has taken place ‘under the guidance of a higher power’ (P252). As these examples demonstrate, integrated reasoning mainly posited supernatural agency or purpose as the ultimate cause (*why* something happened) and the scientific mechanism as the proximate cause (*how* something happened). One of the respondents described this kind of integration in the following manner:

> Religion and science discuss the same thing but answer different questions: science reports how a thing might have happened. For example, the Big Bang theory explains this [the origins of the universe] to a certain extent. But what preceded it? Why did it [Big Bang] happen and lead to the world we know? Religion, on the other hand, can answer the question: who put all of this in motion? Religion provides meaning or a frame for the bigger question: why are we here? (P526)

Compared to the domain of origins, science-oriented Finns less frequently integrated belief in the supernatural and science in explanations for suffering (4%) or death (3%). The rare occasions when participants applied integrated reasoning in their death beliefs differed from other coexistence explanations. In responses

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34 As an example, one participant explained why some people suffer more than others simply by referring to ‘[ch]ance. Genetics. Karma. The baggage of the previous generations and of prior lives’ (P2005).
on what happens after death, supernatural belief in the spirit or the soul was integrated with thermodynamics, and more specifically, the law of conservation of energy which posits that the quantity of energy in the universe is constant (articles III-IV). In these accounts, the scientific theory still provided the proximate causal mechanism that describes how things happen, but there seemed to be no ultimate cause – instead, supernatural belief and a scientific theory were integrated based on their perceived structural similarity (article III).

To summarise, few science-oriented Finns integrated their supernatural belief with science, as overall, a minority of science-oriented Finns gave supernatural explanations for origins, death and suffering in their own words. Integrated explanations were most frequently used to make sense of nature (origins of life)\(^{35}\) and less to explain suffering or death. In the domain of death, those who did appeal to the supernatural mainly relied on traditional afterlife beliefs (complemented with biological cessation in a target-dependent manner), whereas the non-religious majority turned to non-supernatural sense-making strategies.

\(^{35}\) On a similar note, although I did not intend to measure integrated reasoning in the Belief in Supernatural Agency and Purpose Measure, some of the most endorsed items could also be conceptualised as integrated reasoning, and more specifically, the kind that contains supernatural belief in agency/vitalism in nature (see sections 5.4.2 and 6.1.3).
6 Discussion

In the following sections, I will discuss the indications of the results in relation to previous work. Furthermore, the methodology of the dissertation will be evaluated and possible improvements and alternative approaches for future studies will be discussed. Finally, I present a conclusion on the significance of the dissertation to the study of religion and discuss some of the possible implications of the results for research on the public understanding of science.

6.1 The results in relation to previous research

6.1.1 Some science-oriented individuals also believe in supernatural phenomena – but hesitate to do so

The results supported the expectation that, to some extent, science-oriented worldviews also contain supernatural beliefs. Even in non-religious individuals who did not believe in God, some endorsed traditional supernatural beliefs that seem to be widespread around the world, such as belief in the soul, afterlife, and a higher power (article I; Gallup, 2017; Schaefer et al., 2022; Pew Research Center, 2018). Still, when it comes to belief in supernatural phenomena, science-oriented individuals seem to be ‘a tough crowd’. In my Finnish sample of pro-science individuals, participants were more likely to reject (traditional) supernatural beliefs than Finns overall (Church Research Institute, 2015) or the general populations of countries such as the United Kingdom or Denmark (Bullivant et al., 2019).36 Thus, the dissertation lends support for the previous view that in Western contexts, individuals who hold science in high regard are particularly sceptical of supernatural beliefs (e.g. Beit-Hallahmi, 2006; Stirrat & Cornwell, 2013).

Contrary to my expectation, the findings were inconclusive on whether science-oriented individuals are more likely to hold more secular or religious and other ‘traditional’ supernatural beliefs. In a structured measure, traditional supernatural beliefs were endorsed the least (e.g. beliefs that refer to ‘God’).

36 The sample comprised both religious believers and non-believers but mainly consisted of the latter (see section 4.2.2).
Instead, science-oriented Finns were most likely to agree with Gaia-like nature beliefs, including purpose in nature (‘Nature maintains a balance by self-regulating’), and belief in goal-directed evolution. The findings support prior results indicating that even science-oriented individuals are prone to agentic and purpose-driven explanations for natural phenomena, such as evolution (e.g. Brumby, 1984), especially if the explanation entails an intrinsic purpose that serves the ‘interest’ of the organism (see Kelemen & Rosset (2009, p. 141) about belief in the ‘Earth’s natural equilibrium’; Kelemen et al., 2013). The results align with the finding that many Finns find agentic nature belief appealing – in a recent survey, a majority of Finns agreed that COVID-19 is ‘nature’s own way’ to reduce overpopulation and care for the climate (Metelinen, 2020, p. 2). However, when science-oriented individuals answered my questions about fundamental concern in their own words, they were equally likely to explain phenomena with traditional supernatural explanations (such as God) and more secular supernatural notions (such as nature’s agency). Thus, it seems that although secular supernatural beliefs might be appealing to many and less contradictory with belief in science than religious belief, the supernatural vocabulary that science-oriented individuals actually use is not primarily secular. This raises the question of what endorsement of beliefs in structured scales actually means (cf. also Järnefelt, 2020). Endorsement of a belief on a scale might not indicate the relevance of the belief in question for one’s worldview or existential orientation (see section 2.2).

An interesting feature of the science-oriented Finns’ beliefs was that they often applied hesitant wordings (for instance, that the universe ‘could have been created’ (P1572)). There could be several reasons why pro-science Finns often endorsed supernatural belief in such uncertain terms. One factor likely contributing to the uncertainty of supernatural belief is the prevalence of the narrative of conflict between science and religion in Finland (Science Barometer, 2019; Tiaynen-Qadir et al., 2021, see section 4.1.2). Although ‘supernatural’ was operationalised as beliefs that blend ontological core knowledge (and thus also included secular beliefs), many of the views that the participants hesitated to endorse are commonly recognised as religious in the Finnish context, such as belief

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37 As mentioned, further analysis showed that those who endorsed religious belief were somewhat more likely to also hold secular supernatural beliefs, albeit with small effect size. The results support research showing that supernatural beliefs also extend to non-religious individuals (Järnefelt et al., 2018; Banerjee & Bloom, 2014). However, to some extent, they also bolster prior work indicating that individuals differ in their tendency towards supernatural belief (Lindeman et al., 2015; Orenstein, 2002; Svedholm, 2013).

38 For instance, Finns’ endorsement of COVID-19 as purposeful in the national survey, as intriguing as it is, might indicate the appeal of belief in self-serving purpose in nature, but it does not mean that the belief would bear importance for Finns’ answers to ‘the big questions’ – albeit the endorsement might indicate that the belief is not perceived in opposition to one’s worldview.
in an afterlife. It could be that the hesitation was due to the context of a research study on ‘worldviews that value science’. As religious beliefs are often perceived as unscientific in Finland (Koski, 2016), Finns might rely on traditional supernatural belief less in a study that emphasises ‘science’ compared to other contexts (cf. Astuti & Harris, 2008; Preston & Epley, 2009; Utriainen, 2020). Another possibility might be that these participants would not endorse supernatural causality in a more convinced manner in other contexts either. Instead, they might be somewhat drawn to religious beliefs for their cognitive or cultural accessibility (or for motivational reasons, such as the ‘wish’ to believe in an afterlife) but, as they are not fully convinced of the veracity of these beliefs, they might endorse supernatural belief as a kind of ‘imaginative play’ whereas natural explanations are seen as ‘factual beliefs’ (see Van Leeuwen, 2014; cf. also Tregenza, 2014). This would be understandable in the Finnish context, where scientific knowledge is culturally perceived as factual to the extent that religious individuals tend to self-report trusting science over their own religion (Wellcome, 2018; see section 4.1.2).

6.1.2 Non-supernatural beliefs are of primary importance for science-oriented individuals

Despite the presence of supernatural beliefs in science-oriented worldviews, the findings show that overall, non-supernatural beliefs were of primary importance for individuals who hold science in high regard. This was indicated by science-oriented Finns’ explanations for death, suffering, and the origins of life. Although these domains in particular might elicit supernatural reasoning (Legare et al., 2012), most science-oriented individuals made do with natural causes and relied on explanations devoid of anything supernatural. Interestingly, non-supernatural explanations could still resemble supernatural accounts. In the domain of death, non-supernatural beliefs did not only entail cessation – instead, science-oriented Finns also had beliefs about non-supernatural ‘life’ after death (P806), for instance, in memories or in the natural cycle (article IV). Although some have suggested that humans can attain a sense of immortality through continuity in nature or through their legacy (Lifton, 1973; Pyszczynski et al., 2015), there has been little research on whether people actually hold such beliefs. Most studies on

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39 Furthermore, there is evidence that people might be quite apt to recognise also non-traditional beliefs that blend core knowledge as similar to religious belief. See Pyysiäinen et al. (2003) on the perceived religiosity of minimally counterintuitive beliefs.

40 This might not be so due to religious credences and ‘factual beliefs’ as differing per se, as suggested by van Leuween (2014). Instead, it might be that some individuals approach supernatural beliefs as imaginative play at least in part due to the cultural status of beliefs that are recognised as ‘supernatural’, as they generally perceived as ‘credences’ instead of ‘factual beliefs’.
afterdeath beliefs have focused on supernatural belief, and non-supernatural beliefs about death have been expected to simply signify ‘annihilation’ (Burris & Bailey, 2009, p. 175). The findings thus provide nuance to current death studies by describing the versatility of death beliefs, including non-supernatural continuity (cf. also Manning, 2018). The results on belief in biological continuity in nature provide an interesting contrast to previous work in the cognitive science of religion. In studies on explanatory coexistence concerning death, a scientific (biological) conception of death has been coined with cessation beliefs, whereas continuity has been referred to as the supernatural or ‘religious conception’ of death (e.g. Astuti & Harris, 2008, p. 713; Harris & Giménez, 2005; Pnevmatikos & Georgiadou, 2019). The findings of this dissertation challenge this discourse by demonstrating that scientific knowledge can also be relevant for belief in continuity after death, even if this function has often been associated with religiosity.41

If exceeding mortality has often been coined with religion, the same goes for meaning in life and morality (Gould, 1999; Park & McNamara, 2006). The findings of this dissertation indicate that at least according to self-reports, belief in science is also relevant for these domains. Intriguingly, as some philosophical accounts have approached scientism as extending science to questions of meaning and morality (‘scientific expansionism’, see Stenmark, 2001, p. 60), the results on science-oriented theists also gaining a sense of purpose and moral guidance from science could be seen as an indication of scientism in both religious believers and non-believers.42 However, I would be cautious in drawing this conclusion. In much of the previous literature, scientism is used as a pejorative term that indicates excessive reliance on science (Schöttler, 2013, see e.g. Niiniluoto, 1984) and thus contains value-laden judgements on the limits of science. In this dissertation, it is more relevant to conceptualise the findings in terms of the cognitive science of religion and social psychology. In relation to these fields, the results demonstrate that belief in science can provide for certain worldview functions (see section 2.2.1). This dissertation thus supports previous (experimental) findings that for individuals who hold science in high regard, belief in science can provide a cultural worldview that functions similarly to religious belief (Farias et al., 2013; Makellams & Blascovich, 2013; Rutjens et al., 2013; Tracy et al., 2011; Yilmaz &

41 The findings thus indicate that the terminology at times used in the studies could be refined. This has also been suggested by Hodge (2016), who has noted that instead of mainly originating in scientific biological knowledge, people’s expectation on the cessation of bodily functions upon death more likely primarily reflect folk biology – and that it would thus be misleading to refer to these cessation beliefs as a ‘scientific’ conception of death.

42 However, it should be noted that few science-oriented individuals reported science as a source of their conceptions of what is ‘good and bad’. Rather, science was seen as a tool for morality (see article II).
Bahçekapili, 2015), lending support to the belief replacement hypothesis in the psychology of religion (Farias, 2013; see section 2.2.1). The findings of the dissertation however extend upon prior suggestions on belief in science as a non-religious worldview (Farias, 2013), as it was also endorsed by religious individuals and could serve worldview functions regardless of religious belief. This is also indicated by some other studies in the psychology of religion (Luna et al., 2021; Stavrova et al., 2016; Tracy et al., 2011; cf. also Yilmaz & Bahçekapili, 2015). To my knowledge, such findings have merely not been compiled together, and the importance of science for the worldviews of both theists and non-theists has thus so far received little attention in the research on current worldviews (however, see Ecklund et al., 2016). Still, although science-oriented individuals endorsed belief in science regardless of their religious belief, God-believers did differ from non-theistic individuals. Next, I will discuss my findings on whether belief in science entails less supernatural belief.

6.1.3 Belief in science entails less religious belief – but agentic nature belief might blend with science endorsement

The findings of the dissertation align with previous suggestions that religious belief and/or religiosity predicts lower science endorsement in Western contexts (e.g. Chan, 2018; McPhetres et al., 2021; McPhetres & Zuckerman, 2018). However, the results indicate that belief in science might not necessarily be associated with other kinds of supernatural accounts. In particular, beliefs about nature as agentic, vitalistic or purposeful might not contradict belief in science (see also Järnefelt et al., 2018; cf. Kelemen et al., 2013; but see Kelemen & Rosset, 2009). Overall, as I expected, the results show that the relationship between belief in science and supernatural belief is somewhat dependent on how ‘supernatural’ is measured.

The results also indicate that the extent to which belief in science entails less supernatural belief is related to how belief in science is operationalised. In line with my expectation, the relationship between belief in science and religious belief appeared as strongly negative when ‘belief in science’ was estimated with a scale that posited science and religion as competing alternatives (Belief in Science Scale; Farias et al., 2013). However, the relationship was fairly weak when I used a religion-neutral worldview measure (article II). The finding is notable, as the Belief in Science Scale is commonly used in the psychology of religion, and studies that have applied the scale have reported a negative relationship between belief in science and religiosity/religious belief (Farias & Newheiser, 2019) at least with moderate effect size (Farias et al., 2013; Irwin et al., 2015; Rutjens et al., 2018; Saide et al., 2021). Speculations on what might underlie the relationship have included the possibility of reduced critical thinking skills in religious believers (Irwin et al., 2015). The findings of this dissertation indicate that the formulation
of the items in the Belief in Science Scale might in itself decrease religious believers’ belief in science scores (operationalising belief in science as scientism that excludes religiosity).

Altogether, the above findings of the dissertation indicate that there might be little conflict between belief in science and supernatural belief per se, at least when it comes to purpose in natural phenomena (cf. also Järnefelt et al., 2018). Furthermore, some of the previous results on the negative relationship between belief in science and supernatural belief might be driven by i) the scale formulation of the Belief in Science Scale (as suggested), and ii) the cultural perception of conflict between science and religion.43

6.1.4 Belief in science and the supernatural are at times integrated – also in science-oriented ways

The findings of this dissertation support the view that belief in the supernatural and science are by no means exclusive, as suggested in the cognitive science of religion and developmental psychology (Legare et al., 2012; Legare & Shtulman, 2018; Shtulman & Lombrozo, 2016) and also noted by sociologists (Ecklund et al., 2016) and historians of science (Brooke, 2005; Cantor, 2012). All science-oriented Finns who believed in the supernatural also applied natural explanations for phenomena, and many of them integrated supernatural causality with science. The way science-oriented Finns integrated their supernatural beliefs with science mainly followed the age-old conception of supernatural faith as an answer to the ‘why’ questions and scientific knowledge to the ‘how’ questions (supernatural explanation as the ultimate cause and the natural explanation as the proximate mechanism, see Bering, 2011; Legare et al., 2012; cf. also Gould, 1999). However, the results also provided novel insight into how people integrate supernatural and scientific accounts – mainly, by indicating that science-oriented individuals also integrated supernatural belief with scientific theories based on their perceived similarity (the belief that soul ‘energy’ may survive death due to the law of conservation of energy). These accounts seem to follow folk theories of physical energy (energy as a property of an entity rather than a process, see Shtulman, 2017). As physical energy and ‘spiritual energy’ at times blend in everyday reasoning (Svedholm, 2013), some science-oriented Finns integrated their belief in the law of conservation of energy with soul belief (or parts of soul ‘energy’

43 Interestingly, if the results reflect the cultural discourse on ‘science and religion’ as conflicting, they could be used to estimate how ‘religious’ different supernatural beliefs are in the Finnish context. Certain beliefs that could be expected to be ‘religious’ were less associated to belief in science than other traditionally religious beliefs. For instance, belief in ‘fate’ and the ‘soul’ seem to blend better with belief in science than other religious beliefs, such as belief in God or an afterlife.
surviving death). Although sociologists of religion have noted that belief in similarities between scientific theories and supernatural views is not uncommon in alternative spirituality (Hammer & Lewis, 2010; Lewis, 2007), integration of supernatural and scientific accounts based on similarity heuristics has, to my knowledge, not previously been reported as a means of integration in work on explanatory coexistence in the cognitive science of religion.

6.2 Evaluation of the methodology

The aim of the following sections is to provide a critical evaluation of the methodology of the dissertation and to suggest improvements and alternative approaches for future studies. First, I will evaluate the method, including the participants, data collection, and measures. Then, I will discuss possible concerns over the theoretical framework of the dissertation. The latter section will focus on the concept of ‘supernatural’ and how the dissertation relates to recent advances in the cognitive science of religion.

6.2.1 Evaluating the method

Some notions should be made regarding the participants and methods of the dissertation. First, in study 1 we targeted non-religious non-theists to investigate worldview beliefs of individuals who are commonly perceived as lacking beliefs (article I). As the study resources were not sufficient for representative samples, the participants were mainly recruited through the social media of secular organisations, such as freethinkers’ associations, and relevant webpages, including Reddit threads on ‘atheism’ (see Appendices). Thus, the participants of study 1 were not representative of non-religious non-theists in the included countries but rather consisted of the more ‘active’ non-believers, a relatively common limitation in qualitative and mixed method studies on non-religious beliefs (see e.g. Pasquale, 2009; Smith, 2017; Smith & Halligan, 2021).

In study 2, the target group consisted of ‘science-oriented Finns’. I recruited participants through the mailing lists of Finnish universities and other research institutions, followed by social media recruitment through (other) organisations that promote research in Finland (articles II-IV). In the recruitment, I aimed to include an equal amount of mailing lists for different fields of research (see Appendices). Similar to study 1, I deemed the relevant organisations and social

44 Although collecting representative samples might not require a lot of resources, conducting a data-driven analysis on open-ended responses for larger, representative samples in all countries would have constituted a huge (albeit not impossible) research endeavour.
media groups suitable for collecting qualitative data that enabled the explorative approach of the study. However, future quantitative work on belief in science and the supernatural in Finland could also collect a representative sample (with sufficient funding) or analyse pre-existing representative survey data from Finland and other countries, such as the data from World Values Survey (Haerpfer et al., 2021) or Wellcome Global Monitor (Wellcome, 2018).

Altogether, the samples used in this dissertation are mainly ‘WEIRD’, that is, the participants have been recruited from social contexts that are western, educated, industrialised, rich, and democratic (Henrich et al., 2010). Such samples have previously been overrepresented in research on how humans reason about phenomena. Studies in fields such as psychology and cognitive science are notorious for often investigating Anglo-American university students in their quest to understand ‘the human mind’ (Henrich et al., 2010; Newson et al., 2020). In this dissertation, recruiting highly educated participants aligned with the research aims, as the goal was to investigate individuals who hold science in high regard. However, as the perceived relationship between ‘science and religion’ varies across countries (see section 4.1.1; McPhetres et al., 2021), it is of crucial value to conduct future studies on the relationship between belief in science (and other science attitudes) and supernatural beliefs outside the ‘WEIRD’ regions.

A final note on the data is that the data were collected in online surveys – a method that is not without its limitations (Järnefelt, 2020). For one, the responses may have been influenced by the participants’ expectations of the ‘right’ answers. The tendency to lean towards socially desirable responding might be reduced in anonymous online questionnaires (like the ones in this dissertation) compared to other data collection methods, such as research interviews (Taylor et al., 2016). In any case, future studies on ‘belief in science’ could also utilise more practical measures and research designs, to better reach the enacted worldviews of science-oriented individuals instead of ‘mere’ articulated beliefs (Taves et al., 2018).

Regarding the measures of the dissertation, there is the possible concern that science-oriented Finns tended to endorse purpose in nature due to it being metaphorical. While formulating the structured measure on belief in agency and purpose, I took this into account by pairing some of the supernatural belief items on purpose in nature with control items that did not contain supernatural purpose but used otherwise identical wordings (see section 4.3.2). Furthermore, in the coding template of article III, we included a separate category for supernatural wordings that were only deemed metaphorical, to avoid the ‘temptation’ of coding

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45 Albeit in the Finnish context it is likely that many individuals who are less educated also hold science in high regard and, for instance, follow pro-research organisations (Science Barometer, 2022, see section 4.1.2). Thus, recruitment through the research organisations’ mailing lists was complemented with the social media recruitment.
such content into the supernatural belief categories (for the coding instructions, see Appendices). Still, someone might ask: do items and expressions such as ‘nature maintains a balance by self-regulating’ really capture belief in purpose in nature, instead of a mere linguistic convention for discussing complicated systems? Here, it should be noted that agreement with items on such need-based purpose in nature has predicted a tendency to construe natural phenomena as intentionally designed (Järnefelt, 2013; Järnefelt et al., 2015, 2018). Furthermore, studies have reported that individuals endorsing intrinsic (self-serving) purpose in nature are more likely to hold beliefs about nature’s Gaia-like agency (Kelemen et al., 2013) also in the Finnish context (Järnefelt et al., 2015). These findings indicate that endorsement of self-serving purpose in nature is not merely reducible to linguistic pragmatics but generally founded in causal assumptions on nature as agentic (Kelemen et al., 2013). However, neither this foundation nor the listed practical solutions can exclude the possibility that some of the participants who have endorsed the belief items might have interpreted them as metaphors (or that we might have misinterpreted some of the participants’ own expressions in the coding, see also Heywood, 2010). Thus, future research could take further measures to ensure that supernatural beliefs are endorsed literally. Some previous studies have aimed to tackle this issue by asking whether the item qualifies as a ‘true’ or a literally true explanation for a phenomenon (Kelemen et al., 2013, p. 1076; Lindeman et al., 2016). In the future, research that applies the nature items suggested in the Belief in Supernatural Agency and Purpose Measure could utilise a similar procedure at least for some of the items as an additional control to further reduce the possibility of metaphorical interpretation.

6.2.2 Evaluation of the theoretical framework

The concept of the supernatural

One obvious drawback of using the term ‘supernatural’ is that the current definition (blending ontological core knowledge) does not correspond to the semantics of the word, something as supernatural. It could be argued that the term is better understood through its traditional meaning, whereby ‘supernatural’ is defined as something outside the scope of ‘natural’ phenomena and scientific inquiry (see section 2.2.2). In the current definition, too, ‘supernatural’ does violate something ‘natural’ – the somewhat panhuman expectations about phenomena and their attributes based on their perceived ontological category (e.g. a physical entity, such as a stone, or a psychological being, such as a human), which could be referred to as ‘maturationally natural’ (McCauley, 2011, p. 5). However, the main difference between the traditional meaning and the current use of the
term ‘supernatural’ is clear: the former approaches ‘supernatural’ primarily as *unscientific*, whereas the current approach focuses on whether a belief aligns with cross-culturally common *folk theories* about the attributes of entities and processes. As these folk theories at times align with scientific knowledge but often do not (Shtulman, 2017), whether something is ‘scientific’ should be irrelevant to the definition at hand. In other words, defining ‘supernatural’ as blending core knowledge detaches the concept from its traditional meaning to the extent that it might be asked: why use the term ‘supernatural’? This question becomes even more pressing as we take into account that in many cultural contexts examined in the thesis, including Finland, belief in ‘supernatural’ is often scolded upon, especially in social settings where ‘scientific rationality’ is valued (Tiaynen-Qadir et al., 2021, p. 1; Koski, 2016).

Thus, it should be noted that there are good reasons for using other relevant concepts. As mentioned in section 2.2.2, some potential alternatives include beliefs as ‘paranormal’ (Clobert & Saroglou, 2015; Irwin et al., 2016; Willard & Cingl, 2017), ‘magical’ (Lindeman et al., 2000; Pohjanheimo, 2018), ‘counterintuitive’ (Nordin & Bjälkebring, 2021; Pyyräinen et al., 2003), ‘PSMS beliefs’ (Herbert & Bullock, 2020; Svedholm, 2013), or simply referring to ‘core knowledge confusions’ (cf. Lindeman & Svedholm, 2012). However, most of these terms have some shortcomings. Similar to the concept of supernatural, ‘paranormal’ refers to something beyond the sphere of ‘normal’. Discussing beliefs as PSMS (paranormal, supernatural, magical, or superstitious) emphasises the structural similarity of the beliefs that have commonly been coined with these terms, but I would question whether it is meaningful to reproduce the concept ‘superstitious’ as it carries a strong pejorative undertone. Similarly, referring to ‘core knowledge confusions’ can carry a pejorative connotation. However, the ‘supernatural’ beliefs examined in this thesis could have been simply discussed as ones that blend or mix core knowledge on ontological properties of entities and processes.46 The main reason I opted for ‘supernatural’ beliefs at the time of authoring the papers was, in the end, that the term ‘supernatural’ clearly tied the research to much of similar work in the cognitive science of religion (e.g. Legare et al., 2012; Järnefelt et al., 2018). However, in hindsight I would suggest that it might be more precise to refer to 1) ‘traditional supernatural beliefs and beliefs similar in structure’ or to 2) ‘PSM beliefs’ (paranormal, supernatural, and magical

46 Some might suggest that ‘supernatural’ could be replaced with the term ‘uncanny’ (in Finnish *kumma*; see Koski & Honkasalo, 2015, p. 1). However, ‘uncanny’ has mainly referred to something that feels extraordinary, either in terms of one’s own or societal expectations of everyday life (Honkasalo, 2016). As many of the views that blend core knowledge come easily to humans and do not seem surprising or out of the ordinary (e.g. snowflake as designed), only some of the beliefs that mix core knowledge seem to be ‘uncanny’ in the current academic meaning of the term (see also the next section ‘Defining supernatural as blending core knowledge’).
beliefs), to slightly modify the option of PSMS beliefs (cf. Herbert & Bullock, 2020). Concerning the first alternative, however, it should be said that after working on this dissertation, I am personally not convinced that the beliefs commonly listed as ones that ‘violate’ ontological core knowledge actually adhere to this criterion, that is, beliefs discussed as supernatural in this dissertation might not be as similar in structure as has previously been proposed.

**Defining supernatural as blending core knowledge**

Defining the supernatural as blending ontological core knowledge has been proposed to improve upon the ‘conceptual vagueness’ of PSMS beliefs and their definitions (Svedholm, 2013, p. 18). For instance, Lindeman and Svedholm (2012) have argued that their definition of supernatural beliefs as violations of ontological core knowledge improves upon work in the cognitive science of religion on supernatural beliefs as counterintuitive. According to Lindeman and Svedholm (2012), approaching supernatural beliefs as counterintuitive would be problematic, as PSMS beliefs often align with early-developing intuitive expectations about the world (see also Svedholm, 2013). As one example, Svedholm (2013) refers to the vitalistic view of an inherent life force that enables the vital functions of biological entities. On the other hand, Svedholm (2013) also presents vitalism as a PSMS belief, indicating that it violates ontological core knowledge (see also Lindeman & Svedholm, 2012, p. 249). In article III, I therefore present the following question: What, in the end, constitutes ontological core knowledge? Why would, for instance, a vitalistic view of an inherent life force violate the expectations that ‘children learn without explicit instruction’ about biological entities, if vitalism in itself constitutes such an early-developing tendency (Lindeman & Svedholm, 2012, p. 245; Shtulman, 2017)? In their work, Lindeman and Svedholm (2012) have also categorised belief in non-human design and purpose as ‘core knowledge confusions’, a conceptualisation that was followed in this dissertation. In article III, I note that it remains unclear whether beliefs in design and purpose in nature actually blend ontological core knowledge, as research indicates intuitive (and likely early-developing) tendencies to construe natural phenomena as need-based and designed (Järnefelt et al., 2018; Kelemen et al., 2013; Schachner et al., 2017). These observations might mean that there currently are two kinds of beliefs in the scope of ‘supernatural’ or PSMS beliefs: ones that align with core knowledge and others that differ from it (cf. Herbert & Bullock, 2020; Lindeman et al., 2019; Lindeman & Svedholm, 2012; Svedholm, 2013). This could entail that these ‘supernatural beliefs’ also differ in their other properties. For instance, the ideas that violate core knowledge might be more attention-grabbing (a person walking through walls) than the ones that align with
core knowledge (design in the symmetry of a snowflake; see Järnefelt, 2013). Therefore, it can be said that although conceptualising ‘supernatural’ as blending core knowledge improves upon prior definitions that have approached supernatural in relation to science (see section 2.2.2), the definition does not manage to eschew conceptual issues.

Another matter concerning the applied theoretical framework is that previous work tends to underline how PSMS beliefs contradict scientific knowledge or, in the least, are scientifically ‘unfounded’ (Svedholm, 2013, p. 45, see also Lindeman & Aarnio, 2007; Lindeman & Svedholm, 2012). In this dissertation, I have argued that defining supernatural beliefs as violations of core knowledge detaches the definition from whether a phenomenon is ‘scientific’ or ‘scientifically founded’ (see also Lindeman & Svedholm, 2012). In fact, the content of many scientific theories does not align with the early-developing expectations that humans have concerning natural kinds and their properties (see article III). Thus, some have stated that scientific theories can even be unnatural or ‘counterintuitive’ for humans (see McCauley, 2011, p. 7; Blancke et al., 2012; Gregory, 2009). Building upon the notions above, I would conclude that defining and discussing supernatural, and PSMS beliefs in general, as blending core knowledge concerning ontological categories (‘core knowledge confusions’) requires further clarifications to be conceptually consistent and truly based on how people reason about phenomena (see article III).

The dissertation in relation to the current approaches in the cognitive science of religion

In section 2.1, I described that the current mainstream in the cognitive science of religion does not place as much importance on the structure and intuitiveness of supernatural beliefs as the early pioneers of the field. Instead, much of recent work emphasises social learning in explaining differences in religious belief (Gervais et al., 2021; Gervais & Najle, 2015; Lanman, 2012; Lanman & Buhrmester, 2017; Mauritsen & van Mulukom, 2023; Willard & Cingl, 2017). Thus, it should be noted that the current dissertation could be more ‘current’ in relation to recent work in the cognitive science of religion. Although my proposition that social surroundings influence the content of supernatural beliefs does take social learning into account, it still assumes the significance of underlying cognitive tendencies towards supernatural belief in particular. In addition, I have assumed the continued

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47 As the same criticism can be applied to earlier work in the cognitive science of religion on counterintuitive beliefs (Purzycki & Willard, 2016), differing structures of beliefs might underlie why certain ‘counterintuitive’ beliefs are more attention-grabbing or memorable than others.
relevance of supernatural belief in answering ‘fundamental questions’ in a more secular context.

In light of prior findings and the results of this dissertation, it might be warranted to explicitly differentiate between 1) the tendency to formulate and to favour explanations with a certain structure (i.e. ‘intuitiveness’ of beliefs), and 2) the existential relevance of such beliefs (i.e. their worldview functions). It might well be that even though many people in secular contexts are also inclined to, for instance, endorse purpose in nature and life events (Banerjee & Bloom, 2014; Järnefelt et al., 2018), the worldview functions of beliefs are less determined by the belief structure and more influenced by whether beliefs are culturally shared with others and in accordance with one’s identity (cf. Stavrova et al., 2016). This would explain why science-oriented individuals mainly seem to make do with natural (non-supernatural) answers to fundamental questions, and even are able to associate beliefs with worldview components that do not exactly seem connected to the belief content in a straightforward manner (e.g. perceiving continuation in the decomposition of the body, or non-scientists deriving a sense of meaning from science). In other words, the expectations of this dissertation (derived from the explanatory coexistence account) might have been somewhat overstated if not concerning the cross-cultural presence of supernatural beliefs but at least regarding their relevance for making sense of death, for instance.

However, the findings of this dissertation can be applied to further refine recent work on the role of cognitive biases and cultural learning in supernatural belief. This suggestion is related to two features of the recent research. First, the studies have operationalised supernatural belief as religious and other ‘traditional’ PSMS beliefs. Second, cultural learning has mainly been operationalised as religious upbringing or religious actions by one’s primary caregivers (Gervais et al., 2021; Gervais & Najle, 2015; Lanman & Buhrmester, 2017; Willard & Cingl, 2017; but cf. Willard & Norenzayan, 2013). However, the findings of this dissertation lend support for the suggestion that supernatural beliefs are also influenced by cultural factors at the macro level: how supernatural beliefs are perceived in the cultural context, for instance, in relation to science.

48 This is not a novel suggestion, as scholars in the terror management theory have long claimed that although concern over mortality might be best alleviated by belief in literal immortality (such as afterlife belief), culturally shared beliefs that are important for the individual yet have no self-evident connection to reducing the threat of mortality also buffer death concern (i.e. reduce death-thought accessibility) similar to literal immortality beliefs (Darrell & Pyszczynski, 2016; Dechesne et al., 2003).

49 To my knowledge, one study in this body of work has previously considered the influence of the macro level on cultural learning (by taking into account regional differences in proportions of church-goers, see Willard & Norenzayan, 2013). In addition, I am aware of one study that has taken regional factors into account in investigating the possible role of existential insecurity in
6.3 Future directions

Drawing upon the previous sections, I suggest some directions for future research on supernatural beliefs and their relationship with belief in science.

6.3.1 The concepts of belief in science and supernatural belief

Based on the findings of the dissertation, I suggest that future studies investigating the relationship (or the similarities) between belief in science and religious belief should apply measures that do not posit religion and science as competing alternatives, as items that imply conflict likely influence the responses of religious believers (see section 6.1.3). One option for a religion-neutral measure of belief in science is the Science-Oriented Worldview Measure developed in this dissertation (article II), but one could also utilise other recent religion-neutral measures (see e.g. Luna et al., 2021; McPhetres et al., 2021).

Furthermore, I have argued that the definition of supernatural beliefs as ones that blend ontological core knowledge (‘core knowledge confusions’) might require further conceptual refinement, as it is unclear whether the concept also comprises beliefs that do not violate core knowledge (article III). Future work could systematically review research on ontological core knowledge to further investigate to what extent it is meaningful to categorise beliefs about vitalism and non-human purpose and design as violations of core knowledge. Instead of investigating the larger spectrum of ‘PSMS beliefs’, future studies might also focus on certain kinds of beliefs, for instance, religious belief (such as belief in God) and belief in other non-human agency and purpose (such as agentic nature belief).

6.3.2 Further research on ‘supernatural’ beliefs and the influence of cultural learning

The findings of the dissertation indicate that the endorsement of supernatural belief is likely influenced by the cultural discourse about the belief in question (for instance, its perceived relationship with science) and whether the belief aligns with one’s social identity (cf. also Stavrova et al., 2016). In addition, as also the more secular supernatural beliefs were more likely endorsed by God-believers, some individuals may be more inclined towards supernatural belief than others, as suggested in prior work on the importance of individual cognitive factors, such as explaining (traditional) supernatural belief, in addition to investigating the role of cultural learning (see Willard & Cingl, 2017).
thinking style (Lindeman et al., 2016; Svedholm, 2013). As mentioned, previous work in the cognitive science of religion on factors underlying supernatural belief has mainly 1) not taken into account the influence of the cultural macro level, including the perceived relationship between belief in science and religion, and 2) operationalised supernatural belief as ‘traditional’ religious and PSMS beliefs, that is, beliefs that individuals can identify as ‘supernatural’, activating cultural expectations that individuals might have about these beliefs. Thus, I suggest that future studies could i) be conducted in countries that vary in their cultural discourses about the relationship between science and religion, ii) include a measure of the perceived relationship between science and religion, and iii) measure supernatural belief as religious belief and other belief in non-human agency and purpose.

In practice, research designs could include participants from the ‘WEIRD’ countries (Henrich et al., 2010) but also other regions, especially the ones that differ from the Western expectations of science and religion as conflicting. The latter includes regions where a majority of scientists believe in God, such as Türkiye, and where scientists are more likely to identify as religious than the general population, such as Hong Kong (Ecklund et al., 2016). In addition to religious beliefs, belief in non-human agency and purpose could be measured with belief in agency and purpose in nature. Belief in agentic and purposeful nature resembles religious belief in content, yet it is also endorsed in secular contexts (Järnefelt et al., 2018) and, at least according to my findings, it is less likely to collide with belief in science than religious belief (see section 6.1.3). However, attention should be paid to ensure the items on nature beliefs are not metaphoric (see section 6.2.1).

In addition to the suggested factors, future work could also include variables previously taken into consideration in explaining supernatural belief, such as individual cognitive style and religious upbringing (Gervais et al., 2021; Lanman & Buhrmester, 2017; Willard & Cingl, 2017). This would enable an even more refined investigation of the factors underlying supernatural belief, as it would help untangle the potential appeal of agentic and purposeful content in relation to cultural expectations concerning religious belief and, to some extent, take into account the macro-level influence of cultural learning.

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50 It could be argued, though, that nature beliefs often contain an intrinsic (self-serving) purpose and religious beliefs an external purpose, which should be taken into account in the research design. Common ‘supernatural’ nature beliefs likely also comprise vitalistic nature belief (see Results; Svedholm, 2013). However, for comparisons with religious belief, it might be conceptually clearer to only include beliefs about agency and purpose, as religious agency (of God) likely does not appeal to vitalism.
6.3.3 The primary importance of non-supernatural beliefs

Finally, as the findings of the dissertation indicate that secular non-supernatural beliefs were of primary importance for science-oriented individuals in existential questions about death, suffering, and the origins of life, future studies could aim to uncover whether these secular beliefs serve the same psychological functions as religious belief (Farias, 2013; see section 2.2.1). For instance, although work in the terror management theory indicates that people might gain symbolic immortality through their (non-supernatural) belief in nature and continuity in memories (Pyszczynski et al., 2015), to my knowledge, we do not yet know what these beliefs mean to people and whether they actually alleviate concern over mortality (however, cf. Wojtkowiak & Rutjens, 2011). Future studies could investigate whether these beliefs indeed provide for an existential function and, to examine the belief replacement hypothesis, look into whether this function is dependent on God belief (Farias, 2013; see section 2.2.1). Although the results of this dissertation indicate that secular beliefs may serve similar functions for both theists and non-theists, they also suggest that some beliefs may bring solace mainly for non-theists (belief in non-supernatural continuity after death) while others are likely functional regardless of supernatural belief (belief in science more generally in social contexts that are pro-science). As the current dissertation did not focus on the psychological functions of beliefs, the suggestion remains to be investigated in future studies.


7 Conclusion

Some psychologists of religion have suggested that allegiance to science is in conflict with supernatural explanations, indicating that people are likely to rely on either science or supernatural belief (Farias, 2013; Farias et al., 2013; Preston & Epley, 2009; Randall & Desrosiers, 1980). On the other hand, research in the cognitive science of religion has indicated that humans may be cognitively inclined to certain supernatural beliefs, such as belief in nature and biological life as purposeful (Järnefelt et al., 2018; Kelemen et al., 2013), purpose in emotionally-laden life events (Banerjee & Bloom, 2014; Heywood & Bering, 2014), and belief in the continued existence of mental states after death (Bering, 2006; Hodge, 2018). Accordingly, people in various cultures have been reported to hold supernatural beliefs about the origins of life, suffering, and death. However, there has been empirical meagerness on the possible diversity of supernatural beliefs of individuals who hold science in high regard, as previous research has focused on religious and other ‘traditional’ supernatural beliefs of science-oriented individuals (e.g. Ecklund et al., 2016; Mansour, 2011; Walker, 2000), or investigated teleologic nature beliefs in particular (Kelemen et al., 2013; Kelemen & Rosset, 2009). Similarly, research on how the supernatural beliefs of science-oriented individuals are related to their belief in science has been scarce – it has been unclear whether belief in science entails less supernatural belief in a pro-science context and whether science-oriented supernatural believers rely on science, the supernatural, or both in their answers to questions of fundamental concern (cf. Farias, 2013; Farias et al., 2013; Preston et al., 2013).

This dissertation demonstrated that even in samples of individuals who hold science in high regard, some individuals endorse supernatural beliefs and use them in tandem with scientific knowledge to make sense of phenomena, such as death and the origins of life. Science-oriented individuals most frequently endorsed supernatural beliefs about nature and integrated belief in science with supernatural beliefs about the origins of natural phenomena. The results support prior findings suggesting that the worldviews of science-oriented individuals also include certain kinds of supernatural beliefs, albeit to a limited extent (Ecklund et al., 2016; Kelemen et al., 2013; Kelemen & Rosset, 2009). Furthermore, science-oriented individuals hold differing interpretations of scientific theories. Examples reported in this dissertation include the suggestion that the law of conservation of energy points towards ‘the soul’ or one’s spiritual energy surviving death (cf. also Turpin, 2022). Overall, the results indicate that individuals who hold science in
high regard do not necessarily maintain a ‘scientific worldview’ – a concept often associated with a view of the world that fully aligns with science and is devoid of supernatural belief (e.g. Vidal, 2008; Koski, 2016). From the perspective of study of religion, I have suggested that instead of ‘a scientific worldview’, it is more precise to refer to ‘science-oriented worldviews’, as this term better aligns with prior research (see section 1) and my findings on the diverse worldview beliefs of Finns recruited through organisations that promote science and research.

The dissertation applied theoretical frameworks in the cognitive science of religion, psychology of religion, and social psychology. In light of the cognitive science of religion, I expected that science-oriented individuals’ beliefs might be influenced by cognitive biases towards certain belief content (such as phenomena as purposeful) and context biases (e.g. conforming to one’s social surroundings and learning from cultural authorities). Based on these expectations, I suggested that studies on explanatory coexistence model could apply a definition of supernatural that extends beyond the religious and other ‘traditional’ supernatural beliefs also to uncover the coexistence of more secular supernatural beliefs with natural explanations, including scientific knowledge. In the dissertation, I approached ‘supernatural’ as any belief that blends ontological core knowledge – a definition formulated by cognitive psychologists (Lindeman & Svedholm, 2012) and rooted in prior work on ‘counterintuitive beliefs’ in the cognitive science of religion (Boyer, 1996; Pyysiäinen, 2002). Extending the concept of ‘supernatural’ to all views conceptualised as blending core knowledge yielded new insight into how some of these relate to belief in science. Although studies had reported secular supernatural beliefs (e.g. suffering as a mechanism of balance) in religious and non-religious individuals (Banerjee & Bloom, 2014; Bullivant et al., 2019), their relationship with science attitudes had not been investigated (however, cf. Lindeman et al., 2019). The findings of this dissertation show that the relationship between belief in science and secular supernatural belief was weak (and in some cases non-existent). The results demonstrate that the ‘conflict’ between supernatural belief and science endorsement might at least partly be driven by cultural perceptions of science and religion as contradictory, as suggested by prior results on inconsistent patterns in the relationship between science attitudes and religious belief in different cultures (Ecklund et al., 2016; McPhetres et al., 2021).

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51 In the Finnish context, a ‘scientific worldview’ is at times conceptualised in a way that does not exclude religious belief (see Finnish National Church Council, 2019; Enqvist, 2014; Niiniluoto, 1984). My findings align with this conceptualisation in the sense that some science-oriented Finns held supernatural (including religious) beliefs. However, even the Finnish equivalent for the term ‘scientific worldview’ entails that one’s ‘world picture’ is scientific, in the sense that it aligns with science (see section 4.1.2; Niiniluoto, 1984). Therefore, previous research and my findings on science-oriented Finns’ versatile interpretations of science also question the meaningfulness of the Finnish term for ‘scientific worldview’.
In addition to proposing modifications to a theory in the cognitive science of religion, my results indicated a need to revise a measure that has contributed to the formulation of the belief replacement hypothesis in the psychology of religion (Farias, 2013). The suggestion that for ‘atheists’, secular worldviews can be functional like ‘supernatural beliefs are for religious people’ has also been based on the scores of religious individuals in the Belief in Science Scale (Farias, 2013, p. 4; Farias et al., 2013). The findings of this dissertation showed that the lower scores of religious believers might (at least in part) be due to the Belief in Science Scale (Farias et al., 2013) operationalising belief in science as a worldview that competes with religion, demonstrating the importance of religion-neutral measures of attitudes towards science. The findings of this dissertation on the worldview functions of science supported prior suggestions that secular beliefs, such as belief in science, may provide for similar functions as religion (the belief replacement hypothesis and the terror management theory, see Darrell & Pyszczynski, 2016; Farias, 2013; Greenberg et al., 1986). However, based on my findings and previous work, I furthermore suggested that the worldview functions of secular beliefs do not necessarily depend on whether one believes in God (contra Farias, 2013) – instead, the interaction between supernatural belief and secular belief systems seems more nuanced.

The fact that people also hold secular supernatural beliefs has implications for the current research in the cognitive science of religion on the underlying factors of supernatural belief, as this body of work has mainly investigated religious belief. Similar to religious belief, secular supernatural beliefs matter and have practical consequences. As one example, in prior work describing nature as a Gaia-like agent reduced people’s willingness to support natural disaster victims (Sacchi et al., 2013). Although this effect might seem (and be) unfortunate, it indicates that discussing nature as human-like may increase our ability to ‘side with nature’, as nature is perceived as a ‘victim’ in a moral conflict (Gray et al., 2012). It is unclear whether agentic and vitalistic descriptions of nature could then be effective strategies in communicating, for instance, the urgency of actions against climate change (cf. Shtulman, 2017). However, even if this were so, it is another matter entirely whether it would be ethical to capitalise on the tendency towards certain kinds of beliefs to influence public attitudes towards science. Currently, this is done in much of the popular literature on evolution, as it is easier for people to grasp functional accounts of evolution that entail nature’s ‘design’. Scientists have expressed concern that the linguistic expressions entailing agency

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Shtulman (2017, p. 139) has argued that this might not be the case as humans are prone to see nature as ‘eternal’. However, framing nature as vitalistic in particular might help to communicate the importance of these ‘vitalities’ for the overall functioning of the ecosystem (cf. Shtulman 2017, chapter 9).
and purpose in nature facilitate common literal misunderstandings about evolution (Blanke et al., 2012; Gregory, 2009). It can be asked whether it is ever ethical to enhance misunderstandings about science, even in the name of science.

At the beginning of this summary chapter, I stated that a majority of the world’s population believes in (traditional) supernatural phenomena, such as God and the soul (Gallup, 2017; Haerpfer et al., 2021; Pew Research Center, 2018). Based on previous research and the findings of this dissertation, it seems likely that many also endorse more secular beliefs in non-human agency or purpose, such as natural events as ‘meant to be’ or an underlying balance of good and evil (Bullivant et al., 2019; Järnfelt et al., 2018; Heywood & Bering, 2014). The current dissertation demonstrated that more secular supernatural beliefs, such as agentic nature beliefs, are not necessarily viewed in opposition to science (even when there is a perceived conflict between science and religious belief). Thus, secular supernatural beliefs might be expected to endure in a world where science has become a ‘world culture’ (Qadir & Syväterä, 2021, p. 272) even despite the global decline of religious belief (Inglehart, 2021). In his recent book on religion’s diminution in different regions of the world, Inglehart asks, ‘what comes next’ if religion continues to wane (2021, p. 163). Considering the sustained confidence in science across most cultures (Wellcome, 2018), I would suspect that similar to the non-religious worldviews described in this thesis, future worldviews around the globe will largely rely on science. By investigating science-oriented worldviews, this dissertation has thus provided a glimpse of (some) supernatural and non-supernatural beliefs that may well become more prominent in the coming decades, and how these beliefs can be used to tackle the existential questions that also future humans will face.
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What do non-religious non-believers believe in? Secular worldviews around the world

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WE URGE ANY PARTIES INTERESTED IN THIS WORK TO CONTACT THE LEAD AUTHOR (LISTED ABOVE) FOR FURTHER DETAILS OR UPDATES. WE REQUEST THAT THESE FINDINGS ARE REPORTED AS TENTATIVE, AND THEIR STATUS AS A PRE-PRINT.
Abstract

The global increase in non-religious individuals begs for a better understanding of what non-religious beliefs and worldviews actually entail. Rather than assuming an absence of belief or imposing a predetermined set of beliefs, this research uses an open-ended approach to investigate which secular beliefs and worldviews non-religious non-theistic individuals in 10 countries around the world might endorse. Approximately one thousand participants were recruited (N = 996; approximately one hundred participants per country) and completed the online survey. A data-driven coding scheme of the open-ended question about the participants’ beliefs and worldviews was created and includes 51 categories in 11 supercategories (agency & control, collaboration & peace, equality & kindness, morality, natural laws & the here and now, non-religiosity, reflection & acceptance, science & critical thinking, spirituality, truth, and other). The 10 most frequently mentioned categories were science, humanism, critical scepticism, natural laws, equality, kindness & caring, care for the earth, left-wing political causes, atheism, and individualism & freedom. Patterns of beliefs were explored, demonstrating three worldview belief sets: scientific worldviews, humanist worldviews, and caring nature-focused worldviews. This project is a timely data-driven exploration of the content and range of global secular worldviews around the world, and matches previous theoretical work. Future research may utilise these data and findings to construct more comprehensive surveys to be completed in additional countries.

Keywords
secular beliefs; worldviews; non-religion; atheism; cross-cultural
1. Introduction

Both the global increase in individuals who lack religious faith or do not hold religious beliefs (Inglehart, 2021), as well as the concurrent increase in secular organisations and even secular rituals such as humanist weddings and funerals (Engelke, 2014) beg for a better understanding of what ‘unbelief’ or secular belief entails. Unbelief has been defined as ‘a general absence of belief in religious tenets’ and ‘the state of lacking (especially religious) faith or belief’ (Lee & Bullivant, 2016). Thus unbelief connotes a negative phenomenon, as lacking in religious beliefs, as scoring zero on a continuous religiosity scale (Beit-Hallahmi, 2007). However, while non-believers may not hold religious beliefs, they will still hold distinct ontological, epistemological and ethical beliefs about reality (Coleman et al., forthcoming; Farias, 2013; Lee, 2015). To date, there have been numerous sociological and historical attempts to investigate these beliefs (Brown, 2017; Hout & Fischer, 2014; Inglehart & Welzel, 2005; Taylor, 2007; Turner, 1985) and worldviews in general (Droogers, 2014; Johnson et al., 2011; Koltko-Rivera, 2004; Taves et al., 2018), but few quantitative studies. The aim of this study was to empirically investigate the range of secular beliefs and worldviews held by people, as well the variation in these beliefs and worldviews across countries. This exploratory study examines the beliefs and worldviews of approximately 1,000 secular individuals in a set of ten different countries around the world.

The study focused in particular on the worldviews of secular individuals, which was taken to signify the set of beliefs that describe or allow one to understand reality and one’s existence within it: “Not all beliefs are worldview beliefs. Beliefs regarding the underlying nature of reality, “proper” social relations or guidelines for living, or the existence or nonexistence of important entities are worldview beliefs. Other beliefs are not.” (Koltko-Rivera, 2004, p. 5). Worldviews in this sense can be compared to schemas, which are cognitive structures that provide a template for concrete everyday objects and actions, generalised from direct, face-to-face experience (Johnson et al., 2011). Worldviews, by contrast, are cognitive structures for abstract concepts and hypothetical objects, transmitted culturally (Koltko-Rivera, 2004). Importantly, while one can empirically assess the veracity of schemas, it is less clear how one would disconfirm constituent postulates of a worldview, such as those regarding the nature of human relationships, or the ultimate source of moral guidelines. This means that the disconfirmation of schemas entails simple practical adjustment, whereas the disconfirmation of one’s worldview is typically associated with graver psychological consequences (Heine et al., 2006; Jonas et al., 2014): in such personal crises or transformations, one’s very sense of reality has been shaken.

Given our definition of worldviews as sets of beliefs about the nature of reality and one’s existence within it, it becomes clear that religious belief is not a prerequisite for worldviews, and that worldviews are important for religious believers and non-believers alike (Mauritsen & van Mulukom, forthcoming). Given that non-religiosity is not institutionalised in the same way as the major religions
are however, it is not clear what the range of beliefs and worldviews of non-religious non-believers or non-theists might be, and whether the beliefs are clustered in sets as they might be in certain faith denominations. Theoretically, such clusters have been suggested: In his seminal review paper on worldviews, Koltko-Rivera presents seven groups of worldviews: human nature, will, cognition, behaviour, interpersonal, truth, world and life (Koltko-Rivera, 2004). Similarly, distinct philosophical categories (e.g., axiology, teleology, epistemology, ontology, cosmology, and praxeology) have later been suggested by others (Johnson et al., 2011; Taves et al., 2018). There is, however, little empirical research investigating these theoretical proposals.

The present research therefore had three main aims: (1) to examine the content and range of secular (i.e., non-religious non-theistic) beliefs and worldviews; (2) to investigate whether secular beliefs cluster together in ways similar to theoretical proposals; and (3) to explore how these different types of beliefs might vary across countries. To this end, an open-ended survey was designed to ask nearly 1,000 secular individuals from ten countries across the globe what their most important worldview, belief, or understanding of the world was. Koltko-Rivera (2004) argues that the complexity of worldviews needs to be embraced, and that future analyses might point out clusters of beliefs within worldviews, and that they should not be imposed theoretically. In line with this argumentation, in order to not put words into the mouths of the participants, and to ensure as broad a range as possible for the secular beliefs and worldviews from our selected countries, an open-ended question format was selected, as well data-informed or ‘on-the-fly’ coding. This means that there was no coding scheme set up prior to data collection or analysis, but that an ethnographic bottom-up approach was used, whereby the data defined the categories would be used (see Methods).

Our aim was to recruit 100 participants with a 50/50 female/male distribution from ten countries that were selected (here in alphabetical order with universal three-letter codes, or ISO 3166-1 alpha-3 codes): Australia (AUS), Brazil (BRA), Canada (CAN), Czech Republic (CZE), Denmark (DNK), Finland (FIN), the United Kingdom/Great Britain (GBR), the Netherlands (NLD), Turkey (TUR), and the United States of America (USA), see Figure 1. These countries were chosen as this is where we are internationally based with belief and unbelief expertise. Our samples exhibit cultural, geographical, and economic variety, and have differences in terms of importance given to religion in daily life, see Figure 2 (and SM.1 for exact numbers and references).
Figure 1. Map of the world with countries (highlighted in orange) from which participants were sampled (figure created through https://mapchart.net/world.html)

Figure 2. Distribution of (a) country GDP, (b) GDP per capita, (c) GINI, and (d) whether religion is considered important per sampled country.
2. Methods and measures

2.1 Participants

Participants were recruited through online forums such as Reddit, and relevant Facebook groups and pages in the summer of 2018. As to the desired target population consisted of non-religious non-theistic individuals specifically, ads were placed on pages, websites, and newsletters of atheists, agnostic, and other secular organisations – see Supplementary Materials SM.2 for a list of sources. Participants were not reimbursed for their time but raffles were organised for most countries to stimulate participation numbers.

Two main exclusion criteria for the participants – that they do not believe in God (i.e., are non-theistic) and were not religious - were implemented automatically in the survey, through two questions: (1) “Do you believe in God?” with the option to answer ‘Yes’ or ‘No’. If they ticked ‘Yes’, the survey automatically ended; and (2) “What is your affiliation?” with the options ‘Atheist’, ‘Agnostic’, ‘No religion’, ‘Indifferent’, ‘Spiritual but not religious’, ‘Other, namely’ and ‘Religious’. If they selected ‘Religious’, the survey ended automatically as well.

Using these recruitment strategies and exclusion criteria, 100 participants were recruited from each country¹ except for Canada (n = 96). For most countries, the planned 50/50 gender distribution was achieved, with exception of Turkey, Czech Republic, and Canada, see Table 1. The gender frequencies however do not differ significantly between the countries ($\chi^2 (9, N = 996) = 10.52, p = .31$). The age of the participants ranged from 15 to 87 years old and years of education from 5 to 37 years. Age differed significantly between the countries ($F(9, 979) = 29.53, p < .001, \eta_p^2 = .21$), as did years of education ($F(9, 979) = 2.64, p = .005, \eta_p^2 = .02$); see Supplementary Materials SM.1 for post-hoc comparisons. Participants were also asked to indicate how spiritual they consider themselves to be on a scale from 0 “Not at all” to 6 “Extremely so” (see Table 1), but not religiosity, as participants had been asked whether they were religious or not beforehand, and all religious individuals were automatically excluded from participation (see above). Average self-reported spirituality differed significantly between the countries ($F(9, 986) = 9.49, p < .001, \eta_p^2 = .08$), see SM.1.

¹ In countries where more than 100 participants were recruited, 100 participants were randomly chosen from the pool, whilst maintaining a 50/50 gender distribution. Moreover, participants whose nationality and country of residence matched were selected where possible, in an attempt to obtain ‘country-representative’ individuals as much as possible.
Table 1
Proportion of gender and means (standard deviations) for age and years of education, and self-reported spirituality per country

<table>
<thead>
<tr>
<th>Country</th>
<th>Gender distribution</th>
<th>Age (years)</th>
<th>Years of education</th>
<th>Self-reported spirituality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>50F/50M</td>
<td>59.1 (14.5)</td>
<td>17.4 (3.9)</td>
<td>0.60 (1.23)</td>
</tr>
<tr>
<td>Brazil</td>
<td>50F/50M</td>
<td>40.0 (13.6)</td>
<td>17.1 (4.2)</td>
<td>0.25 (0.66)</td>
</tr>
<tr>
<td>Canada</td>
<td>46F/50M</td>
<td>47.7 (12.4)</td>
<td>16.7 (3.3)</td>
<td>0.56 (1.10)</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>33F/67M</td>
<td>33.5 (10.9)</td>
<td>17.8 (4.1)</td>
<td>0.81 (1.25)</td>
</tr>
<tr>
<td>Denmark</td>
<td>50F/50M</td>
<td>46.8 (13.4)</td>
<td>17.4 (2.8)</td>
<td>0.53 (1.05)</td>
</tr>
<tr>
<td>Finland</td>
<td>50F/50M</td>
<td>44.6 (12.9)</td>
<td>18.1 (3.8)</td>
<td>1.42 (1.59)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>50F/50M</td>
<td>49.2 (13.1)</td>
<td>17.1 (3.9)</td>
<td>0.76 (1.32)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>50F/50M</td>
<td>42.9 (14.9)</td>
<td>18.0 (3.3)</td>
<td>1.32 (1.58)</td>
</tr>
<tr>
<td>Turkey</td>
<td>44F/56M</td>
<td>35.7 (10.9)</td>
<td>16.1 (3.8)</td>
<td>1.41 (1.86)</td>
</tr>
<tr>
<td>United States</td>
<td>50F/50M</td>
<td>44.3 (14.1)</td>
<td>16.9 (3.0)</td>
<td>0.71 (1.13)</td>
</tr>
<tr>
<td>average</td>
<td>47F/52M</td>
<td>44.34 (14.76)</td>
<td>17.26 (3.68)</td>
<td>0.84 (1.37)</td>
</tr>
</tbody>
</table>

Note. Spirituality was measured on a scale from 0 “Not at all” to 6 “Extremely so”.

The frequencies of affiliations or unbeliever labels were also significantly different between the countries (Figure 3; $\chi^2 (117, \, N = 996) = 208.05, \, p < .001$). However, while most participants indicated they were atheists, many declared in their answers to the open-ended question also to be antitheists or rationalists for example, a label which was not provided by us. Therefore, we consider this label to be a rough indication only. Under ‘Other’ categories, the most frequently participant-provided labels included ‘Antitheist’ (0.8% of the total sample across all countries), ‘Agnostic atheist’ (0.7%), Ignostic (0.3%), Buddhist (0.2%), Apatheist (0.2%), Rationalist (0.2%) and Materialist (0.1%), with a further 1.0% not specified in any of the previously mentioned categories.
Figure 3. Stacked barplot of percentages of non-religious affiliations of the participants per country

2.2 Measures

The data of this study was part of a larger survey. In the present article, the most important worldview(s) the participants held are reported, as well as ratings on a predetermined set of beliefs/worldviews, to explore what the non-religious non-theistic participants believe in.

Most important worldview. Our main aims included to investigate what types of beliefs and worldviews are held by non-religious non-theistic individuals, and how this may vary across countries around the world. As such, as little guidance as possible was given (i.e., no predetermined lists of worldviews), but to make sure that that respondents did not just list their political stance for example, the worldview question was preceded by an explanation of the researchers’ stance on secular beliefs and worldviews: “There has been a global increase in individuals who hold no religious affiliation or have no religious beliefs, and a concurrent increase in secular organisations and secular rituals (e.g., humanist weddings and funerals). We are interested in understanding better what forms of ‘non-religious belief’ entail. While non-believers do not hold religious beliefs, they may still have distinct secular views, for example moral or ethical beliefs or views. Moreover, such secular worldviews may provide non-religious individuals with sources of meaning which are important to explain the world and which may also function as coping mechanisms.” This piece of text was followed by: “If you do not believe in God, what worldviews, beliefs, or understandings of the world do you hold? Please list the worldviews, beliefs, or understandings of the world that are particularly meaningful to you.” The participants were provided with a text box to type their answers in (with no restrictions to text length).

Beliefs. In addition to the open-ended worldview question, to get an idea of which beliefs/views were adhered to/believed in compared between the different countries, and since we did
not know what to expect from the open-ended questions (providing the participants with a lot of freedom to write either lots or hardly anything), a predetermined list of beliefs was created. This list is based on previous pilot studies and research on unbelief and belief done by the authors of the present article. Participants were asked the question “Which of the following worldviews/understandings of the world/beliefs do you hold? A belief in or a worldview or understanding of the world that primarily relies on” followed by a list of 26 items, see Table 2 below. Participants chose one of the following options for each of the items: “I definitely do not hold this belief/view” (-2), “I do not hold this belief/view” (-1), “Neutral (0), “I hold this belief/view” (1) and “I definitely hold this belief/view” (2). Importantly, this question was asked after the open-ended question so as not to influence the participants’ answers there.

Demographics. Participants were asked to indicate their gender (female/male/other), age (in years), and years of education (starting from 1st grade/1st year of primary school). Participants were also asked: “How spiritual do you rate yourself to be?” where they were provided with options ranging from 0 “Not at all” to 6 “Extremely so” (with only number labels in between).

Translations and coding. All translations were done by co-authors on this paper, who were also involved in the coding. For some countries, additional people helped out with the translation and coding. Moreover, three research assistants from Coventry University coded data from United Kingdom, Canada, and Australia. Translation included both the survey and the participants’ answers. The survey was translated and back-translated for every country where English is not the first language (Finnish rather than Swedish was used for Finland).

2.3 Coding procedure

One of the strengths of this study is the ambition to obtain a data-driven rather than a pre-specified/hypothesis-driven description of secular beliefs. Thus, the coding template was developed bottom-up by each of the national co-authors (native speakers), and then agreed upon across countries. First, each national coder identified thematic categories in their datasets, and returned these to the first and second author. The first and second author then integrated identified categories to align the national codes to a common coding template both within and across the countries, and ways to make the number of categories more succinct (some countries had initial coding templates of 200 categories). The new and final coding template, consisting of 51 categories (see Supplementary Materials SM.4 for the full coding template), was sent back to the national coders, who recoded the data of their countries. Finally, the second author (HT) coded every country (according to the template), and through an examination of the difference between the coding, and in discussion between the country’s main coder and HT, an agreed coding was settled on for each country, which was then used in the analyses.
The percentage agreement between HT and the country coder ranged from 92.56-96.82%, with the following agreements per country: United States (92.98%), Brazil (94.08%), Denmark (95.38%), Finland (96.50%), Turkey (96.62%), Czech Republic (96.82%), the Netherlands (93.70%), United Kingdom (92.56%), Canada (95.44%), and Australia (96.02%). Cohen’s kappa was calculated with the formula: Pr(a) - Pr(e)/1 - Pr(e), whereby Pr(a) represents the actual observed agreement, and Pr(e) represents chance agreement (in this case 0.50 as the only scores were present (1) or absent (0)). Cohen’s kappa for each of the countries was: United States (0.86), Brazil (0.88), Denmark (0.91), Finland (0.93), Turkey (0.93), Czech Republic (0.94), the Netherlands (0.87), United Kingdom (0.85), Canada (0.83), and Australia (0.92), all > 0.80, which we deemed satisfactory.

3. Results

3.1 Predetermined secular belief sets

The responses to the predetermined belief sets were investigated first, to obtain a baseline beliefs measure irrespective of the variety of the participants’ responses. An exploratory principal axis factor analysis was run on the list of provided belief items to examine whether there are certain patterns in the type of beliefs that secular individuals hold. The scree plot tapering off after three factors led to a decision to keep three factors, with a cumulative explained variance of 47.7%. The first factor has an eigenvalue of 6.34 and explains 24.4% of the variance, the second factor has an eigenvalue of 4.49 and explains 17.3% of the variance, while the third factor has an eigenvalue of 1.58 and explains 6.1% of the variance. See Table 2 for the items and factor loadings.

<table>
<thead>
<tr>
<th>Belief/worldview item</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>-0.49</td>
<td>0.40</td>
<td>0.50</td>
</tr>
<tr>
<td>Logic/reason</td>
<td>-0.37</td>
<td>0.44</td>
<td>0.43</td>
</tr>
<tr>
<td>Common sense</td>
<td>0.06</td>
<td>0.47</td>
<td>0.03</td>
</tr>
<tr>
<td>Nature</td>
<td>0.12</td>
<td>0.54</td>
<td>0.08</td>
</tr>
<tr>
<td>Natural order/Order of the universe</td>
<td>0.16</td>
<td>0.50</td>
<td>0.01</td>
</tr>
<tr>
<td>Chance/randomness</td>
<td>-0.10</td>
<td>0.27</td>
<td>0.07</td>
</tr>
<tr>
<td>Big Bang</td>
<td>-0.30</td>
<td>0.36</td>
<td>0.33</td>
</tr>
<tr>
<td>Evolution</td>
<td>-0.44</td>
<td>0.41</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Factor 1 includes the endorsement of more spiritual beliefs such as soul, karma, afterlife, reincarnation and a higher power is combined with a lack of endorsement for belief in science and evolution. This set of beliefs reflects that of the ‘spiritual but not religious individuals’ (Fuller, 2001; Lindeman et al., 2019), also called ‘spiritual seekers’ (Manning, 2015), and appears to emphasise ontology and cosmology. Factor 2 includes not only science, logic, evolution, natural order, progress, but also a belief in human ability and goodness, and similar human-centric values such as belief in the self and belief in emotions. We suggest that these beliefs together reflect a ‘secular humanist’ package (Lee, 2015; Taylor, 2007; Turner, 1985). These beliefs appear to focus on epistemology, axiology, and praxeology. Notably, two beliefs - belief in seizing the day, and a belief in positive thinking - fall just short of the threshold of factor loadings of >.40, with a .39 factor loading for Factor 2. Belief in
the Big Bang falls short with a factor loading of .36, thus differentiating it from beliefs in science and evolution, which currently may not be at the forefront of people’s minds and worldviews. Factor 3 is comprised of just belief in science and in logic and reason. This belief set appears particularly fitting for individuals who have been described as ‘philosophical secularist’ (Manning, 2015) and ‘intellectual atheist/agnostic’ individuals (Silver et al., 2014) who proactively try to educate themselves and acquire knowledge in the search for truth (ontology) and enjoy discussing the epistemological positions (epistemology).

The scores for each belief set for each participant were calculated by averaging all items loading into each belief set (Spiritual Beliefs, $\alpha = .891$; Humanistic Beliefs, $\alpha = .797$; Belief in Science & Logic, $\alpha = .809$). On a range from -2 (“I definitely do not hold this belief/view”) to 2 (“I definitely hold this belief/view”), Spiritual Beliefs scored negatively on average ($M = -1.43$, $SD = 0.63$) indicating an average lack of endorsement for the individuals of this overall sample, with Humanistic Beliefs ($M = 1.15$, $SD = 0.51$) and Belief in Science & Logic scoring positively on average ($M = 1.74$, $SD = 0.53$), indicating endorsement (see SM.3 for averages for each of the belief sets per country). Given the composition of our sample - that is, high numbers of participants selecting an atheist label and lower numbers selecting the spiritual but not religious label - we suggest that these results are not unexpected.

3.2 Open-ended secular belief and worldview question

3.2.1 Belief categories and worldview supercategories

Next, we turn to the open-ended question about the participants’ most important secular beliefs and worldviews. First, the final coding scheme will be presented. In this coding scheme the final 51 categories were grouped in 11 supercategories of secular beliefs, see Figure 4 (see Supplementary Materials SM.4 for the full coding template).
Figure 4. Overview of all 51 coding categories of the template within their 11 super-categories (both categories and super-categories are ordered alphabetically with ‘Other’ added last; colours hold no particular significance and are used for visual assistance)

Next, the super-categories were compared to previously proposed theoretical components, see Table 3. There is a relatively good match with the theorised components; the only category which we were not able to place is the ‘other’ category, which is unsurprising given its idiosyncratic contents. Non-religiosity is the only category occurring twice: both in the ‘epistemology’/‘world and life’ component, and in the ‘ontology-cosmology’/‘cognition; truth’ component.
Table 3
Theoretical proposals of worldview categories matched with the categories found in the present research

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Human nature; Behaviour (moral)</td>
<td>Axiology</td>
<td>Axiology</td>
<td>Morality</td>
<td>What is the good that we should strive for, what is good and evil</td>
</tr>
<tr>
<td>Will; Behaviour (control)</td>
<td>Teleology</td>
<td>-</td>
<td>Agency &amp; control; Reflection &amp; acceptance</td>
<td>What can we control, do we have free will</td>
</tr>
<tr>
<td>Cognition; Truth</td>
<td>Epistemology</td>
<td>Epistemology</td>
<td>Science &amp; critical thinking; Truth; Non-religiosity</td>
<td>What can we know, how do we know what is true, how should we reason</td>
</tr>
<tr>
<td>World and life</td>
<td>Ontology; Cosmology</td>
<td>Ontology; Natural laws &amp; the here and now; Non-religiosity; Spirituality</td>
<td></td>
<td>What exists, what is real; Where do we come from and where are we going (incl. afterlife)</td>
</tr>
<tr>
<td>Interpersonal; Behaviour (moral)</td>
<td>Praxeology</td>
<td>Praxeology</td>
<td>Collaboration &amp; peace; Equality &amp; kindness</td>
<td>What actions should we take (in particular within the context of communities)</td>
</tr>
</tbody>
</table>

Next the categories which were mentioned most often across all countries were investigated. The top ten most named categories across all countries are listed in Table 4 below, with the percentage of participants mentioning each particular category. After the global top ten, all other categories are mentioned by 8.4% of the participants or less.

Table 4
Global top ten of most frequently mentioned belief/worldview categories

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>35.1</td>
<td>Responses that endorse science in general, scientific methodology or perspectives (including responses such as believing in ‘evidence’ or ‘observations’ or methodological naturalism), or scientific expertise and authority (including responses indicating a trust in scientific and medical experts).</td>
</tr>
<tr>
<td>Humanism</td>
<td>25.5</td>
<td>Responses that fall under the general umbrella of humanism or related worldviews, including beliefs that human beings are special (human relativism),</td>
</tr>
</tbody>
</table>
that human history is inherently progressive, that human reason or ingenuity can overcome all problems (belief in human ability).

<table>
<thead>
<tr>
<th>Critical Scepticism</th>
<th>17.4</th>
</tr>
</thead>
</table>
| Responses that espouse the value of a questioning, critical disposition towards information. It includes responses that simply state a belief in ‘scepticism’, ‘rationalism’, ‘logic’, and ‘reason’ but also answers that include belief in mathematics, philosophy or philosophical reasoning. In addition, answers indicating belief in open-mindedness and the ability to change your beliefs were included here as well.

<table>
<thead>
<tr>
<th>Natural Laws</th>
<th>15.6</th>
</tr>
</thead>
</table>
| Responses that talk about the laws underlying biological or physical systems, and/or emphasise that humans are subject to the same laws as the rest of the physical universe. This includes answers reflecting a belief in nature, naturalism and biology. Answers that indicate a belief in ‘Big Bang’, and ‘Evolution’ are also included here, as well as statements such as “We are all made of stardust/particles, and we will return to this when we die”.

<table>
<thead>
<tr>
<th>Equality</th>
<th>14.0</th>
</tr>
</thead>
</table>
| Responses that emphasise the equality of human beings, their inherent value or dignity, the importance of legal or philosophical innovations ensuring such equality is respected (such as democracy and human rights), and the general obligation to make society more equal (including universal healthcare and general (rational) care for all humans).

<table>
<thead>
<tr>
<th>Kindness &amp; Caring</th>
<th>13.6</th>
</tr>
</thead>
</table>
| Responses that praise the importance of empathy or concern for others, and/or the importance of caring actions, and helping and supporting others. It includes beliefs in human goodness and kindness (though not human ability, see Humanism) and beliefs in compassion, empathy, being kind and loving, and love. It encompasses belief in a more intuitive rather than rational care (see Equality).

<table>
<thead>
<tr>
<th>Care for the Earth</th>
<th>11.5</th>
</tr>
</thead>
</table>
| Responses that emphasise the importance of environmentalism, looking after the planet, and respecting and caring for other species, including beliefs in care and respect for all flora and fauna, and in animal rights. It also includes the belief that we have a legacy, and that we need to leave the Earth in a good state for future generations.

<table>
<thead>
<tr>
<th>Left-Wing Political Causes</th>
<th>10.1</th>
</tr>
</thead>
</table>
| Responses that mention a cause or worldview associated with left-wing politics (regardless of actual mentioning of left-wing politics). This category includes feminism, socialism, Marxism, and Anarchism, as well as being a vegetarian, pro-choice, pro-euthanasia and an advocate for LGBTQ.

<table>
<thead>
<tr>
<th>Atheism</th>
<th>9.9</th>
</tr>
</thead>
</table>
| Responses that reject religious belief, particularly a belief in God. However, this category does not include responses that adopt a negative or critical stance towards belief in God (Antitheism), or those that focus on the separation between state and Church (Secularisation), a rejection of belief in an afterlife (No afterlife), a rejection of belief in the supernatural more generally (Reject superstition), or an endorsement of a belief in secular morality (Secular morality).

<table>
<thead>
<tr>
<th>Individualism &amp; Freedom</th>
<th>9.8</th>
</tr>
</thead>
</table>
| Responses that emphasise the importance of individual liberty (including answers that simply state ‘Individualism’ or ‘Libertarianism’), and/or advocate resisting the imposition of excess constraints on behaviour. This category includes responses that indicate a belief in freedom of speech or freedom more broadly, and that state ‘live and let live’.

To investigate whether participants globally responded in a systematic way, a principal components analysis with varimax rotation was conducted on the data of all participants (all countries) for the top
ten categories. Three factors were extracted, and varimax rotation was used to create three maximally orthogonal factors (i.e., every item—i.e., every item—in this case the category—loads maximally onto one of the three factors), since there likely is overlap between the categories. The result of the analysis showed that there are three significant factors—see Table 5 below. Of the entered categories, only atheism did not load on any of the factors despite a varimax rotation, indicating that atheism is not connected uniquely to any one of these factors.

Table 5

| Global response patterns for the global top ten of category frequencies |
|-----------------------------|-------|-------|-------|
|                              | F1    | F2    | F3    |
| Equality                    | 0.63  | -0.04 | 0.39  |
| Left-Wing Political Causes  | 0.59  | 0.07  | 0.10  |
| Individualism & Freedom     | 0.52  | -0.06 | -0.03 |
| Humanism                    | 0.43  | 0.24  | -0.23 |
| Care for the Earth          | 0.22  | -0.03 | 0.67  |
| Critical Scepticism          | 0.16  | 0.68  | -0.11 |
| Atheism                     | -0.03 | 0.03  | -0.07 |
| Science                     | -0.11 | 0.81  | 0.02  |
| Kindness & Caring           | -0.15 | -0.03 | 0.62  |
| Natural Laws                | -0.35 | 0.21  | 0.41  |

Note. Factor loadings are reported; factor loadings > .40 in bold.

The first factor we might call the left-wing humanist responses (or care for humans). It bears resemblance to Lee (2015)’s definition of humanism, though with more focus on praxeology than Lee’s conceptualisation, which emphasises epistemology. The second factor we might call the scientific sceptic responses (or how to think), which emphasises epistemology. Given that this factor includes both belief in science and critical scepticism, it might include individuals who are not necessarily convinced about the ‘truth’ of current scientific knowledge but ascribe to the scientific method as a meaningful worldview. Thus, this component might overlap with previously described worldview types that value an open disposition towards knowledge, such as ‘seeker agnostics’ in Silver et al. (2014), but also other non-theists who are attuned to the intellectual, such as analytic atheists in Lindeman et al. (2019) or ‘intellectual atheist/agnostic’ individuals in Silver et al. (2014) and possibly ‘philosophical secularists’ in Manning’s (2015) typology. The third factor we might call the environmental caring responses (or care for earth and acceptance of nature). These responses focus on humans as a natural part of nature and hence nothing ‘special’ (Haimila & Muraja, 2021; Zuckerman, 2020) and also indicate an interconnectedness, as discussed in the existential culture of agnosticism (Lee, 2015), thus combining cosmology/ontology with praxeology.
To further investigate possible connections with other belief sets, a correlation analysis was conducted with the predetermined belief sets (see section 3.1), see Table 6. The correlations between scientific sceptic beliefs and the pre-determined belief sets are as predicted: negative correlations with spiritual beliefs, and positive correlations with science and logic beliefs. The other correlations are somewhat more surprising however: left-wing humanist beliefs do not correlate with humanist beliefs \((p = .08)\), but like scientific sceptic beliefs correlate negatively with spiritual beliefs and positively with science and logic beliefs. Environmental caring beliefs did not correlate significantly with any of the predetermined belief sets, with a trend for a positive correlation with humanist beliefs \((p = .06)\). One reason for these somewhat surprising findings might be that these correlations are run across countries, and there may be differences in correlations between the countries. However, the country-level sample size, while sizable for open-ended questions, is too small to run sufficiently powered correlations, so we are not able to further examine this possibility.

**Table 6**

*Correlations between open-ended secular belief sets and predetermined belief sets*

<table>
<thead>
<tr>
<th></th>
<th>Spiritual beliefs</th>
<th>Humanist beliefs</th>
<th>Science &amp; logic beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-wing humanist</td>
<td>-.11**</td>
<td>.06 #</td>
<td>.09**</td>
</tr>
<tr>
<td>beliefs</td>
<td>[-.17, -.05]</td>
<td>[-.01, .12]</td>
<td>[.03, .15]</td>
</tr>
<tr>
<td>Scientific sceptic</td>
<td>-.20**</td>
<td>-.04</td>
<td>.16**</td>
</tr>
<tr>
<td>beliefs</td>
<td>[-.26, -.14]</td>
<td>[-.10, .02]</td>
<td>[.10, 22]</td>
</tr>
<tr>
<td>Environmental caring</td>
<td>.01</td>
<td>.06 #</td>
<td>.02</td>
</tr>
<tr>
<td>beliefs</td>
<td>[-.05, .08]</td>
<td>[-.00, .12]</td>
<td>[-.04, .09]</td>
</tr>
</tbody>
</table>

Note. Correlations for 995 observations. **\(p < .01\), # \(p < .10\).

### 3.2.2 Cross-cultural variation in secular beliefs and worldviews

Finally, the top ten categories of each country were examined, and how they might differ, see Table 7. As is visible from this table, all countries’ top ten lists contain categories that are mentioned in 9-59% of the participants’ responses, with the most intra-country agreement for Canada, in which 11-59% of the responses include the top ten categories, and the least agreement for the Netherlands, where the top ten categories only cover 9-24% of the Netherlands’s responses. Interestingly, the top ten most frequently named categories are very similar across the different countries, despite the geographical spread and cultural differences between the countries (see Table SM5.1 for an overview of the cultural distance between the countries, Muthukrishna et al., 2020). In particular, the six top
categories occur frequently in each of the countries separately: Science, Critical Scepticism, Natural Laws, and Humanism, Equality, and Kindness & Caring.

Together, these six frequently occurring categories seem to reflect a worldview based on scientific, critical thinking and human-centred values surrounding equality and care, and is consistent with prior descriptions on the belief systems of secular group affiliates (Pasquale, 2009; Smith, 2017; Smith & Halligan, 2021). Many have noted the importance of the scientific and humanistic frameworks for secular individuals (e.g., Bullivant et al., 2019; Lee, 2015), and in some studies these provide a common ground for the worldviews of secular group affiliates (Kontala, 2016). Furthermore, scholars such as Pasquale (2009) and Bullivant et al. (2019) have previously reported the importance of intuitive care (e.g., compassion, friendship) and rational care (human dignity, equality) for secular individuals’ sense of meaning in life and the world.

Differences between the top ten lists of the different countries are interesting also – a few categories appeared where they were not necessarily expected, or lacked where they may have been expected. For example, while left-wing political causes ranks first in Turkey, this category does not occur at all in the top ten of Denmark or Finland. This may be considered surprising given what is known about these countries: left-wing political causes such as abortion and euthanasia are currently forbidden in Turkey, while Denmark and Finland are some of the most progressive, left-wing countries on earth. We suggest here that what these most frequently named categories reflect is the current political or societal climate in these countries in interaction with the country-specific secular identities. Thus, taking the example of Turkey, there was, at the time of the survey, a strong opposition to Erdogan’s de-secularising policies. People opposing Erdogan are often strongly left, and see themselves as defending Kemalism, the legacy of the country’s secularising moderniser Ataturk, which could be why left-wing political causes are so important to these people. We suggest that in Denmark and Finland on the other hand, these topics are not highly important to secular individuals specifically.
Table 7
Top ten most important worldviews per country with percentages of individuals mentioning responses in each category

<table>
<thead>
<tr>
<th>Country</th>
<th>Science</th>
<th>Critical Scepticism</th>
<th>Humanism</th>
<th>Natural Laws</th>
<th>Secularism</th>
<th>Equality</th>
<th>Flourish</th>
<th>Antitheism</th>
<th>Reject Superstition</th>
<th>Philosophical Materialism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>41</td>
<td>29</td>
<td>23</td>
<td>17</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Brazil</td>
<td>35</td>
<td>35</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Canada</td>
<td>44</td>
<td>25</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>26</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Denmark</td>
<td>39</td>
<td>36</td>
<td>27</td>
<td>16</td>
<td>16</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Science</th>
<th>Humanism</th>
<th>Natural Laws</th>
<th>Critical Scepticism</th>
<th>Left-Wing Political Causes</th>
<th>Flourish</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>59</td>
<td>34</td>
<td>26</td>
<td>16</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Netherlands</td>
<td>24</td>
<td>20</td>
<td>16</td>
<td>17</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Turkey</td>
<td>29</td>
<td>21</td>
<td>21</td>
<td>20</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>United States</td>
<td>39</td>
<td>31</td>
<td>21</td>
<td>21</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

Note. Countries ordered alphabetically; categories also present in global top ten are displayed in coloured font.
4. Discussion

This research project had three main aims: (1) to examine the content and range of secular (i.e., non-religious non-theistic) beliefs and worldviews; (2) to investigate whether secular beliefs cluster together in ways similar to theoretical proposals; and (3) to explore how these different types of beliefs might vary across countries. To meet these aims, we designed a survey with a predetermined list of beliefs as well as an open-ended question asking participants about their most important secular beliefs and worldviews. Approximately one thousand non-religious non-theistic individuals were recruited from ten countries around the world (~100 participants from each country) to complete the survey. These countries included Australia, Brazil, Canada, Czech Republic, Denmark, Finland, the Netherlands, Turkey, United Kingdom, and the United States. The majority of these participants indicated to be atheists, followed by individuals who indicated to have 'no religion', followed by agnostics, humanists, and spiritual but not religious individuals, as well as indifferent individuals.

First, endorsements of prelisted beliefs were investigated, and it was found that they clustered together in three separate clusters: spiritual beliefs (e.g., belief in reincarnation, souls, karma, etc.), humanist beliefs (belief in nature, human ability and goodness, science), and science and logic beliefs (belief in science and logic or reason). These sets respectively represent the worldviews of spiritual but not religious individuals (Fuller, 2001; Lindeman et al., 2019), secular humanists (Lee, 2015), and intellectual atheist/agnostic individuals (Silver et al., 2014). On average, spiritual beliefs were not endorsed in this sample, which was unsurprising given a majority of atheists and minority of spiritual but not religious individuals in the participant distribution.

Next, the responses to the open-ended question about the participants’ most important or meaningful worldviews, beliefs, or understandings of the world were examined. To code these responses, a bottom-up, data-driven method was used to develop a coding scheme. This resulted in a coding scheme with 51 categories within 11 supercategories (listed alphabetically): agency & control, collaboration & peace, equality & kindness, morality, natural laws & the here and now, non-religiosity, reflection & acceptance, science & critical thinking, spirituality, truth, and other. These supercategories each fit within previously proposed theoretical worldview components (Koltko-Rivera, 2004), such as axiology, teleology, epistemology, ontology/cosmology, and praxeology (Johnson et al., 2011; Taves et al., 2018), with the category non-religiosity fitting under both epistemology and ontology/cosmology. In other words, while having emerged from a data-driven rather than theory-driven approach, the supercategories are together able to answer the ‘big questions’ (Taves, 2020), including ‘what is the good that we should strive for, what is good and evil’ (axiology), ‘what can we control, do we have free will’ (teleology), ‘what can we know, how do we know what is true, how should we reason’ (epistemology), ‘what exists, what is real; where do we come from and where are we going (incl. afterlife)’ (ontology & cosmology), and ‘what actions should we take (in particular within the context of communities)’ (praxeology).
In terms of the individual categories, the top ten categories that responses fell into, were: Science (mentioned in 35.1% of all responses), Humanism (25.5%), Critical Scepticism (17.4%), Natural Laws (15.6%), Equality (14.0%), Kindness & Caring (13.6%), Care for the Earth (11.5%), Left-Wing Political Causes (10.1%), Atheism (9.9%), Individualism & Freedom (9.8%). Science was the top category for eight of the ten countries (second place for Turkey, and third place for United Kingdom). This is in line with previous research, which suggests that science is secular individuals’ central epistemological worldview component: atheists and other secular people emphasise evidence-based, rational thought in their narratives (Hunsberger & Altemeyer, 2006), unbelievers are more likely than the general population to perceive science as the ‘only reliable path to knowledge’ (Bullivant et al., 2019), effects which are especially pronounced for atheists in the United States (Pasquale, 2009). Science can also feature as an ontological/cosmological feature however: it can allow atheists to feel part of something greater than themselves (Caldwell-Harris et al., 2011; Haimila, 2020) and allow one to find ‘one’s place in the universe’ (Lee, 2015, p. 146). Thus, the identification with science may provide a sense of meaning for secular individuals, and can help find meaning in the world (Bullivant et al., 2019; Farias et al., 2013; Haimila, 2020).

Humanism, the category mentioned second most often, is interesting in that it overlaps with a high appreciation for science and scientific method (indeed, secular individuals have been found to often rely on a secular-scientific and humanist belief system in certain samples; Smith, 2017), but also places much value on humans and their goodness and ability (Lee, 2015). This extends to praxeology, whereby actively contemplating - and even seeking to change – societal structures and values is important (Kontala, 2016; Taylor, 2007). Critical scepticism is again similar to the science category, but it emphasises epistemology and may include a more critical view on the scientific method, thus allowing more uncertainty (Smith & Halligan, 2021) and for more critical or logical thought (Pasquale, 2009). The natural laws category reflect the previously researched secular beliefs that humans are a natural creature (Smith & Halligan, 2021), like other animals (Zuckerman, 2020), and consist wholly of matter (Wilkinson & Coleman, 2010), a clear ontology/cosmology worldview component.

Notably, in the present research the participants were asked about their “worldviews, beliefs, or understandings of the world that are particularly meaningful”, which was phrased this way to get at the participants’ worldview or ‘existential’ beliefs (Lee, 2015). Other research has indicated however that, when asked ‘what provides [the participants] meaning’ (note the slightly different angle), the answer is generally first and foremost ‘family’ (Bullivant et al., 2019; Pasquale, 2009), followed by freedom or friendship, equality or compassion (Bullivant et al., 2019) or helping or caring for others, and on fifth and sixth place ‘people, social relations in general’ and ‘friends, friendship’ (Pasquale, 2009). These responses did appear in the current research as well (family, friends, and community were coded under the category ‘Connection’, supercategory ‘Collaboration & peace’), but were not a highly frequent response, although the supercategory Equality and Kindness & Caring did occur in the
top ten (fifth and sixth place, respectively). These discrepancies may be the result of the question formulation or sample recruitment, among other things.

A principal components analysis on the top ten most mentioned categories (across countries) demonstrated further patterns: equality, left-wing political causes, individualism & freedom and humanism all loaded onto a factor which we called ‘left-wing humanist responses’; science and critical scepticism loaded onto a factor which we called ‘scientific sceptic responses’, and care for the earth, kindness & caring, and natural laws loaded onto a factor we called ‘environmental caring responses’. Atheism did not uniquely load onto a single factor. We suggest that this may have the same underlying reason as non-religiosity as a category fitting into multiple worldview components: secular individuals (in particular a sample comprised of mostly atheists as the current one) may dissociate themselves from religion in several ways, such as denying religion as a way of knowing things (epistemology) and as a way of understanding where we come from and what is real (cosmology and ontology).

While the predetermined belief sets or patterns did not always correlate significantly with these worldview patterns, it was telling that three similar sets were found across both: predetermined spiritual beliefs reflecting cosmology and ontology components and environmental caring responses reflected cosmology and praxeology, predetermined humanist beliefs reflecting praxeology, epistemology and axiology and left-wing humanist responses reflecting praxeology, and predetermined science and logic beliefs reflecting epistemology and ontology and scientific sceptic responses reflecting epistemology. Thus this research demonstrates several of the ways in which secular individuals fill in these ‘big questions’ that worldviews address. Interestingly, in this sense, future research may consider running a similar version of this survey for religious individuals. While theologies may prescribe certain answers to the big questions, there is space for individual variation as well as between theological traditions (even of the same religion).

While we do not have comparative data, it is worth speculating how much secular worldviews may differ from those of religious people in the same countries. This is an enormous question and we can only briefly consider it here. On the one hand, some recent evidence suggests that religious and non-religious individuals overlap greatly in their reported values (Bullivant et al., 2019), and historians have noted that secular humanism has Christian roots (e.g., Holland, 2019; Taylor, 2007), something that likely entails common core values (equality and compassion, for instance). On the other hand, some studies suggest underlying differences in moral cognition between religious and secular individuals, something that would likely impact their worldviews (Haidt & Graham, 2007; Lanman, 2009). More fundamentally, comparisons are complicated by the fact that there is no clean binary division between religious and secular people (highly secularised European societies, for instance, are noteworthy for having large ‘fuzzy’ populations who are neither explicitly religious nor non-religious; Voas, 2009).
The cross-cultural variation in secular beliefs and worldviews in the ten countries was examined. A question of interest therein is whether differences in societal values are reflected in country-level differences in the contents of secular worldviews. For instance, left-wing politics is noticeably more salient in the Turkish sample, which probably reflects a rejection of Erdogan’s conservative Islamism and the threat it poses to the secular state. However, this stands out as an exception, with our data suggest that ‘unbelieving’ worldviews are broadly similar in the countries studied: despite the geographical, cultural, and socioeconomic differences between these countries, the lists of top ten most frequently named categories of each country showed many overlaps. It could be the case that secular worldviews really do not differ that much country to country. The growth of the non-religious population in recent decades has coincided with an amplification in the globalisation of ideas thanks to developments in communications technology, which may help to transplant new worldviews from place to place with a high degree of fidelity (e.g., Acerbi, 2019), and some observers suggest the internet has been highly influential in spreading and sustaining atheist worldviews (Smith & Cimino, 2012). We must be very cautious about making such inferences though.

Another reason for the similarities might be that despite the variety in the countries, most of the sampled countries are still western or W.E.I.R.D. (Western Industrialized Educated Rich Democratic; Henrich et al., 2010). The countries were chosen on the basis of a combined desire for cross-cultural variety and presence of collaborative expertise in belief and/or unbelief. We suggest that future research may go further beyond this selection of countries, in increasing cultural distance (Muthukrishna et al., 2020). For example, it may be particularly interesting to investigate secular beliefs and worldviews in countries where religion is considered important for the majority of the population. The present sample contained three such countries (out of ten): Brazil, Turkey, and the United States. An advantage for such future research may be that rather than using another open-ended survey approach, a questionnaire or list of secular beliefs may be based on the coding categories resulting from the present dataset (and overarching supercategories or worldview components). Future research projects utilising such a survey would then also have the advantage of going beyond a limitation of one hundred participants per country, which was a necessary limitation given the time and other resources it took to translate and code the responses for this open-ended survey.

If there is funding for it, future research may also consider targeting representative samples (e.g., Bollivant et al., 2019; Schnell & Keenan, 2011). Here, recruitment was online without participant reimbursement (though several raffles were organised to stimulate participation), and participants were mostly recruited through online groups (Facebook pages or newsletters). This means that many of the secular individuals that were reached were involved in digital media and had an interest in, or were part of, a secular organisation (like much of the previous research, e.g., Kontala, 2016; Langston et al., 2020; Pasquale, 2009; Smith, 2017; Smith & Halligan, 2021). This may indicate that religious non-belief is an important component of their social identities, and it may be
that secular individuals in the general population, outside these digital environments, are more indifferent to religion and less cross-culturally similar than the current sample, which warrants exploring.

While this research did not aim to cluster secular individuals, and instead focused on exploring potential clusters of secular beliefs, overlaps with previously suggested and demonstrated non-religious groupings (Lee, 2015; Lindeman et al., 2019; Manning, 2015; Silver et al., 2014) were noted. Previous data-driven groupings have been based on qualitative research (Lee, 2015; Manning, 2015) or quantitative research (Lindeman et al., 2019), or combination of qualitative and quantitative research (Silver et al., 2014). These groupings included analytical atheists, spiritual but not religious and uncertain nonbelievers (Lindeman et al., 2019), unchurched believers, spiritual seekers, philosophical secularists and indifferent (Manning, 2015), humanists, agnostics, theists and subjectivists, and anti-existentialists (Lee, 2015), and academic atheists, activist atheist/agnostic, seeker agnostics, anti-theists, non-theists, and ritual atheists (Silver et al., 2014). Throughout these groupings, as well as in the present research to some extent, three main lines become evident: individuals who are strongly confident about the scientific method, individuals with non-religious spiritual beliefs, and those who are uncertain, agnostic or indifferent. Strong anti-religious sentiments are not consistently present in the classifications, and, while they occurred in the present data as well, do not have the overtone.

Non-religious affiliation labels are a contested topic for researchers (Bullivant & Ruse, 2013; Lee, 2015; Lee & Bullivant, 2016) and secular individuals alike: a recurring lack of established ‘worldview programmes’ for each of the non-religious affiliations as one might see for, broadly speaking, the Catholic church or Pentecostalism, means that the individuals need to gauge themselves which labels is most befitting to them, even if the labels are not particularly specific (“no religion”) or if a restricted range is given (e.g., “humanist” or “rationalist” may be lacking from commonly presented options). Bullivant et al. (2012) for example had a question categorising each ‘unbeliever’ participant as either atheist (“I don’t believe in God”) or agnostic (“I don’t know whether there is a God, and I don’t believe there is any way to find out”), but these individuals were still distributed over 12 different labels which they could pick themselves (i.e., atheist, non-religious, rationalist, free thinker, spiritual but not religious, humanist, ‘religious label’, agnostic, seeker, sceptic, secular, or other). It should be noted that our exclusion criteria – non-religious non-theistic individuals – may have resulted in an overrepresentation of atheists, and underrepresentation of agnostics or people who do not believe in God but still consider themselves religiously affiliated in some way. However, it was the aim of this study to specifically look at non-religious non-theistic individuals, and we were interested in an open-ended exploration of beliefs and worldviews rather than group affiliation labels.

There are exceptions for certain secular organisations which make explicit their overarching worldview, such as for example the Rationalist Society of Australia, https://rationalist.com.au/about/about-us/.
which may conceal diversity and complexity (Pasquale, 2009), but future research may extend this to larger groups of secular individuals with less stringent criteria.

Finally, it is worth pausing to consider the implications of our findings for atheists and other non-religious individuals themselves. Cross-cultural evidence suggests that those who do not believe in a God or gods are frequently the targets of prejudice, and that this is based on the implicit assumption that atheists must be amoral nihilists (Gervais et al., 2017). The present research clearly demonstrates that ‘unbelievers’ by no means ‘believe in nothing’. They have principled worldviews which encompass many highly prosocial components, such as the importance of equality and compassion. Hopefully, worldview research and the insights it provides can start making changes to these negative attitudes.

Conclusions

An increase in non-religious individuals around the world and a concurrent increase in secular organisations ask for a better understanding of secular beliefs and worldviews beyond a simple lack of religious beliefs. This open-ended data-driven exploratory research has demonstrated that there is a range of secular beliefs which answer the big questions about life, broadly in line with previous theoretical work on beliefs and worldviews. These beliefs were found to cluster together in scientific worldviews, humanist worldviews, and caring nature-focused worldviews. This research is a timely exploration of beliefs and worldviews of the growing population of secular individuals around the world.

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References


Abstract

Endorsement of science is often associated with non-religiosity and lack of supernatural belief. However, the relevance of science for worldviews might also relate to the cultural context and/or personal investment in science. This study investigates the following question: Is endorsement of worldview components of science associated with unbelief among science-oriented respondents? Here, worldview components refer to science providing 1) a sense of meaning, 2) moral standards, and 3) literal or symbolic continuity after death. 387 Finnish adults recruited via pro-research organizations were included in the analysis. The results suggest that self-reported worldview functions of science are associated with unbelief also among science-oriented individuals. These findings lend support to the belief replacement hypothesis, which suggests that secular worldviews such as belief in science are of particular importance for unbelievers. However, the effect sizes are small and also other God belief groups endorse the significance of science for e.g., meaning in life.

Keywords

science and religion; belief in science; nonreligion; secular worldviews; unbelief; atheism; belief replacement
Science and religion are often discussed as competing explanatory frameworks that are inherently in conflict (Evans and Evans 2008; see Dawkins 2006) or as complementary, yet separate stances. Perhaps the most prominent suggestion on science and religion as complementary is that they are “non-overlapping magisteria” that provide answers to different questions and needs. Science informs us how events occur in the natural world, whereas religion can provide us with ultimate meaning, moral values, and deeper insight on why things happen (Gould 1997; 1999, 6). According to palaeontologist Stephen J. Gould,

... these two magisteria do not overlap, nor do they encompass all inquiry (consider, for starters, the magisterium of art and the meaning of beauty). To cite the arch clichés, we [scientists] get the age of rocks, and religion retains the rock of ages. (Gould 1997, 18)

On the other hand, one example of the recent competition-based accounts of science and religion is the belief replacement hypothesis, which suggests that secular worldviews may serve similar psychological functions as religiosity for atheists (Farias 2013). Much of the relevant research has focused on belief in science and other science-related views (Rutjens et al. 2016; Rutjens, van Harreveld, and van der Pligt 2013). Several studies seem to support the belief replacement hypothesis, since trust in science can provide existential meaning and mitigate death anxiety, as God belief does for theists (Farias et al. 2013; Lifshin et al. 2018; Norenzayan and Hansen 2006).

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1 Farias et al. (2013) found that reminders of mortality bolstered belief in science in academic respondents, but they were unable to explore the possible effect of God belief and/or religiosity, due to an overall secular sample. However, in a study by Lifshin et al. (2018), reminders of mortality decreased afterlife belief and increased support for indefinite life extension (ILE) mainly for psychology students who scored low on religiosity. Religious participants, instead, found ILE less appealing. The results of Lifshin et al. suggest that striving for immortality via scientific innovation can “replace” religious afterlife belief – but mainly for people that are less religious. Rutjens et al. (2016), on the other hand, found null effects of mortality salience on belief in scientific-technological progress. In their study, however, the sample was non-academic (representative of the general Dutch population).
However, it might not be meaningful to focus mainly on atheists in studies of secular worldviews. Stavrova, Ehlebracht, and Fetchenhauer, for instance, found that in more than 60 countries, belief in scientific-technological progress predicted a higher sense of control and increased life satisfaction – an effect that was robust to religiosity. The effect was enhanced in countries where belief in science was more common. Studies also suggest that trust in science might be relevant for moral reasoning (Ma-Kellams and Blascovich 2013) regardless of religiosity (Yilmaz and Bahçekapılı 2015). Additionally, Tracy, Hart, and Martens (2011) found that both nonreligious and religious individuals rely on scientific knowledge to relieve death anxiety if they are personally invested in science. To summarize, the importance of science for an individual’s worldview might relate more to the cultural context and/or personal investment in science than religious affiliation or belief (Stavrova et al. 2016; McPhetres, Jong, and Zuckerman 2020).

So far, studies on the significance of science for worldviews have mainly been experimental (Farias et al. 2013; Tracy et al. 2011; Rutjens et al. 2016). Therefore, we know little about how people themselves evaluate how their confidence in science is meaningful for them. The few studies that have shed light on the meaning of science for worldviews from people’s own perspective have focused on atheists (van Mulukom et al., manuscript; Coleman and Arrowood 2015). Additionally, studies have at times measured attitudes towards science with items that posit science and religion as conflicting (see Farias et al. 2013; Rutjens, Sutton, and van der Lee 2018; Hayes and Tariq 2000), as high endorsement of science is often associated with non-religiosity and lack of God belief. This assumption seems empirically solid, as there has long been a reported link between science-orientation and atheism (e.g., Beit-Hallahmi 2006; Stirrat and Cornwell 2013). However, prior studies on the relationship between science attitudes and religious belief have mostly been

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2 For instance, several studies have applied the Belief in Science Scale (Farias et al. 2013) and reported negative correlations between belief in science and religious or paranormal belief (Farias et al. 2013; Aghababaei 2016; Irwin et al. 2015) – some have suggested that the relationship might be due to e.g., the effect of science education on critical thinking skills (Irwin et al. 2015). However, the scale posits science and religion as competing (Farias et al. 2013).
conducted in the United States, and recent work suggests that the correlations between religiosity and attitudes towards science show inconsistent patterns when the scope of research is extended beyond the Anglo-American context (McPhetres et al. 2020, see also Ecklund et al. 2016). Additionally, across studies conducted in different cultures, people often rely on natural and scientific explanations, but many also endorse supernatural causality for phenomena such as human origins and death in a context-dependent manner (Legare et al. 2012; Busch, Watson-Jones, and Legare 2017). In scientific contexts, people often apply more scientific explanations and less religious beliefs, and vice versa (Astuti and Harris 2008; Legare and Shtulman 2018; Preston and Epley 2009). These findings suggest that although scientific and supernatural explanations may “compete”, people might still utilize both in their everyday thinking and even integrate supernatural causality with scientific content (see Evans et al. 2009).

The present study explores self-reported attitudes towards science in the Nordic context. The study investigates the following question: Is endorsement of worldview components of science associated with unbelief among science-oriented respondents? The study was conducted in Finland among science-oriented respondents who were both believers and non-believers. This allowed assessing how the participants’ self-reported views of science answered to existential questions as well as investigating whether the believers and unbelievers systematically differed in their views. It was expected that both unbelievers and believers might self-report that science answers existential questions, and there might not be significant differences in self-reported endorsement of the worldview components of science.

In this study, worldview refers to a theory of reality that provides an individual with 1) a sense of meaning, 2) standards assessing human behaviour, and 3) hope of literal or symbolic immortality (Greenberg, Pyszczynski, and Solomon 1986; Pyszczynski, Solomon, and Greenberg 2015). This definition draws from terror management theory literature and bears similarities to
recent suggestions in the study of religion, such as worldviews as answers to “big questions” integrated into a meaning systems framework. Both emphasize the human need to experience meaning through connection, hold values on right and wrong, and form theories on what is true, where we come from, and where we are going (Taves, Asprem, and Ihm 2018; Taves 2018; Droogers 2014).

**What is a science-oriented worldview?**

Studies in the field of science-and-religion have at times been criticized for not specifying what is meant by science (Johnson, Scheitle, and Ecklund 2015). The current study investigates the significance respondents give to the concepts of “science” (in Finnish, *tiede*) and “scientific research”. Therefore, science is applied as an emic concept (see also Qadir and Syväterä 2017; cf. Johnson, Scheitle, and Ecklund 2015). However, it is necessary to note that in Finnish (as in many Nordic and Western European languages), the common meaning of science is wider in scope than in the Anglo-American context: the Finnish word for science often includes the social sciences and humanities, and at times, all research conducted at universities and other research institutions. The Finnish word for “science” therefore resembles the German term *wissenschaft* and equivalent terms in the Nordic languages, such as *vetenskap* in Swedish and *videnskab* in Danish (Hansson 2015, 15; Kiikeri and Ylikoski 2004, 16). Like prior research in the Nordic and Western European context (e.g., Lindeman et al. 2019), this study applies the nationally widespread word for science.

In prior academic and popular discussions, the importance of science for worldviews has often been discussed with the term “scientific worldview” (e.g., Enqvist 2014; National Church Council 2019; Irwin, Drinkwater, and Dagnall 2015). This expression implies that worldviews that hold science in high regard are also in accordance with science in their content, in the sense that
they are “scientific” (see also Niiniluoto 1984). However, it seems plausible that many people who identify with science still hold versatile everyday beliefs, including misconceptions about scientific theories (see e.g., Knobe and Samuels 2013). Since religious and supernatural content are often perceived in contrast with science, some also assume that scientific worldviews are non-religious (see e.g., Science Barometer 2019). Although atheism is often more common among researchers than the general population, there are many God believers among scientists (Ecklund et al. 2016) and also scientists may be prone to certain kinds of supernatural thinking, such as perceiving purpose in nature (Kelemen, Rottman, and Seston 2013). Since it is expected that not all the worldview content of respondents aligns with current scientific theories (and it is not the aim of my study to evaluate this), the current article does not discuss scientific worldviews but instead applies the term science-oriented worldview (cf. Johnson, Scheitle, and Ecklund 2015). Here, science-oriented worldview refers to meaning-making systems that rely on science – regardless of other possible beliefs of the respondents.

What is unbelief?

Although belief replacement literature defines an atheist as “an individual who lacks or denies belief in gods”, it is also implied that atheists more generally lack supernatural belief (which belief in science and other secular worldviews replace) (Farias 2013, 2). But what is supernatural? In prior literature, supernatural has often been defined e.g., as phenomena outside the realm of natural laws and scientific inquiry and/or beliefs that have culturally been considered supernatural, such as religious concepts and witchcraft (Flanagan 2008, 3; Legare et al. 2012; Watts et al. 2020). However, some studies suggest that most beliefs deemed as religious, paranormal or supernatural often share a cognitive structure that violates panhuman expectations concerning ontological properties
of beings (e.g., Lindeman and Svedholm 2012; Pyysiäinen, Lindeman, and Honkela 2003; see also Boyer 2001). For instance, the belief in intelligent design in nature contains intentional agency without a physical body – which humans readily expect intentional agents such as themselves to have. Studies suggest that beliefs such as mind-body dualism and perceiving purposeful design in nature might be intuitively appealing and occur in different cultural contexts (Järnefelt, Canfield, and Kelemen 2015; Järnefelt et al. 2018; Chudek et al. 2018). Therefore, it is possible that some hold beliefs that bear similarities to religious supernatural belief but operate with secular terminology.

In this article, unbelief is discussed as 1) unbelief in God, and 2) unbelief in other supernatural agency or purpose, when supernatural refers to beliefs that mix ontological core knowledge (cf. Lindeman and Svedholm 2012).

2 Method and participants

The data were collected with an online questionnaire, implemented on the GDPR compliant LimeSurvey platform. The respondents were recruited via Finnish research institutions and organizations that promote research. The invitation was first sent via email to research-affiliated organizations, followed by social media recruiting in Facebook, Twitter and selected discussion boards (for details of the recruitment procedure, see Supplementary material A). As an incentive, the respondents could participate in a raffle for an Amazon gift card (60 €). Participants could also request a report on the study results. The participants first answered open-ended questions on human origins, suffering, and death (to be reported in another article). After the open-ended questions, the respondents completed items for the science-oriented worldview measure. These were followed by questions on beliefs that mix core knowledge, a control question (see
Supplementary material B), and the Belief in Science Scale. Lastly, the participants answered demographic questions and were debriefed. The respondents had the opportunity to comment on the questions in open-ended text fields throughout the survey.

Altogether, 683 respondents completed the questionnaire. After excluding the respondents that answered control items incorrectly, 387 participants remained for analysis. The participants were of multiple genders (202 women; 170 men; 15 other / I don’t want to say). To protect anonymity of participants, age was explored with ordinal groups (18–30, 31–40, 41–50, 51–65, and over 65 years; range all age groups, Mdn = 31–40 years). Most respondents were aged 40 years or less (54%). The participants were highly educated (years of education $M = 19.6$, $SD = 4.6$), and half of the respondents had worked in research institutions (194; natural sciences 93, humanities 54, social sciences 33, other 14 participants). The majority did not belong to any religious community (269, religiously affiliated 118). Similarly, most respondents did not believe in God (268, 69%), or felt unsure of their God belief (66, 17%). Fifty-three respondents stated that they believed in God (14%). Next, the measures and open-ended questions applied in the study are described.

**Supernatural agency and purpose**

To investigate respondents’ belief in supernatural agency and purpose, the participants were asked to rate statements on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The items contained statements often associated with religion (e.g., “God created the Earth and living things (animals, plants)”) and statements that do not contain religious terminology (e.g., “The world is a
fair place”, “It is most likely that we live in a reality created by an agent (such as AI)”). The items were collected from several prior measures, and some of the items were based on prior qualitative data (Davis, Juhl, and Routledge 2011; Stanovich 1989; Lipkus 1991; Haimila 2016). The source most relied upon was Järnefelt et al.’s (2018) culturally sensitive supernatural beliefs survey, originally designed for Chinese respondents. Some items were modified to better suit the contemporary Finnish context (for all items and modifications, see Supplementary material C). The questions also contained filler items, such as “Humans have evolved from other, prior species of animals” and “People mostly have good intentions”. The internal consistency of the belief items as Cronbach’s alpha was high (α = .89). The God belief of the participants was investigated in the final section of the survey with the question “Do you believe in God?” The respondent could choose one of the following options: Yes, No, and I cannot say (or “I do not know”).

**Science-oriented worldview**

To explore the significance of science for one’s worldview, the respondents answered items on 1) a sense of meaning, 2) standards for assessing human behaviour, 3) literal immortality, and 4) symbolic continuity from scientific research (see Tables 1–4). The items were rated on a Likert scale 1–5 (1 = strongly disagree to 5 = strongly agree). Reversed items were recoded so that higher scores reflect higher endorsement of the worldview components. The internal validity of each subscale was investigated with principal component analysis, and items that were the least related to the

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3 To exclude the possibility of respondents perceiving the purposeful/agentic items as mere metaphors, the items that according to the pilot study could be read as metaphorical were preceded by an item that did not contain agency or purpose but was otherwise identical to the belief item. E.g., the item “All humans are made of the same material (for instance, matter/energy, stardust)” was preceded by the item “All humans consist of the same matter (for instance, [a synonym for matter]/energy, stardust).”

4 There are several scales for measurement of supernatural and paranormal belief – however, these mainly explore beliefs that are culturally perceived as religious, New Age or “superstitious” (Jong et al. 2013; Tobacyk 2004; Irwin and Marks 2013) or are formed for a specific topic, such as magical beliefs about nutrition (Lindeman et al. 2000; however, see Lindeman et al. 2019).
extracted component(s) (loading < .35) or other items of the subscale (all correlations $r < .35$) were deleted (see Supplementary material D). This procedure was followed by internal consistency analysis utilizing the Cronbach’s alpha.\(^5\)

The structure of the remaining items was explored. Principal component analysis with Varimax rotation yielded six components with eigenvalues > 1.0 that accounted for 65% of the variance. The first component contained the meaning subscale (loadings .60–.79), and the second component encompassed the symbolic continuity subscale (loadings .54–.85). The third and fourth components comprised the standards for assessing human behaviour subscale: component 3 contained the items that focused on science as a tool for moral evaluations (with loadings .53–.83), and component 4 mainly comprised the items that also described science as a source of moral evaluations (loadings .60–.82). Similarly, the literal immortality subscale items loaded to two separate components: component 5 contained the items on avoiding death via science (with both items loading = .94) and component 6 on science that enables continuity after death (loadings .74–.76). The subscales were merged for an overall measure of self-reported meaning, morality, and post-death continuity from science. The reliability of the measure as internal consistency was high (Cronbach’s $\alpha = .89$). For further analyses, median scores were computed for the measure and each subscale. In the following sections, the items and internal consistency of each subscale are described. The items and their median values for God belief groups are listed in Tables 1–4.

For formulation of the items on a sense of meaning, George and Park’s (2017) operationalization of existential meaning in life was applied (cf. also Singer 2004). According to George and Park, meaning in life contains at least the following 1) increasing comprehension of one’s life, 2) providing a sense of purpose and 3) a sense that one’s existence matters. Although

\(^5\) However, the final sample contained more non-religious participants (269) than religious participants (118). Therefore, the PCA item reduction procedure was also conducted for the non-religious and religious participants separately to investigate any differences in response patterns and/or interpretation of items.
items drawing from all three dimensions were included, the items exploring the comprehension of one’s life were excluded from the subscale based on the PCA analysis on the underlying component of the subscale. The items on purpose and mattering of one’s own existence, however, loaded onto a single component that is applied here as the meaning subscale. The internal consistency of the subscale was good (Cronbach’s $\alpha = .86$).

**TABLE 1**  Science-oriented worldview items on sense of meaning: medians organized by subscale for God belief groups (scale 1–5, where 1 = totally disagree, and 5 = totally agree)

<table>
<thead>
<tr>
<th>Sense of meaning</th>
<th>Atheists (unbelief in God)</th>
<th>Unsure / cannot say</th>
<th>Theists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science increases the feeling of purpose and meaning in my life.</td>
<td>4.5</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2. Scientific research strengthens my identity.</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>3. Science gives my life direction.</td>
<td>4.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4. Science makes my life more valuable.</td>
<td>4.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>5. Science motivates me.</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>6. Science and research increase my sense that my life is meaningful.</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

According to Darrell and Pyszczynski (2016), worldviews also provide “standards of value for individuals within a culture to live up to”. In this study, these standards of value were interpreted similarly to Vidal’s (2008) suggestions on the worldview components of axiology (What is good and bad?) and praxeology (What actions we should take?), and the items were formed accordingly (van Mulukom et al., manuscript; see also Taves 2018). However, the underlying components of the items did not adhere to this theoretical structure – instead, in the PCA analysis the items that contain milder expressions and mainly depict science as a tool loaded onto one component, and items that mostly focus on science as a source for these standards were isolated to another
component. Despite this, the subscale had moderately high internal consistency (Cronbach’s $\alpha = .86$).

TABLE 2  Science-oriented worldview items on standards assessing human behaviour: medians organized by subscale for God belief groups (scale 1–5, where 1 = totally disagree, and 5 = totally agree)

<table>
<thead>
<tr>
<th>Standards for assessing human behaviour</th>
<th>Atheists (unbelief in God)</th>
<th>Unsure / cannot say</th>
<th>Theists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scientific research is irrelevant for moral decision-making. [R]</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2. I evaluate people’s [or human’s] moral character with science.</td>
<td>3.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>3. Science provides ingredients for my moral views.</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>4. Science provides me with a framework for evaluating the actions of the humankind.</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>5. Science provides me with a framework for evaluating my own actions.</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>6. Scientific research tells me what actions we should take.</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>7. Science tells me what is good and bad.</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>8. Science helps to evaluate whether humankind has succeeded or failed.</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>9. Science tells us what is valuable.</td>
<td>3.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Some have suggested that similar to religious belief, scientific progress may provide hope of literal immortality. According to Lifshin et al. (2018), afterlife beliefs may be interchangeable with the belief in avoiding death via indefinite life extension, which can serve as alternative means for literal immortality (see also Vail et al. 2020). Therefore, the items on hope of literal immortality via science refer to 1) surviving death or 2) avoiding death with scientific tools. The internal consistency of the literal continuity items was acceptable (Cronbach’s $\alpha = .75$).
TABLE 3  Science-oriented worldview items on literal immortality: medians organized by subscale for God belief groups (scale 1–5, where 1 = totally disagree, and 5 = totally agree)

<table>
<thead>
<tr>
<th>Literal immortality</th>
<th>Atheists (unbelief in God)</th>
<th>Unsure / cannot say</th>
<th>Theists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science provides hope that my loved ones can avoid death.</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2. Science provides hope that I can avoid death.</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>3. Scientific research provides a feeling of my own continuity after death.</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>4. Science makes it possible that my essence survives death.</td>
<td>1.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

However, cultural meaning systems can also provide hope of continuity in less literal ways, and these were explored in the items of symbolic continuity. According to Pyszczynski, Greenberg, and Solomon (1999), people gain hope of symbolic immortality when they contribute to something meaningful that outlasts their individual existence. Symbolic continuity is often described as being a part of something larger and more significant than oneself (Dechesne et al. 2003), an experience Caldwell-Harris et al. (2011) also associate with feelings of awe that they describe as “feelings of wonderment and of being a part of something greater than themselves” (cf. also Gottlieb, Keltner, and Lombrozo 2018). Therefore, an item on awe from science was also added to the symbolic continuity subscale. The other items were drawn from open-ended responses of Finnish atheists in a prior study (Haimila, manuscript). In PCA analysis of all subscales, the symbolic immortality items loaded onto a single component, and the Cronbach’s alpha measure of the subscale was good (α = .84).
TABLE 4  Science-oriented worldview items on symbolic continuity: medians organized by subscale for God belief groups (scale 1–5, where 1 = totally disagree, and 5 = totally agree)

<table>
<thead>
<tr>
<th>Symbolic continuity</th>
<th>Atheists (unbelief in God)</th>
<th>Unsure / cannot say</th>
<th>Theists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel that science connects me to a chain of generations.</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2. I feel that science connects me to animals [part of the animal kingdom].</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>3. I feel that scientific research attaches me to humankind.</td>
<td>4.5</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>4. I feel that science connects me to the circulation of nature.</td>
<td>5.0</td>
<td>4.5</td>
<td>4.0</td>
</tr>
<tr>
<td>5. Science offers me an experience of respectful wonder (awe experience).</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>6. Science makes me feel that I am a part of the universe.</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

The symbolic immortality subscale was followed by an open-ended field to explore which bigger whole the participants felt connected to via science (for those participants that agreed that science connected them to a larger whole or community). Due to the multiple possible connotations of the word “science”, it was also explored what kind of science the participants thought of while they answered the measure. This was investigated with an open-ended question: “Could you tell us briefly what kind science you thought of while answering the questions?”

The open-ended responses were analysed with question-dependent coding templates, and the categories of the templates were based on the open-ended data. The responses were coded without demographic information on the participants.
Belief in Science Scale

The participants also completed a Belief in Science Scale (Farias et al. 2013). During recent years, the scale has been applied in several studies on psychology of religion and nonreligion (Valdesolo, Park, and Gottlieb 2016; Ståhl, Zaal, and Skitka 2016), including studies implemented in non-Western contexts (e.g., Aghababaei 2016). However, there are multiple interpretations on what the Belief in Science Scale measures, as the scale has been utilized to measure “scientific faith” (Farias et al. 2013) but also other concepts, such as “belief in the values of science” (Irwin, Dagnall, and Drinkwater 2016). The items are based on Swedish philosopher Mikael Stenmark’s suggestions on scientism that 1) aims to increase the influence of science in research and other parts of society (“science expansionism”), and 2) includes a negative disposition towards religion (Farias et al. 2013; see Stenmark 2001). It was expected that the Belief in Science Scale and science as a cultural worldview items might measure different, yet possibly overlapping, aspects of attitudes towards science. Firstly, the items on the Belief in Science Scale focus on possible content of science endorsement instead of its self-reported functions. Secondly, the Belief in Science Scale juxtaposes science with religion. As in prior studies, the internal consistency of the measure was high (Cronbach’s α = .90).
TABLE 5  Belief in science scale (Farias et al. 2013): item medians organized by subscale for God belief groups (scale 1-6, where 1 = totally disagree, and 6 = totally agree)

<table>
<thead>
<tr>
<th>Belief in science scale items</th>
<th>Atheists (unbelief in God)</th>
<th>Unsure / cannot say</th>
<th>Theists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science provides us with a better understanding of the universe than does religion.</td>
<td>6.0</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2. “In a demon-haunted world, science is a candle in the dark.” (Carl Sagan)</td>
<td>5.0</td>
<td>5.0</td>
<td>3.5</td>
</tr>
<tr>
<td>3. We can only rationally believe in what is scientifically provable.</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4. Science tells us everything there is to know about what reality consists of.</td>
<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>5. All the tasks human beings face are soluble by science.</td>
<td>3.0</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>6. The scientific method is the only reliable path to knowledge.</td>
<td>5.0</td>
<td>4.0</td>
<td>2.0</td>
</tr>
<tr>
<td>7. The only real kind of knowledge we can have is scientific knowledge.</td>
<td>5.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>8. Science is the most valuable part of human culture.</td>
<td>4.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>9. Science is the most efficient means of attaining truth.</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>10. Scientists and science should be given more respect in modern society.</td>
<td>6.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

3  Results

Preliminary analysis

Preliminary analyses indicated that God belief was not related to age, gender, education or work affiliation to research institutions. The overall belief in supernatural agency and purpose was not associated with age or work affiliation to research, but women endorsed supernatural belief more than men, albeit with very weak effect size ($H(2) = 10.416, p = .005, \eta^2 = .02$; Dunn’s test with Bonferroni correction between women and men $p = .024$, mean rank of women 209.13, men 180.29). Additionally, education years were associated with less supernatural belief, although the
correlation was weak ($r_s = -0.13, p = .013$). As expected, respondents that believed in God scored higher in general belief in supernatural agency and purpose ($H(2) = 167.139, p < .001$) with large effect size ($\eta^2 = .43$).\textsuperscript{6}

The belief in science scale medians were moderately associated with overall median score of science-oriented worldview subscales ($r_s = .50, p < .001$) and with the science-oriented worldview subscales, except for literal immortality ($r_s = .11, p = .032$). In accordance with prior studies, the belief in science median was strongly related to God belief ($H(2) = 102.717, p < .001, \eta^2 = .26$), and mean ranks indicated that atheists (229.83) endorsed the Belief in Science Scale more than the undecided (135.29), and theists endorsed the items the least (80.12).

326 participants elaborated on what kind of science they thought about while answering the science-oriented worldview measure. Many participants reported that they mainly thought of natural sciences (34\% of those who answered the question). However, more respondents described that their perception of science also included social sciences and/or humanities (43\%). Several respondents also stated that they thought about different research fields in different subscales or items (7\%). For instance, one participant wrote that s/he thought about “primarily the natural sciences but also about the humanities, especially in the question ‘I feel that scientific research connects me to humankind’” (P1054). Additionally, some participants mentioned that they thought about their own field of study (9\%).\textsuperscript{7}

\textsuperscript{6}It should be noted that there were no significant differences in education years among gender groups. To investigate how the participants interpreted the God belief question, self-reported belief identities were examined for each God belief group. Respondents that answered “Yes” to the question “Do you believe in God?” primarily identified themselves as religious (45\%), other (26\%), or spiritual but not religious (17\%). Those that responded that they do not know (or cannot say) whether they believe in God mainly self-reported as agnostics (41\%), spiritual but not religious (29\%), or other (15\%). On the other hand, participants who did not believe in God most frequently identified themselves as atheists (45\%), as having no religion (18\%), as agnostics (14\%) or indifferent (9\%).

\textsuperscript{7}A minority reported that they thought about e.g., the scientific method (5\%) or science as research conducted at the universities or by the “scientific community” (4\%). The respondents also held other notions of science, but these were less common in the open-ended responses (e.g., science as progress and a remedy for humankind (3\%); science as an explanation/increasing humans’ understanding of the world (2\%)).
Group comparisons on self-reported functions of science

To explore the relationship of God belief and endorsement of meaning, morality and literal and symbolic continuity from science, Kruskal-Wallis H tests were carried out on the science-oriented worldview measure and each subscale, followed by Dunn’s test with Bonferroni correction for pairwise group comparisons. Furthermore, a Welch F test of equality of means was conducted when the variances of subscale medians were non-homogenous across groups (see Delacre et al., 2019). The pairwise comparisons of the Welch test were conducted using the Games-Howell test. The relationship between scale results and demographic variables was also investigated.\(^8\)

Overall, God belief was associated with endorsement of worldview components from science \((H(2) = 26.941, p < .001)\) with medium effect size \((\eta^2 = .06)\). Pairwise comparisons of God belief groups showed significant differences between atheists and theists \((p < .001)\) and between atheists and those unsure of their God belief \((p = .011)\). Mean ranks indicated that atheists scored the highest in the science-oriented worldview \((212.43)\), followed by those undecided in their God belief \((168.06)\), and God believers \((133.11)\).

Science providing meaning and morality

The God belief groups differed significantly in their sense of meaning from science \((H(2) = 18.210, p < .001, \eta^2 = .04)\). Post hoc comparisons indicated differences between atheists and theists \((p = .001)\), and between atheists and those unsure of their God belief \((p = .009)\). Mean ranks showed

---

\(^8\) Education years weakly correlated the meaning subscale median \((r = .11, p = .041)\), and also work affiliation to research was related to a higher median in the meaning subscale \((\text{Mann-Whitney } U = 16549.00, p = .043, \text{ research affiliation mean rank } = 205.20, \text{ non-affiliated mean rank } = 182.75)\). Endorsement of literal continuity from science was negatively correlated to age \((r = -.25, p < .001)\). Interestingly, respondents that had not worked in research institutions scored slightly higher on the symbolic continuity subscale \((\text{mean rank } = 205.38)\) than those working in research \((182.68)\), according to a Mann-Whitney test \((U = 16525.00, p = .035)\).
that atheists scored the highest in meaning from science (mean rank 209.59), followed by the undecided (165.02), and theist participants (151.24).

God belief was also related to perceived significance of science for morality ($H(2) = 22.814$, $p < .001$, $\eta^2 = .05$). Post hoc comparisons indicated a difference between atheists and theists ($p < .001$), atheists scoring higher than theists (atheists’ mean rank 209.15, theists’ mean rank 137.67). Due to the non-homogeneity of variances, a Welch F test was also conducted ($F(2, 100.26) = 10.93$, $p < .001$) with Games-Howell post hoc tests, indicating a significant difference between atheists and theists ($p < .001$).

167 respondents specified their responses with open-ended comments (118 atheists, 26 unsure in their God belief, and 23 theists). Twenty-seven participants commented on the implications of confidence in science for a sense of meaning. However, the comments mostly discussed the role of science for morality (100 respondents, 60% of open-ended responses). The comments on morality were coded into two main categories: 1) importance of science for morality (54 respondents), and 2) limitations/resistance of combining science and morality (65 respondents). In general, the most widely mentioned limitation was that science can only answer “factual questions” (P1294), as science cannot inform us of good and bad, or right and wrong (27 respondents). However, many respondents both described the significance of science for morality and acknowledged the limitations of science. These responses were coded to both categories (33 respondents). One pattern of responses described science as a necessary tool for moral consequences, as one participant wrote:

9 Most frequently, the respondents mentioned a sense of paradox between science and meaning in life (nine respondents). They described that the endeavour of scientific research on one hand increases their sense of significance, yet decreases it. As one participant wrote, “[…] science and research have made my life very meaningful, but also deprived it of all meaning. I feel positive about the personal goals I’ve set for science and research, and I therefore experience my everyday life as meaningful, but on the other hand when you think of the vastness of the universe and time, in the long run what I do doesn’t matter at all” (P688, atheist). The respondents experienced human insignificance in differing ways. Four participants specified that the lack of personal significance is a positive experience that brings comfort or “relief” (P1302, atheist). However, few described personal insignificance as a pathway to their own existential anxiety or increased “nihilism” (P804, atheist).
Science in itself does not tell what is good and bad or what we should choose to develop a just society. However, it helps to predict the consequences of choices, in one’s own life as well as societally and globally, and is therefore an essential tool when we aim for morally right actions. (P1066, atheist)

Fewer respondents reflected on the moral importance of science without discussing possible limitations (21 participants). Some focused on the ability of research to increase well-being, as one of the respondents described:

… we know through research on things that are important to humans and what causes [social] malaise. This [knowledge] can be applied to understand humanity and to make the world a better place to live for us all. Bad causes suffering, good well-being. (P1284, unsure of God belief)

Kruskal-Wallis H tests indicated no significant differences between God belief groups in the two main categories of open-ended responses (importance of science for morality; limitations/resistance of combining science and morality). However, the number of theists that specified their views on morality and science was small (11 theists, 16 unsure in their God belief, and 73 atheists), as theist respondents were fewer in the sample than atheists or those unsure of their God belief.\(^\text{10}\)

\(^{10}\) Additionally, in the Kruskal-Wallis test between God belief groups on the importance of science for morality the p value of the significance test was small, albeit non-significant (\(H(2) = 5.250, p = .072\)).
Literal and symbolic immortality from science

There was no significant effect of God belief on self-reported hope of literal continuity via science ($H(2) = 0.582, \ p = .748$). Further insight was sought from the open-ended comments following the continuity subscales. The most frequent feedback on the literal continuity subscale concerned the “hope of” avoiding death: thirty respondents criticized the expectation that human immortality would be a positive phenomenon (25 atheists, 3 unsure in their God belief, and 2 God believers).\footnote{Although 30 responses out of 387 might seem like a small number, these responses are noteworthy especially since the open-ended field following the literal continuity subscale was not a general comments field but explored what kind of science the participants thought of while answering.}

For instance, one participant wrote that it is “[…] weird to talk of these kinds of ‘hopes’ since I don’t have any. I consider that humans are not immortal, and consciousness does not survive death” (P796). Several atheist participants also described mortality as comforting, and some perceived the thought of surviving death as negative or “distressing” (P2522). An atheist respondent specified that the finity of life “makes the things I do during these 80–90 years more meaningful” (P1294). In a similar vein, another respondent wrote, “the question gave me the impression that mortality would be somehow negative. But isn’t it mortality that makes life sweet?” (P792).

Despite this, God belief groups did differ in symbolic continuity items, operationalized here as a sense of belonging from science to something that outlasts individual existence and awe from science, ($H(2) = 24.138, \ p < .001$). The differences between groups were small to moderate in effect size ($\eta^2 = .06$). Pairwise comparisons indicated that the differences were between atheists and theists ($p < .001$), and theists and respondents not sure about their God belief ($p = .035$). Similar to the meaning and morality measures, atheists (mean rank 209.15) endorsed symbolic continuity from science the most, followed by the undecided (181.92) and theists (132.45). Due to non-homogenous variances, a Welch F test was conducted. The Welch test supported the Kruskal-Wallis
results \( F(2, 93.75) = 11.34, p < .001 \) with Games-Howell post hoc tests indicating a significant difference between atheists and theists \( p < .001 \).

191 respondents also answered the open-ended question of the item “Science makes me feel that I’m a part of some bigger whole, what?” In the responses, participants mainly reported that science connects them to other humans and communities, such as the research community (36% of those who answered the question), other communities (9%), humankind or humans more generally (8%), and/or like-minded people who were described in positive and at times moral terms (Intelligent/curious/good people, 7%). Relatedly, some respondents felt that science connects them to human progress (9%). All categories and the frequencies of the responses are reported in Table 6. The categories overlap in many of the responses. The possible relationship of the open-ended responses and God belief was examined for the top categories (1–5). Chi-square tests of independence showed no significant association between God belief and open-ended reports on the connection with a larger whole via science.

<table>
<thead>
<tr>
<th>Category</th>
<th>n (% of open-ended responses)</th>
<th>Example quotes from respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scientific community</td>
<td>68 (36%)</td>
<td>“Scientific community” “Researchers”</td>
</tr>
<tr>
<td>2. Other/nonspecified community</td>
<td>18 (9%)</td>
<td>“Community” “My own inner circle” “Gender”</td>
</tr>
<tr>
<td>3. Progress/Enlightenment</td>
<td>17 (9%)</td>
<td>“The project of Enlightenment” “The constant progress of the society” “The civilization of humankind”</td>
</tr>
<tr>
<td>4. Humankind</td>
<td>15 (8%)</td>
<td>“Humankind” “Humanity”</td>
</tr>
<tr>
<td>5. All living/biological</td>
<td>15 (8%)</td>
<td>“Everything living” “The circle of life” “Nature, animals and plants, soil”</td>
</tr>
<tr>
<td>Category</td>
<td>n (% of open-ended responses)</td>
<td>Example quotes from respondents</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>6. Intelligent/curious /good people</td>
<td>14 (7%)</td>
<td>“Advanced level of thought”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The chain of people that are curious and thirsty for knowledge”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The group of those that aspire to truth and wisdom”</td>
</tr>
<tr>
<td>7. Society/culture</td>
<td>12 (6%)</td>
<td>“Society and culture”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Society where the science rhetoric is strong (in its good and bad ways)”</td>
</tr>
<tr>
<td>8. Cosmos/space</td>
<td>12 (6%)</td>
<td>“Space”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“A very tiny part of the universe”</td>
</tr>
<tr>
<td>9. History/time</td>
<td>12 (6%)</td>
<td>“History”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Inheritance of thought”</td>
</tr>
<tr>
<td>10. Nature/physical</td>
<td>6 (3%)</td>
<td>“Nature”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The circulation of matter in this world”</td>
</tr>
<tr>
<td>11. Interconnectedness</td>
<td>4 (2%)</td>
<td>“Everything”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“The common consciousness that we share”</td>
</tr>
<tr>
<td>12. This planet/Earth</td>
<td>3 (2%)</td>
<td>“This planet”</td>
</tr>
<tr>
<td>13. Creation or God’s plan</td>
<td>3 (2%)</td>
<td>“The created universe”</td>
</tr>
</tbody>
</table>

**Science-orientation and belief in agency and purpose**

The relationship between science-oriented worldview scores and supernatural belief was explored with Spearman correlation coefficients, due to ordinal measurement and non-normal distribution of variables. There was a weak negative correlation between the science-oriented worldview score and the overall supernatural belief score ($r_s = -.21$, $p < .001$). Belief in supernatural agency and purpose was associated with lower endorsement of all science-oriented worldview subscales except for literal continuity after death (see Table 7). All correlations between supernatural belief items and science-oriented worldview subscales were weak (between coefficients $-.30$ and $.21$). In general, reporting a sense of meaning, moral standards, and symbolic continuity from research was associated with less supernatural belief. However, the literal continuity from the science subscale
formed an exception: the median score was mainly not related to supernatural belief, and the median was even positively associated with two items: reality as created in scientific terms and perceiving nature as a living creature. Similarly, belief in science was also associated with less supernatural belief, albeit more strongly than science-oriented worldview measure ($r_s = -0.43, p < 0.001$).

The negative correlations were the strongest between science-oriented worldview measures and supernatural beliefs that may often be perceived as religious (afterlife belief and statements containing the word “God”). Similarly, supernatural belief statements that apply secular terms were less associated with science-oriented worldview scores. Moreover, some secular belief items were not correlated to the endorsement of a science-oriented worldview or belief in science. These included items on a purposeful and/or just world (“The world is a fair place”, “Everything happens for a purpose”), dualistic free will belief (“Humans have free will that is independent of the body”), agentic nature belief (e.g., “Nature is a living creature”, “Nature maintains a balance by self-regulating”), and creator belief operating with scientific terminology (e.g., “It is most likely we live in a reality created by an agent (such as AI)”.

TABLE 7 Spearman’s correlation coefficient between the median scores of supernatural belief items and science-oriented worldview measures

<table>
<thead>
<tr>
<th>Items on supernatural agency and purpose</th>
<th>Science-oriented worldview</th>
<th>Meaning subscale</th>
<th>Morality subscale</th>
<th>Literal continuity subscale</th>
<th>Symbolic continuity subscale</th>
<th>Belief in science scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The world is a fair place.</td>
<td>.05</td>
<td>.02</td>
<td>.01</td>
<td>.10*</td>
<td>−.04</td>
<td>−.06</td>
</tr>
<tr>
<td>2. Everything happens for a reason [in Finnish: purpose].</td>
<td>−.09</td>
<td>−.06</td>
<td>−.09</td>
<td>.03</td>
<td>−.12*</td>
<td>−.27**</td>
</tr>
<tr>
<td>3. People eventually get what they deserve.</td>
<td>−.11*</td>
<td>−.08</td>
<td>−.11*</td>
<td>.04</td>
<td>−.15**</td>
<td>−.22**</td>
</tr>
<tr>
<td>4. The essence of a human survives his/her death.</td>
<td>−.21**</td>
<td>−.13**</td>
<td>−.20**</td>
<td>.09</td>
<td>−.23**</td>
<td>−.40**</td>
</tr>
<tr>
<td>5. Life events are random in the sense that they don’t have a purpose. [R]</td>
<td>−.25**</td>
<td>−.19**</td>
<td>−.23**</td>
<td>−.02</td>
<td>−.28**</td>
<td>−.41**</td>
</tr>
<tr>
<td>6. The human mind is somewhat separate from bodily functions.</td>
<td>−.17**</td>
<td>−.20**</td>
<td>−.12*</td>
<td>.02</td>
<td>−.21**</td>
<td>−.21**</td>
</tr>
<tr>
<td>7. Humans have a soul.</td>
<td>−.17**</td>
<td>−.15**</td>
<td>−.15**</td>
<td>.03</td>
<td>−.20**</td>
<td>−.39**</td>
</tr>
<tr>
<td>8. Humans have free will that is independent of the body.</td>
<td>−.09</td>
<td>−.06</td>
<td>−.11*</td>
<td>.05</td>
<td>−.06</td>
<td>−.09</td>
</tr>
<tr>
<td>9. I believe in fate.</td>
<td>−.13*</td>
<td>−.12*</td>
<td>−.10</td>
<td>.04</td>
<td>−.17**</td>
<td>−.24**</td>
</tr>
<tr>
<td>10. I believe in life after death.</td>
<td>−.26**</td>
<td>−.21**</td>
<td>−.24**</td>
<td>.03</td>
<td>−.26**</td>
<td>−.49**</td>
</tr>
<tr>
<td>11. Events have a purpose determined by God.</td>
<td>−.26**</td>
<td>−.20**</td>
<td>−.26**</td>
<td>.02</td>
<td>−.25**</td>
<td>−.48**</td>
</tr>
<tr>
<td>12. Nature is a living creature.</td>
<td>.00</td>
<td>.01</td>
<td>−.04</td>
<td>.13*</td>
<td>−.01</td>
<td>−.16**</td>
</tr>
<tr>
<td>13. Some kind of greater force created the Earth and living things (animals, plants) and continues to have an influence on them.</td>
<td>−.27**</td>
<td>−.19**</td>
<td>−.25**</td>
<td>.00</td>
<td>−.27**</td>
<td>−.52**</td>
</tr>
<tr>
<td>14. God created the Earth and living things (animals, plants).</td>
<td>−.31**</td>
<td>−.25**</td>
<td>−.30**</td>
<td>−.02</td>
<td>−.29**</td>
<td>−.51**</td>
</tr>
<tr>
<td>15. It’s most likely we live in a reality created by an agent (such as AI).</td>
<td>−.05</td>
<td>−.06</td>
<td>−.06</td>
<td>.21**</td>
<td>−.05</td>
<td>−.04</td>
</tr>
<tr>
<td>16. Nature maintains a balance by self-regulating.</td>
<td>.09</td>
<td>.02</td>
<td>.08</td>
<td>−.05</td>
<td>.19**</td>
<td>.10</td>
</tr>
<tr>
<td>17. Animal species can change their own biological traits in order to survive.</td>
<td>.10*</td>
<td>.05</td>
<td>.10*</td>
<td>−.07</td>
<td>.15**</td>
<td>.12*</td>
</tr>
<tr>
<td>18. In the world, there is some purposeful force (e.g., a life force).</td>
<td>−.23**</td>
<td>−.19**</td>
<td>−.19**</td>
<td>.00</td>
<td>−.22**</td>
<td>−.48**</td>
</tr>
<tr>
<td>19. All humans are made of the same material (for instance, matter/energy, stardust).</td>
<td>−.02</td>
<td>−.03</td>
<td>−.04</td>
<td>.01</td>
<td>−.04</td>
<td>−.12*</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. Note. N = 387 in all variables except for the belief in science median (n = 386).
It has long been suggested that people may find a sense of meaning and comfort from secular beliefs as some do from religion (e.g., Popper 1945, 3–4; Bailey 1983; Smith 1994). According to the belief replacement hypothesis, secular worldviews may serve similar psychological functions as religious belief and replace supernatural beliefs for atheists (Farias 2013). This study investigated whether endorsement of meaning, morality, and continuity from science is associated with unbelief for pro-science respondents. The study operationalized supernatural belief (and therefore unbelief) in two ways: 1) as belief in God and 2) as belief in supernatural agency or purpose that can operate with religious or secular terminology, where supernatural is defined as beliefs that mix ontological core knowledge (Pyysiäinen, Lindeman, and Honkela 2003; Lindeman and Svedholm 2012).

Contrary to expectations, both types of unbelief were related to higher endorsement of a sense of meaning, moral standards, and symbolic continuity from science. The effect sizes of these differences ranged from weak to moderate. The respondents self-reports therefore align with Farias’ (2013) suggestion that science may serve worldview functions that have been associated with religiosity (e.g., meaning and moral guidance) for unbelievers, since atheists did differ from other God belief groups and endorsement of worldview functions was related to less supernatural belief – and religious belief in particular.

However, small to moderate effect sizes suggest that among science-oriented individuals, the differences between God believers, atheists and those unsure of God’s existence (e.g., agnostics) might be less significant than some have suggested. For instance, Rutjens et al. (2018, 9) have argued that “science and religion both function as ultimate (and therefore incompatible)
explanatory frameworks” (see also Farias 2013).\textsuperscript{12} The results reported here suggest that among science-oriented Finns, also God believers draw a sense of meaning and purpose from science, endorse the role of research for moral decision-making, and experience a sense of connection and awe through science (see Tables 1–4). Therefore, the results question at least the statements on an irreconcilable conflict between a science-oriented worldview and supernatural beliefs (cf. Farias 2013, 5; see also Watts et al. 2020; Legare et al. 2012).\textsuperscript{13} Small differences between groups also suggest that it would be premature to discuss science as relevant for merely the worldviews of atheists and/or religiously non-affiliated.

Interestingly, unbelief in the supernatural was not related to the hope of exceeding human mortality via science. Comments from participants suggest that a this-worldly orientation and the rejection of afterlife belief might partly account for the low scores in literal immortality from science in atheist respondents. Prior literature has associated atheist worldviews with the importance of the “here and now” that has even been suggested as the “Atheist Salvation” (Coleman and Arrowood 2015, 11, 19; Coleman et al. 2019). However, this plausible reason for the low belief in literal continuity via science for atheists does not explain the low scores among theists and participants that are unsure of their God belief. Although literal immortality may not be commonly associated with science in public discussions, the same could be argued for the significance of science for morality, which still yields higher endorsement in all belief groups. It is also interesting that scientific research provides hope of literal continuity for so few in the sample, despite prior findings on the ability of indefinite life extension to provide literal immortality for the non-religious

\textsuperscript{12} However, Rutjens et al. (2018) also take into account studies on explanatory coexistence and that scientific and religious explanation can coexist “in some cases”.

\textsuperscript{13} However, it is possible that in the context of this study, theists did not apply their God belief mainly as an explanatory framework but relied more on the explanatory power of science (Ecklund et al. 2016), as also science-oriented God believers mostly agreed with the Belief in Science item “Science provides us with a better understanding of the universe than does religion” (albeit less strongly than atheists, see Table 5). Still, it should be noted that although many God believers in this sample identified as religious, God belief does not equal to religiosity.
(Lifshin et al. 2018). However, in this study merely the significance of “science” and “scientific research” was explored – it is possible that items with more specific content (e.g., on indefinite life extension or mind uploading) would have yielded different and more versatile kinds of results.

The results also suggest that supernatural belief that operated with secular terminology was less negatively associated with a science-oriented worldviews than religious belief. If religious belief and the importance of science for many (science-invested God believers) do not clash, it appears there is even less sense of conflict between trust in science and supernatural belief that does not contain religious or paranormal terminology (e.g., perceiving that everything happens for a purpose). This may be related to many adhering to the perceived conflict of science and religion also in the Finnish context (Science Barometer 2019), as prior studies have noted the importance of cultural connotations of terms and their relationship to respondents’ identities for self-reported attitudes (e.g., Caldwell-Harris et al. 2011). However, in the case of nature items, it should be noted that some of the participants may have interpreted the items metaphorically (e.g., the item “Nature maintains a balance by self-regulating”). As prior studies have noted, there is a fine line between a so-called “strong metaphor” and belief, as both can infer goal-directed causality and hinder non-teleological understanding of phenomena (Taber and Watts 1996; Sacchi et al. 2013; cf. also Boyer 2018). Still, the question is relevant as the endorsement of items is interpreted as an indication of self-reported explicit belief.\textsuperscript{14} However, it is not uncommon to endorse agency or purpose in nature in the Finnish context (Metelinen 2020).\textsuperscript{15}

\textsuperscript{14} Based on the pilot analysis, it was suspected that some respondents might interpret two items metaphorically, as the items were widely endorsed and the wordings were not disputed in the open-ended comments (unlike other items that applied nature/naturalistic terminology and contained agency or purpose). Therefore, the statements were preceded by a filler item that did not contain agency or purpose but was otherwise identical in content, see Supplementary material C. However, this procedure does not clarify to what extent the respondents may have interpreted the other nature items as metaphors (e.g., “Animal species can change their own biological traits in order to survive”).

\textsuperscript{15} For instance, a recent representative survey found that 49% of Finns somewhat agree or agree with the statement “The coronavirus epidemic is nature’s own way to reduce overpopulation and care for the capacity of the environment and the climate” (Metelinen 2020). However, such a high endorsement rate of purposeful agency in nature might be exceptional and somewhat accounted for by the COVID epidemic, as the data of the survey were collected during the Finnish epidemic (cf. Sibley and Bulbulia 2012; Legare et al. 2012).
In popular and academic discussions, the role of religion and science in worldviews is at times depicted in a dualistic manner: scientific research tells us what is true (*Weltbild*), and religion guides us in meaning and morality (*Weltanschauung*) (see e.g., Enqvist 2014; The Finnish National Church Council 2019; Gould 1999). Although some respondents of this study endorse this view, the results suggest that people’s belief in science is a more complex phenomenon and overlaps with “magisteria” that are traditionally associated with religion (Gould 1997, 18). Science-oriented respondents report gaining meaning in life from science and many depict science as important, and occasionally essential, for moral decision-making. Therefore, in the responses of science-invested Finns, science does extend to the scope of meaning and morality – although in differing ways.

**Limitations and further questions**

The findings of this study should be evaluated in relation to general limitations of self-report methods (Järnefelt 2020). One of the limitations relates to self-reported functions of science as the topic of interest in this research, as studies have found that experimental findings often collide with self-reports (Greenwald et al. 2002). More simply put, humans may not be aware of the functions beliefs provide for them. This also applies to the worldview paradigm applied in this research (Burke et al. 2010). For instance, the open-ended comments from participants suggest that some atheists consider mortality to be important for their meaning in life – an articulated belief that is in contradiction with terror management theory paradigm (Pyszczynski et al. 2015). In this study, the aim was not to provide results on the psychological functions of science per se – instead, the rationale is to increase insight into people’s own evaluations on phenomena and the role of unbelief in these assessments. Prior studies suggest that identification with scientific and supernatural accounts are context-dependent (Preston and Epley 2009), and scientific knowledge is endorsed
more in a secular than a religious context (Watson-Jones et al. 2017). Therefore, it might be expected that the participants were more inclined to endorse the importance of science for their worldview in a research context in which they were recruited as science-oriented individuals, and this context might partly account for the small effect sizes of differences between belief groups. However, it is noteworthy that despite these contextual cues, unbelief was associated with higher endorsement of meaning, morality, and symbolic continuity from scientific research.

One further limitation of the study is the limited nature of the sample regarding cultural context. Many Finns, like Americans, expect that “science and religion” are in inherent conflict (Pew Research Center 2015; Science Barometer 2019). Therefore, future studies could recruit respondents in more versatile cultural contexts and examine what underlies the systematic differences between science-oriented unbelievers and believers – what is the role of cultural expectations concerning the roles of science and religion? Would unbelievers and believers differ in their evaluations of the role of science for meaning, morality, and continuity in a cultural context that does not portray science and religion as opposites (or where supernatural beliefs are not commonly associated with “religion”)? For instance, scientists in India, Hong Kong and Taiwan endorse a conflict account less often than Americans, and in Taiwan and Hong Kong biologists and physicists are more religious than the general population (Ecklund et al. 2016).

The Nordic context underlies how participants perceive “science” also in other ways. Although most participants reported that they thought of natural sciences in their responses, many included social sciences and/or humanities in their conception of science. This is in line with prior philosophical suggestions on the term “science” in many Nordic and West European countries (Hansson 2015, 15; Kiikeri and Ylikoski 2004, 16). As prior literature often refers to science in the Anglo-American connotation of the term, cultural differences in terminology should be noted while citing this study and planning future research. The diverse connotations of terminology may be
relevant especially for self-reports on “science” serving worldview functions, as some respondents described thinking about the humanities (such as historical research) in items that explored a sense of connection to humankind and e.g., educational sciences while completing the question on the role of science in moral standards.

5 Conclusion

The study investigated a sense of meaning and post-death continuity from science, and respondents’ evaluations on the significance of science for morality. The results suggest that endorsement of the worldview components of science are associated with unbelief also among science-oriented respondents. Therefore, the results lend support for the belief replacement hypothesis, which emphasizes the importance of secular worldviews (e.g., trust in science) for atheists. However, the results also indicate that many science-oriented God believers endorse the significance of science for meaning, morality, and symbolic continuity. As prior research has been mainly experimental, the current study provides rare knowledge on people’s identification with science providing moral guidance and deeper meaning. However, the results highlight the need to discuss what constitutes “science” in different countries to better make sense of cross-cultural results, as many respondents in this study include social sciences and the humanities in the Finnish equivalent for the term “science”.

Ethics and consent

Research has been performed in accordance with the Declaration of Helsinki. The University of Helsinki Ethical Review Board has stated that the study design follows the ethical principles of
research in the humanities and social and behavioural sciences issued by the Finnish Advisory Board on Research Integrity (statement number: 56/2019). Informed consent has been obtained from the participants, and the identity of the respondents has been anonymised.

**Competing interests**

The author has no competing interests to declare.

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**Data access statement**

Supporting data will be available from the Finnish Social Science Data Archive (in preparation). Further information about the data and conditions for access will be available at the Finnish Social Science Data Archive.


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Supernatural belief in ‘scientific’ worldviews?
Investigating science-oriented Finns’ explanations for origins, death and suffering

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Citation:
Abstract

A ‘scientific worldview’ is commonly seen as contradictory to belief in supernatural forces, and there is little research on the supernatural beliefs of individuals who identify with science. In this article, we investigate the supernatural explanations of science-oriented individuals in domains of fundamental concern (suffering, death, and origins), and how supernatural causality is reconciled with belief in science. The open-ended responses of 387 Finns were analysed. The results show that science-oriented Finns endorsed both religion-related and more secular supernatural beliefs (such as belief in evolution as a purposeful process). Following the coexistence model, science-oriented Finns applied synthetic and target-dependent reasoning. In addition, many who invoked supernatural explanations integrated supernatural causality with science. Two forms of integrated reasoning were found: 1) supernatural agency as the ultimate cause and scientific theory as the proximate cause, and 2) a similarity-based heuristic, as seen in afterlife beliefs appealing to the law of conservation of energy.

Keywords: science and religion, explanatory coexistence, belief in science, supernatural, causal explanation, Finland
Introduction

Every one who is seriously involved in the pursuit of science becomes convinced that a spirit is manifest in the laws of the Universe—a spirit vastly superior to that of man, and one in the face of which we with our modest powers must feel humble.

— Albert Einstein (Einstein & Rosenkranz, 2013, p. 10)

In this quote, the world-famous physicist Albert Einstein aimed to answer a tricky question posed to him by a sixth-grader in 1936: Do scientists pray and, if so, what do they pray for? In his response to the child, Einstein made it clear that he did not believe in the power of prayer or ‘a wish addressed to a supernatural Being’ (Einstein & Rosenkranz, 2013, p. 10). Instead of believing in a personal god of any religion, Einstein found it likely that there exists a superior spirit that ‘reveals itself’ in the laws of nature (Einstein & Rosenkranz, 2013, p. 31). Einstein is hardly the only researcher who seems inclined to believe in a design in natural phenomena. As another example, one of the ‘founding fathers’ of the cognitive science of religion, Justin Barrett, has promoted the (supernatural) view that the human tendency to perceive agency in nature in itself points towards an intelligent designer (Atkinson, 2020).

Belief in supernatural phenomena in science-oriented individuals is not limited to isolated cases of prominent names. In a study on biologists and physicists in eight regions of the world, Ecklund et al. (2016, p. 4) found that a significant minority (and in Turkey, the majority) of scientists believe that ‘God exists, no doubts’. Similarly, in cultures where people generally believe in the soul or an afterlife, these beliefs also seem to manifest in high rates among individuals who are likely to value science (such as medical staff and students; see Martyn et al., 2014; Walker, 2000). A handful of studies have depicted how science-oriented individuals integrate different supernatural beliefs with scientific theories (Mansour, 2011), such as the evolutionary origin of species (Evans et al., 2009). Yet, research on how science-oriented individuals relate their supernatural belief to scientific accounts remains scarce. One contributing factor includes the expectation that supernatural beliefs are not part of a ‘scientific worldview’ (Koski, 2016, p. 11). Many scientists of religion have assumed that

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1 In a study on Egyptian science teachers’ views on science and religion, Mansour (2011) reported that some described God as the creator and the ultimate cause of natural laws and processes. Consonantly, in a study of people visiting US natural history museums, Evans et al. (2009) found that some science-oriented individuals endorse theistic evolution, that is, evolution designed by God (see also Poling & Evans, 2004; Pew Research Center, 2015).
allegiance to science runs counter to belief in supernatural phenomena (Hartman et al., 2017; Williams et al., 1989; Randall & Desrosiers, 1980; Farias, 2013). In contrast to these accounts, we expect that even researchers and other individuals who identify with science hold a variety of views about the world, including supernatural beliefs and diverse interpretations of scientific theories. In the present study, we investigate the possible supernatural beliefs of science-oriented Finns and how these ‘coexist’ with natural explanations – including scientific ones.

The coexistence of scientific and supernatural explanations

Both lay and academic accounts have suggested that as individuals learn scientific knowledge, it replaces their previous explanations for phenomena, including supernatural beliefs (Harris, 2009; Shtulman & Lombrozo, 2016; see Dawkins, 2006). However, people typically hold more than one kind of explanation in their ‘repertoire’ and can even explain the same event in differing ways. In developmental psychology and the cognitive science of religion, this phenomenon has been called explanatory coexistence (Legare et al., 2012; Shtulman & Lombrozo, 2016). Although explanatory coexistence can mean the parallel use of any different ‘kinds’ of explanations, such as formal and informal ones (Legare & Shtulman, 2018), work in the cognitive science of religion has focused on how the same individuals invoke both supernatural and natural causes. This kind of coexistence reasoning has been reported in a line of studies conducted in a variety of cultures (Legare & Shtulman, 2018; see also Astuti & Harris, 2008; Brent et al., 1996; Busch et al., 2017; Evans et al., 2009; Gelman & Raman, 2004; Gutiérrez et al., 2020; Harris & Giménez, 2005; Jerotijević, 2015; Legare & Gelman, 2008). Certain phenomena are expected to elicit explanatory coexistence more than others. These include themes that tap into fundamental concerns, such as death and what follows (Astuti & Harris, 2008; Harris & Giménez, 2005), illness and other suffering (Haimila, 2016; Jerotijević, 2015; Legare & Gelman, 2008), and the origins of humans and life more generally (Evans et al., 2009; Poling & Evans, 2004).

According to the coexistence model, individuals rely on both supernatural and natural explanations in several ways. An individual may lean towards one or the other depending on the context or apply both simultaneously (Legare & Shtulman, 2018; see Astuti & Harris, 2008; Preston et al., 2013; Busch et al., 2017). When individuals refer to supernatural and natural causes simultaneously, it is suggested that they apply one of the following: 1) synthetic reasoning, where both supernatural and natural explanations are inferred in a ‘loose’ manner and their relationship is not specified (e.g.
explaining illness as consuming food not fit for one’s body and a lack of faith in God); 2) **target-dependent reasoning**, which applies supernatural and natural causes to different aspects of a phenomenon (e.g. biological death of the body and afterlife of the persona); and 3) **integrated reasoning**, whereby supernatural and natural causes are ‘well-coordinated’ and formulated into a single explanation (Watson-Jones et al., 2015, p. 613; Legare et al., 2012; Legare & Shtulman, 2018). In prior work, examples of integrated reasoning have inferred supernatural processes as the ultimate cause and natural ones as the proximate mechanism. A common example of integrated reasoning is belief in God as the designer of evolution (Evans et al., 2009; Haimila, 2016; Legare et al., 2012; Legare & Shtulman, 2018; Legare & Visala, 2011; Watson-Jones et al., 2015; cf. also Mansour, 2011; Poling & Evans, 2004).

Despite the variety of studies on the explanatory coexistence of supernatural and natural explanations (for reviews, see Legare & Shtulman, 2018; Pnevmatikos & Georgiadou, 2019), the current body of work contains some shortcomings. First, we are only aware of two studies investigating explanatory coexistence across several domains (Busch et al., 2017; Watson-Jones et al., 2015; cf. also Pnevmatikos & Georgiadou, 2019). Second, previous work has rarely examined how people integrate their supernatural belief with natural explanations (Legare & Shtulman, 2018). Generally speaking, it is expected that the integration of supernatural and natural explanations is shaped by cultural influences (Watson-Jones et al., 2015), similar to the content of supernatural beliefs more generally (Haimila, 2020; Järnefelt et al., 2018; Legare et al., 2012). Next, we will discuss the definition of ‘supernatural’ used in prominent works on explanatory coexistence and in this study.

**What is ‘supernatural’?**

The literature on explanatory coexistence has predominantly approached the ‘supernatural’ as phenomena that are 1) outside the scope of scientific enquiry or known natural laws and 2) often associated with religious or other beliefs that are culturally perceived as supernatural (Legare et al., 2012; Legare & Visala, 2011; Pnevmatikos & Georgiadou, 2019). Similar definitions have long been applied in other work on supernatural belief (see, e.g., Flanagan, 2008; Randall & Desrosiers, 1980;
Watts et al., 2020). However, this domain-general definition has been criticised, as it ties the content of the category ‘supernatural’ to 1) possibly differing views on what can be investigated with a scientific method (Lindeman & Svedholm, 2012) and to 2) what is perceived as ‘supernatural’ in the Western context, that is, mainly beliefs that have been traditionally conceptualised as religious, spiritual or paranormal (Haimila, 2020). A body of work indicates that some of these beliefs are also endorsed in more secular cultural contexts. For example, Bullivant et al. (2019) have reported that a majority of the population in China believes in karma, even though few Chinese individuals consider themselves religious (Haerpfer et al., 2021). In the regions of WEIRD cultures, several studies have also reported traditionally religious or spiritual beliefs among (mainly minorities of) non-religious individuals, atheists and agnostics (Banerjee & Bloom, 2014; Bullivant et al., 2019; Lindeman et al., 2019; Visuri et al., 2022; cf. also Pew Research Center, 2012; van Mulukom et al., 2022; Herbert & Bullock, 2020). In addition to these traditionally supernatural beliefs, we would expect that in more secular contexts, some people hold beliefs that resemble (supernatural) religious and spiritual views but do not apply terminology identified as such (cf. Banerjee & Bloom, 2014; Heywood & Bering, 2014; Järnefelt et al., 2018). For instance, the belief that we most likely live inside a simulation designed by artificial intelligence is commonly not perceived as religious, yet it bears a structural similarity to the religious belief in a reality designed by God (Haimila, 2020).

To extend the scope of the investigation to any possible beliefs that resemble traditionally supernatural beliefs in their structure yet operate with secular vocabulary, we will approach ‘supernatural’ with a prior definition that does not explicitly posit the supernatural in opposition with what is considered ‘scientific’. More specifically, we define supernatural beliefs as ones that blend cross-culturally common core knowledge about the ontological properties of entities and processes, such as a stone (a non-living object) that knows things (a mental agent) (Lindeman & Svedholm, 2012). Defining supernatural conceptions as those that blend core knowledge draws from work in cognitive psychology (Lindeman & Aarnio, 2007; Lindeman & Svedholm, 2012) and, preceding the former, in the cognitive science of religion on religious beliefs as counterintuitive (CI; see Boyer, 1996, 2001; Pyysiäinen, 2002). Although such beliefs

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3 It should be noted that in prior work, the term ‘supernatural belief’ often overlaps with concepts such as belief in ‘paranormal’, ‘extraordinary’ (Drinkwater et al., 2020), ‘magical’ or even so-called ‘superstitious’ belief (Randall & Desrosiers, 1980; Stone et al., 2018). In psychology of religion, these are at times referred to as PSMS beliefs (paranormal, superstitious, magical and supernatural beliefs; see Lindeman & Aarnio, 2007; Lindeman & Svedholm, 2012; see also Herbert & Bullock, 2020). Some apply the concept of ‘supernatural’ belief as an umbrella term for PSMS beliefs (Schofield et al., 2018).

4 However, Lindeman and Svedholm (2012) have noted several weaknesses in the literature on supernatural and/or religious beliefs as counterintuitive (CI). First, conceptualising supernatural
have been extensively studied from certain perspectives (e.g. the retention rates of supernatural beliefs compared to other content), fewer studies have addressed how and when people actually apply concepts that violate deep inferences about ontological categories (Purzycki & Willard, 2016), especially outside the Anglosphere (however, see Nordin & Bjälkebring, 2021; Purzycki, 2013).

**The present research**

In the present study, we investigated whether science-oriented individuals in the Finnish context also apply supernatural explanations in their open-ended responses to domains of fundamental concern. Furthermore, we examined how these explanations are expressed and whether they are applied with scientific accounts. More precisely, we addressed the following questions:

1) Do science-oriented Finns express so-called supernatural explanations for origins, death and suffering?
2) If so, what kinds of supernatural explanations do science-oriented Finns express?
3) Are supernatural explanations integrated with science? (If so, how?)

Based on prior research, we expected that some science-oriented Finns might also apply supernatural reasoning whilst making sense of death, suffering and the origins of life. In the Nordic countries, including Finland, many perceive science and religion as conflicting (Science Barometer, 2019; Tiaynen-Qadir et al., 2021), and overall, the social surroundings of science-oriented Finns might encourage a secular vocabulary over a religious one (Haimila, 2020; Caldwell-Harris et al., 2011). Thus, we also hypothesised that the participants’ supernatural accounts would mainly be secular, in the sense that they would mostly avoid expressions often associated with religiosity in phenomena as counterintuitive diverges from other work (including work in the cognitive science of religion) suggesting that certain forms of supernatural reasoning are intuitive, a notion that aligns with dual-process theories (e.g. Bering, 2006; Järnefelt et al., 2015). Second, it has been unclear what qualifies as counterintuitive, as studies have categorised concepts as counterintuitive using a variety of criteria. For example, a purple cow might be surprising but it does not necessarily violate cross-cultural deep inferences about animals (Lindeman & Svedholm, 2012). For similar lines of criticism in the cognitive science of religion on CI theory, see Boyer (2001); Purzycki (2013); Purzycki & Willard (2016). Thus, Lindeman and Svedholm (2012) have simply suggested to define ‘paranormal, superstitious, magical and supernatural’ beliefs as conceptions where distinctions between ontological categories of entities and processes (expectations that appear cross-culturally in cognitive development) are blurred, without reference to the possible (counter)intuitiveness of such beliefs.
the Finnish context and instead apply other terms, including scientific ones. To answer
the research questions and address the hypotheses, we analysed science-oriented
Finnish open-ended descriptions of the domains of interest using a mixed-methods
approach (see also Watson-Jones et al., 2015).

**Data and methods**

**Recruitment and participants**

The first author collected the data using an online questionnaire, which was conducted
on the GDPR-compliant LimeSurvey platform. The respondents were recruited via
Finnish pro-research organisations. The invitation was first sent to research
institutions and other research-affiliated organisations, followed by social media
recruiting on Twitter, Facebook and selected discussion boards (for additional
information, see [Supplementary Material A](#)). As an incentive, the respondents could
participate in a raffle for an Amazon gift card (€60) and request a report on the results.
Altogether, 683 respondents completed the questionnaire. Furthermore, 387
participants that answered the control question correctly were included in the analysis
(see [Supplementary Material B](#)). The participants were of multiple genders (202
women; 170 men; 15 other / I don’t want to say). To protect the anonymity of the
participants, age was explored using ordinal groups (18–30, 31–40, 41–50, 51–65, and
over 65 years; range all groups, Md 31–40 years). The participants were highly
educated (years of education M = 19.63, SD = 4.59), and half had worked in research
institutions (194 participants: natural sciences, 93; humanities, 54; social sciences, 33;
other, 14 participants). The participants were mainly non-religious (269 respondents),
and the majority did not believe in God (268) or else felt unsure about their belief in
God (66), whereas 53 stated that they believed in God (see also Haimila, 2020; Haimila
& Muraja, 2021).

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5 The participants who answered all items of the control question were excluded from the sample, with
the exception of some participants who stated in an open-ended comment below that they had
accidentally answered the question. The instructional manipulation check resulted in a relatively high
exclusion rate. One underlying factor might be the length of the questionnaire: prior to answering the
structured questions (including the control question), the participants had responded to seven open-ended
questions (see Procedure). Another factor possibly contributing to the exclusion rate was a
technical feature of the platform, as the participants were not able to withdraw their choices from the
multiple-choice question. Despite these factors, the exclusion rate is similar to that of many previous
online studies (e.g. Järnefelt et al., 2018; Morren & Paas, 2020; Oppenheimer et al., 2009).
**Procedure**

In the questionnaire, the respondents first answered open-ended questions on origins, suffering and death, followed by the Belief in Supernatural Agency and Purpose Measure, the Science-Oriented Worldview Measure (Haimila, 2020), and the Belief in Science Scale (a measure of belief in scientism; see Farias et al., 2013). In addition, the questionnaire contained an instructional manipulation check and demographic questions (see the supplementary material). In previous publications on the data, we have examined the relationship between self-reported worldview functions of science and belief in the supernatural (on structured measures, see Haimila, 2020) and supernatural and non-supernatural continuation in death beliefs (Haimila & Muraja, 2021). In the present study, we investigated the open-ended responses on suffering, death and origins. The respondents were asked seven questions pertaining to these domains (see Table 1). The questions were based on prior literature on the likely domains of the coexistence of supernatural and natural explanations and a pilot study (e.g. Legare et al., 2012; Legare & Shtulman, 2018). Concerning the domain of origins, we asked the respondents to describe their views on the origins of human consciousness, the shared ancestry of humans and chimpanzees (a question abbreviated from Evans et al., 2009), and the origins of the universe. The domain of suffering was investigated by asking the participants for their views on why ‘bad things’ (e.g. serious illness) happen more frequently to some people than others and why they think humans suffer. The participants’ possible supernatural explanations for death were explored with two questions: what do they think happens to humans after death and whether they perceive human existence as finite or infinite, and why. The questions were preceded by instructions/prompts that specified the domain of interest and encouraged the participants to reflect on different views (by stating that there might not be unanimity on the topic; e.g. ‘Finns have several conceptions regarding the origins of human consciousness’).

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6 The questions on suffering were based on 1) prior studies on the coexistence of supernatural and natural explanations for misfortune (and illness in particular) (see Jerotijević, 2015; Legare & Gelman, 2008); and 2) studies on the justice motive, especially on the possible tendency of humans to perceive an ultimate justice in life events (Anderson et al., 2010), which may manifest also as supernatural explanations, such as belief in karma (Raman & Winer, 2004).
Table 1: The open-ended questions investigated in this study and their instructions, presented in order of appearance.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Instructions/prompt:</th>
<th>Question:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origins</td>
<td>Finns have several conceptions regarding the origins of human consciousness. This question is also debated in the scientific community.</td>
<td>What kinds of views do you hold regarding the origins of our consciousness? (On an individual level or on a species level.)</td>
</tr>
<tr>
<td></td>
<td>Scientists think that humans and chimpanzees shared a common ancestor as recently as 5 million years ago.</td>
<td>We ask you to describe how both chimpanzees and humans could arise from the same kind of ancestor.</td>
</tr>
<tr>
<td>Suffering</td>
<td>Next, we will ask you to describe your views on suffering.</td>
<td>Why do bad things (e.g. a serious illness) happen more to some people than others?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Why do you think there is suffering in our lives?</td>
</tr>
<tr>
<td>Death and thereafter</td>
<td>In the following questions, we will ask about your death-related views.</td>
<td>What do you think happens to us (humans) after death?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[An additional non-mandatory question]: Do you think the existence of an individual is temporally finite or infinite? (Could you tell us why you think this is so?)</td>
</tr>
<tr>
<td>Origins</td>
<td>Before proceeding to the science-related multiple-choice questions, we will ask you one more question on the origins of the universe.</td>
<td>How do you think the universe came to exist?</td>
</tr>
</tbody>
</table>
\[
\begin{align*}
\text{Origins} & \quad \text{Finns have several conceptions regarding the origins of human consciousness. This question is also debated in the scientific community.} \\
& \quad \text{Scientists think that humans and chimpanzees shared a common ancestor as recently as 5 million years ago.} \\
\text{Suffering} & \quad \text{Next, we will ask you to describe your views on suffering.} \\
& \quad \text{Why do bad things (e.g. a serious illness) happen more to some people than others?} \\
& \quad \text{Why do you think there is suffering in our lives?} \\
\text{Death and thereafter} & \quad \text{In the following questions, we will ask about your death-related views.} \\
& \quad \text{What do you think happens to us (humans) after death?} \\
& \quad \text{[An additional non-mandatory question]: Do you think the existence of an individual is temporally finite or infinite? (Could you tell us why you think this is so?)} \\
\text{Origins} & \quad \text{Before proceeding to the science-related multiple-choice questions, we will ask you one more question on the origins of the universe.} \\
& \quad \text{In current [cultural] discussions, several views exist on how the universe began [to exist].} \\
& \quad \text{How do you think the universe came to exist?}
\end{align*}
\]
driven categories were added to capture the respondents’ positions on supernatural causality in more detail. Moreover, during the coding we noticed that some respondents expressed their views more firmly, while others used hesitant wording, such as the respondent who wrote that after death ‘the consciousness may continue’ (P19). To take this into account, we coded all the main categories on a scale of 0–2, where the value ‘1’ referred to responses that fit the criteria but applied hesitant wording and ‘2’ for responses that did not contain hesitant wording about the view in question. In total, we conducted three rounds of coding to test and revise the template, and each of the authors analysed 10–20% of the data during this phase. The interrater reliability was good (94.9% during the third coding round). Finally, the first author coded all the responses using the established template and instructions (Campbell et al., 2013; Hruschka et al., 2004; Syed & Nelson, 2015). The categories and their definitions can be seen in Table 2. For the full coding instructions (including the criteria on what qualifies as an MCK concept), see the supplementary material.
Table 2. The coding template

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Definition</th>
<th>Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The main categories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Scale 0–2                       | Non-MCK                  | The respondent expresses a view that does not mix core knowledge (that is separate from any possible MCK conceptions in the response).          | 'The universe originated from the Big Bang.' (2)  
'When a human dies, the mind flames out and the body decomposes.' (2)  
'Suffering is due to chance and genes. I also believe in some kind of karma.' (2)  
(Note: The last is also categorised as MCK religious or spiritual.) |
|                                | MCK incl. religious or   | A conception that mixes core knowledge contains a term that is commonly associated with religiosity or spirituality in the Finnish context. | 'One cannot help but think that in other dimensions, we might discover what we conceive of as God.' (1)  
'Evolution is a part of God’s plan.' (2)  
'Humans have a soul.' (2)  
'Karma can kick one hard.' (2) |
|                                | spiritual terminology    |                                                                             |                                                                                                                                                                                                          |
|                                | MCK incl. science        | A conception that mixes core knowledge and contains a term associated with scientific research in the Finnish context.                     | 'God could have created the Big Bang.' (1)  
'The purpose of evolution is to develop humanity.' (2) |
|                                | terminology              |                                                                             |                                                                                                                                                                                                          |
|                                | MCK other                | A conception that mixes core knowledge and only uses expressions that are not primarily associated with religion/spirituality or science.     | 'Of course, it could be that our essence survives death in some form.' (1)  
'Consciousness is everywhere.' (2)  
'It comes to mind that some being could have made the universe.' (1) |
| **Additional categories**        |                          |                                                                             |                                                                                                                                                                                                          |
| Scale 0–1                       | MCK conflicted           | The respondent expresses experiencing conflict about a conception that mixes core knowledge. (In addition, MCK categories can be coded.)       | 'The thought of an afterlife feels comforting, but I can’t bring myself to believe in it.' (1)  
'It comes to mind that some being could have created the universe. But I do not consider this likely.' (1) |
|                                | MCK mere rejection       | A conception that mixes core knowledge merely to reject it (MCK categories are not coded).                                          | 'At least there is no purpose to suffering. Things just happen.' (1)                                                                                                                                 |
|                                | MCK ambiguous            | It is difficult to decipher whether the conception fills the criteria of the MCK categories (or whether it is used e.g. as a metaphor).        |                                                                                                                                                                                                          |

7 In addition to the categories listed here, we originally included a category for views that discussed species as an intentional individual (‘MCK evolution species as an individual’). However, we decided to exclude this category since it was only relevant in the domain of origins, and such views could also be coded to other MCK categories (namely, to MCK conceptions that contain scientific terminology).
Note. ‘MCK’ refers to ‘mixing core knowledge’. In the main categories, we used a scale of 0–2 (0 = does not fit the criteria, 1 = fits the criteria but applies hesitant wording, and 2 = fits the criteria). The examples listed here are from the coding instructions and were based on the pilot study data and the authors’ observations while developing the template.

It should be noted that there were some limitations to the method: First, we decided to categorise some expressions as supernatural based on terminology alone if respondents did not specify how they perceive the concept (whether their interpretation of the term mixes core knowledge). The concepts that we decided to categorise in this manner included belief in ‘God’, a ‘soul’, ‘karma’ and ‘the afterlife’. Second, since the questions on origins, death and suffering were not formulated similarly, this might affect the findings on comparisons across domains, and this should be kept in mind when interpreting the results.

Results

Preliminary analysis

Endorsement of supernatural explanations in the open-ended responses was weakly associated with some demographic variables. There was a weak negative correlation between years of education and supernatural explanations ($r_s = -.16, p = .002$), and gender was also associated with the endorsement of supernatural causality (Kruskal-Wallis $H(2) = 6.575, p = .037$). Formulating supernatural explanations in one’s own words in the open-ended responses was not related to age or work affiliation to research. We also examined the relationship between the extent of supernatural explanations in the open-ended responses and a structured scale on supernatural belief

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8 Although we expected that concepts such as ‘God’ would activate certain schematic content, people’s conceptions of God might still differ (Purzycki & Willard, 2016). Hence, it is plausible that someone might have referred, for example, to belief in God in an unconventional manner, a belief that would still be classified as supernatural if the respondent did not elaborate on their view. However, it did not seem meaningful to exclude mentions of e.g. God from the supernatural explanations. Consequently, this was a trade-off we decided to accept for the purpose of analysing the open-ended data.

9 Although use of the same wording for questions on each domain would have been demanding to implement in a meaningful manner, this notion is still important, since in the current study only the domain of suffering contained a ‘why’ question. Some authors have noted that people might be more prone to apply supernatural reasoning in their reflections on why things happen (e.g. why bad things happen) compared to how they happen (Bering, 2011; cf. also Kelemen, 2003).

10 Those who responded ‘Other/I do not want to say’ formulated supernatural explanations less than other gender groups, albeit the differences between groups not being significant in pairwise post hoc tests.
(Belief in Supernatural Agency and Purpose Measure) and belief in science (Science-Oriented Worldview Measure and Belief in Science Scale, see Farias et al., 2013; Haimila, 2020). There was a strong positive relationship between expressing supernatural causality in one’s own words and the score of the supernatural belief scale ($r_s = .563, p < .001$). Belief in science was at least somewhat negatively associated with supernatural belief in the open-ended responses (moderate relationship with the Belief in Science Scale ($r_s = -.384, p < .001$) and weak relationship with the Science-Oriented Worldview Measure ($r_s = -.215, p < .001$)).

**Science-oriented natural and supernatural beliefs about origins, death and suffering**

In their accounts on origins, death and suffering, the science-oriented respondents mainly relied on non-supernatural (non-MCK) explanations. A non-supernatural explanation of some kind was mentioned by an overwhelming majority (98.9%), whereas approximately one in three (36.3%) invoked supernatural (MCK) causality in at least one of their responses (see Table 3). More conservatively speaking, around one in four (27.6%) referred to supernatural processes without any hesitation, for instance by stating that the universe ‘was created’ (P2077) instead of wondering if it ‘could have been created’ by God (P1572).

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Across all responses</th>
<th>Responses on origins</th>
<th>Responses on suffering</th>
<th>Responses on death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-MCK</td>
<td>98.9 (98.7)</td>
<td>96.9 (95.1)</td>
<td>95.9 (95.6)</td>
<td>92.9 (91.6)</td>
</tr>
<tr>
<td>MCK</td>
<td>36.3 (27.6)</td>
<td>16.0 (12.1)</td>
<td>23.8 (20.4)</td>
<td>21.8 (14.2)</td>
</tr>
<tr>
<td>MCK religious/spiritual</td>
<td>20.3 (14.5)</td>
<td>10.9 (8.3)</td>
<td>8.3 (7.0)</td>
<td>17.9 (12.6)</td>
</tr>
<tr>
<td>MCK science</td>
<td>13.7 (10.3)</td>
<td>8.0 (6.2)</td>
<td>4.1 (3.6)</td>
<td>3.2 (1.8)</td>
</tr>
<tr>
<td>MCK other</td>
<td>21.3 (16.1)</td>
<td>4.4 (3.4)</td>
<td>14.0 (12.1)</td>
<td>6.3 (2.9)</td>
</tr>
<tr>
<td>MCK conflicted</td>
<td>12.6</td>
<td>3.1</td>
<td>2.1</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Note. Without clauses: percentages of respondents who applied supernatural explanations (values 1–2 on the scale 0–2). In clauses: percentages of respondents who applied assured wordings (value 2). N = 387, except in the variables with all the domains or death (n = 380), as seven respondents did not answer Q6, a non-mandatory death-related question.
As reliance on natural explanations was a common denominator among most respondents, very few merely applied supernatural explanations (1.1%; see Table 4). Instead, those who invoked supernatural causality also inferred natural causes, at least in some domains/part of their responses. Next, we examine the kinds of supernatural reasoning that science-oriented Finns expressed in the data and how these were related to reliance on natural causes.

**Vocabulary of supernatural beliefs and the modes of coexistence**

Supernatural explanations were expressed in different ways. More specifically, respondents applied *traditionally religious or spiritual* explanations (20.3%), while some also formulated supernatural beliefs that applied *scientific terminology* (13.7%) or expressed supernatural causality with *(other)* secular terms (21.3%). These ways of expressing supernatural causality were not necessarily distinct, as many applied more than one of these frameworks in their responses (see Table 4). In the sections below, we first examine how the traditionally religious and ‘other’ explanations were applied. Following these descriptions, we discuss explanations that integrated scientific terminology with supernatural reasoning, including with traditional religious and spiritual accounts.

Table 4: Frequencies of response patterns (percentage of cases)

<table>
<thead>
<tr>
<th></th>
<th>Across all responses</th>
<th>Responses on origins</th>
<th>Responses on suffering</th>
<th>Responses on death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-MCK only</td>
<td>63.7</td>
<td>83.4</td>
<td>76.1</td>
<td>77.1</td>
</tr>
<tr>
<td>MCK only</td>
<td>1.1</td>
<td>2.6</td>
<td>4.2</td>
<td>6.1</td>
</tr>
<tr>
<td>Non-MCK &amp; MCK</td>
<td>35.3</td>
<td>13.4</td>
<td>19.7</td>
<td>15.8</td>
</tr>
<tr>
<td>Non-MCK &amp; MCK rel.</td>
<td>19.2</td>
<td>8.2</td>
<td>5.3</td>
<td>12.1</td>
</tr>
<tr>
<td>Non-MCK &amp; MCK scie.</td>
<td>13.7</td>
<td>7.9</td>
<td>4.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Non-MCK &amp; MCK other</td>
<td>20.8</td>
<td>3.7</td>
<td>12.1</td>
<td>5.0</td>
</tr>
<tr>
<td>&gt; 1 MCK type</td>
<td>15.3</td>
<td>6.6</td>
<td>2.6</td>
<td>5.3</td>
</tr>
<tr>
<td>MCK scie. &amp; rel.</td>
<td>8.4</td>
<td>5.3</td>
<td>0.8</td>
<td>2.6</td>
</tr>
<tr>
<td>MCK oth. &amp; rel.</td>
<td>9.7</td>
<td>1.3</td>
<td>1.3</td>
<td>2.6</td>
</tr>
<tr>
<td>MCK scie. &amp; other</td>
<td>5.0</td>
<td>1.6</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>MCK &amp; Conf.</td>
<td>7.6</td>
<td>1.3</td>
<td>1.8</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Note. N = 380. Here, we have included all the respondents who applied supernatural and natural explanations (values 1–2 on a scale of 0–2).

Religious and spiritual explanations: understanding death and origins

Respondents most often applied traditionally religious and spiritual accounts to explain death and what follows (17.9% of the respondents) and/or the domain of origins (10.9%). Some, albeit very few, merely endorsed supernatural religious causes without discussing natural explanations (see Table 3). These responses were somewhat more frequent in the domain of death – some merely discussed death and what follows with religious and/or spiritual terms, such as ‘God’, ‘soul’ or ‘Heaven’. As one respondent stated, after death ‘[l]ife continues. Since God has created the human, the human remains’ (P2705).

However, as most respondents applied at least natural explanations in all domains, religious explanations mainly coexisted with natural causes. Many engaged in target-dependent reasoning. This was evident especially in the domain of death, where biological explanations were applied to the body and supernatural (religious) ones to the persona (see also Legare & Shtulman, 2018). One respondent inferred supernatural continuity to the consciousness and natural decay of the body in the following manner:

In death, our bodily functions cease to exist, and our body becomes earth’s dust and ashes. Our mind, soul and consciousness exist in God’s plans even before our birth. [...] The existence of the soul [literally: soul-like existence], mind and consciousness after our death is infinite in time. (P1723)

Some of the religious explanations for origins also operated in a target-dependent manner. Such accounts separated matter (bodily functions) from the persona (spirit or soul), hereby attributing the origins of human consciousness to supernatural causes. These accounts were often accompanied by the notion that scientific explanations are insufficient when it comes to making sense of conscious experience. As one respondent wrote:

With biological explanations, there’s the problem that they do not explain the origins of experience in any satisfactory way, the Chinese room. [...] Biology can explain functions but not experience/consciousness. The spiritual account provides a more satisfactory explanation for consciousness arising. [...] My own beliefs: [...] consciousness (depending on the definition), to the extent that a computer programme could be conscious, arises physically and biologically. The
experience arises in a divine manner \([yli\text{maallisesti}]\). I like to think that we live in a simulation that was created for some purpose. (P1624)\(^{11}\)

In line with prior findings, some respondents hesitated to apply an evolutionary theory of origins to human consciousness (Elsdon-Baker et al., 2017) due to the perceived uniqueness of humans, or the human soul (see also Blancke et al., 2012). Thus, although the respondents generally believed in the theory of evolution, some also specified that as human beings are a unique creation of God, ‘the core of humanity, the soul, was formed by some supernatural means’ (P105).

In addition to the target-dependent accounts, respondents also integrated religious views with scientific content, especially in the domain of origins (see Table 4). They did so by discussing ‘God’ or a ‘higher power’ as the ultimate explanation for origins and the natural process serving as the proximate cause (see also Evans et al., 2009). Thus, the integrated accounts applied the same natural explanations as most other respondents (i.e. the Big Bang for the origin of the universe and evolution for the origin of humans), but such accounts posited God or a higher power as the underlying catalyst, or, at minimum, as an influence that resulted in reality in its present form. For instance, when asked how humans and chimpanzees can have a common ancestry, one respondent replied: ‘because both species have diverged into their own [species]. Due to natural selection, but also through divine intervention’ (P2128).\(^{12}\)

In addition to the domains of death and origins, some respondents applied religious or spiritual explanations to make sense of suffering. In this domain, respondents less frequently mentioned ‘God’, but also discussed the effects of ‘karma’ as the cause of misfortune. They mainly referred to the concept of karma in longer discussions or lists of causes, often mentioning it last.\(^{13}\) The respondents usually did not specify how karma was related to the other, natural causes, and thus engaged in synthetic reasoning. Some even mentioned that it would be very difficult to explain the underlying mechanism of karma or how it functions in relation to other (natural)

\(^{11}\) Similar lines of reasoning were also present in the respondents’ conflicted accounts. As one respondent wrote: ‘Rationally, I believe that consciousness has evolutionary origins that have led to the development of the brain. Consciousness, thus, is formed in a fully materialistic manner, as a result of the brain’s functions. Still, instinctively, I am prone to think that humans have some kind of soul that is distinct from the body, and that it contains an understanding of the individual self – and in that way, probably of consciousness. Even if it would be possible to replicate a human with such accuracy that we could rebuild all the connections and the memories in the brain, it still would not be me […]’ (P676).

\(^{12}\) Others did not integrate evolution and religious design to the same extent but still supposed that evolution at least ‘partly’ operates ‘under the guidance of a higher power’ (P252).

\(^{13}\) One respondent explained why some people suffer more than others as follows: ‘Chance. Genetics. Karma. The baggage of the previous generations and of prior lives’ (P2005).
causes. For instance, one participant discussed why some people suffer more than others in the following manner:

At the individual level, for instance, due to chance, attitude and an attentive bias, [...] a person who has baby fever will see strollers and kids everywhere, a banker sees expectations of profit and opportunities to invest, and a pessimist waiting for disasters will find them [...]. Additionally, on a more general level, I also believe in the effect of things such as soul paths and karma, but this text and the respondent’s skills are not sufficient to analyse them. (P1254)

The presence of a belief in karma is interesting, as it indicates that some science-oriented Finns also apply moral explanations for suffering – and, more particularly, ones that entail supernatural punishment as ultimate justice (Maes, 1998; Bullivant et al., 2019; cf. Jerotijević, 2015). However, the participants more frequently explained suffering with reference to other supernatural accounts – ones that did not entail traditionally religious or spiritual terminology.

‘Other’ explanations: an emphasis on folk accounts of suffering

Many supernatural explanations that did not contain traditionally religious terminology still relied on similar lines of reasoning as those described in the previous section. For instance, while discussing the shared ancestry of humans and chimpanzees, some referred to a more general ‘designer’ instead of God (P2705; P2173). However, supernatural causality that did not refer to religious content was mainly applied to make sense of suffering. In these accounts, supernatural reasoning did not necessarily entail (direct) agency or design but rather an inherent purpose or underlying mechanism of balance. For the most part, the perceived purpose of suffering was to enable or increase humans’ appreciation of that which is good. As one respondent wrote, suffering exists ‘[t]o make us value life during better times [...]’ (P2559). In these accounts, respondents viewed suffering as beneficial, or at least necessary, as it enables non-suffering or happiness and ‘balances the entirety’ (P2069).14

14 As another respondent wrote: ‘Suffering is associated with the circulation of life. For example, illnesses decrease the amount [of humans] and help maintain a balance in the world. Suffering is also a part of life and its qualia; to attain something good there must be another side. [...]’ (P998). Another respondent also explained suffering by it reducing ‘overpopulation’, as ‘[...] there are way too many of us. The purpose of life is not pleasure but the logical order of things, and I gather that the human population is not meant to be this high [...]’ (P201).
Supernatural accounts with less specific (‘other’) terminology also coexisted with natural explanations. Respondents mainly engaged in target-dependent reasoning, in which supernatural and natural explanations were applied to different kinds of suffering. For instance, some described one’s own suffering as purposeful but preferred to explain the afflictions of others by referring to natural, such as societal, causes. As an example, one respondent wrote that ‘[t]o some extent the purpose of suffering is to teach us something about ourselves. On the larger scale, like in the case of famine, pandemics, slavery, etc., suffering is often caused by the unequal and inhumane world order’ (P2614).

Overall, what these ‘other’ supernatural explanations of suffering have in common is that, through a perceived purpose, they engage in benefit-finding (see also Banerjee & Bloom, 2014). It should be noted that respondents also applied somewhat similar lines of reasoning to natural explanations for suffering (for example, misfortune can enable personal growth). However, the difference between the natural and the supernatural explanations (from our perspective) was that the latter expressed a perceived benefit and/or purpose as the cause of suffering, and hence engaged in (supernatural) teleo-functional reasoning (Kelemen, 2003; see also Heywood & Bering, 2014).

In addition to the aforementioned ‘other’ explanations, some also discussed whether the purpose of suffering might be its benefit as a warning signal. As one respondent wrote:

> Essentially, suffering is nature’s way to get humans or another animal to avoid things that are dangerous and decrease their odds to reproduce. The purpose of it [suffering] is hence to advance survival. (P2635)

Although this response (and other similar responses) did not explicitly mention the biological nature of this function, a similar line of reasoning was evident in responses that integrated scientific theories, such as the theory of evolution, with supernatural agency and purpose. Next, we describe the integrated reasoning of the science-oriented respondents.

**Integrating science and the supernatural**

Science-oriented Finns mainly integrated supernatural belief with scientific theories in the domain of origins. As mentioned above, they often did so by referring to supernatural agency or design as the ultimate cause, while applying scientific knowledge to describe the proximate (physical/biological) mechanism. In the case of the origin of the universe, some deemed supernatural causality to be necessary, since
‘the universe cannot come out of nothing, but it has to have a creator’ (P1404). Some further specified why they perceive creation or design as a necessary element for the origins of the universe:

(...) even the Big Bang requires the influence of something greater, [something] more planned. Thus, behind the world’s beginning there must be an intelligent designer, who has seen all the colours, the beauty, the diversity and the combinations of basic chemical elements. I cannot comprehend how everything could be mere coincidence. (P1723)

In other words, many struggled to grasp how the perceived order of the universe could have been formed by chance or how the universe could have emerged ‘out of nothing’ – a somewhat frequent interpretation of the Big Bang theory among the respondents who integrated scientific origins with religious belief. Still, integrated reasoning did not necessarily entail religious agency. Instead, some added agency, design or purpose to natural processes with mere scientific terms. Such accounts mainly perceived some part of the evolutionary process as goal-directed. One form of reasoning involved describing individual-like intentionality in species. For example, one respondent posited that consciousness might also exist at the species level, as ‘species aim to prosper (i.e. reproduce and develop) in competition over lebensraum, but also in collaboration with other species, for the ecosystem to thrive’ (P648). However, the respondents also applied integrated reasoning in other ways. Another means of integrating a supernatural explanation with a scientific one was to indicate similarity between a scientific theory and supernatural account. More specifically, some science-oriented Finns applied this kind of reasoning to vindicate the continuity of the soul or (some aspects of) consciousness after death. In practice, they did so by referring to thermodynamics – and, more precisely, the law of conservation of energy. For example, one respondent stated a belief in

(...) some kind of reincarnation or ‘realignment’, since it’s the only theory that sustains all existence but still follows the laws of entropy. Particles disintegrate and realign into different (possibly smaller, more chaotic, etc.) entities. Our consciousness is electromagnetic energy. According to the first law of thermodynamics, all energy remains, it cannot disappear but only changes its form. (P356)

15 It should be mentioned that the same experience (how something can come out of ‘nothing’) also puzzled many of those who merely relied on natural causes to explain origins.
16 In addition to this Gaia-like belief in balance/flourishing in the ecosystem as the purpose of evolution, some mentioned that evolution aims to fill all the ecological niches or ‘possibilities in nature’ (P2152) or seeks to ‘try’ different combinations and mutations ‘to preserve life’ (P2171).
In a somewhat similar manner, some referred to quantum mechanics (and the possible future knowledge that it might eventually produce) to justify their beliefs or more hesitant supernatural reasoning about death and what follows.\textsuperscript{17}

\textit{Are there secular forms of supernatural reasoning (among science-oriented Finns)?}

To further investigate whether the supernatural explanations expressed using different kinds of terminology could be conceptualised as religious or secular, we examined whether supernatural accounts in the open-ended responses (operationalised as blending core knowledge) were related to religious belief (operationalised as God belief). For the analysis, we calculated a supernatural belief score for each participant across all domains,\textsuperscript{18} for each domain and for each term category. Furthermore, as we were interested in the coexistence of supernatural and non-supernatural explanations, we also formulated similar sum variables for the category of non-supernatural causes.

According to our analysis, supernatural belief and religious belief were positively associated with large effect size (Kruskal-Wallis $H(2) = 125.71, p = .000, \eta^2 = .32$). The mean ranks indicated that theists (320.95) scored higher in supernatural reasoning than the undecided (219.47) and atheists (162.62). The relationship between God belief and supernatural reasoning was by far the strongest in the domain of death ($H(2) = 185.20, p = .000, \eta^2 = .49$). However, belief in God was also positively associated with a supernatural explanations with a fairly large effect size in the domain of origins ($H(2) = 118.76, p = .000, \eta^2 = .30$) and in the domain of suffering ($H(2) = 73.49, p = .000, \eta^2 = .19$).

Moreover, there was a positive relationship between belief in God and supernatural explanations \textit{regardless} of the terminology that was applied. Somewhat unexpectedly, operating with religious vocabulary was associated with belief in God with a very large effect size ($H(2) = 173.96, p = .000, \eta^2 = .46$). However, God belief was also positively associated with supernatural explanations operating within a science-related terminology ($H(2) = 31.66, p = .000, \eta^2 = .08$) or other terminology: ($H(2) = 27.14, p = .000, \eta^2 = .07$), albeit with a considerably smaller (medium to small)

\textsuperscript{17} One respondent described their thoughts on what happens after death as follows: ‘I do not know. When our body dies, our brains flame out and our consciousness with it. On the other hand, I’m thinking that in a similar way as physical things are only interactions in quantum fields (or how did it go), so too could consciousness also survive after all, somewhere deeper, or merge into a larger consciousness’ (P1313).

\textsuperscript{18} Sum of the supernatural belief score on a scale of 0–14 (on a scale of 0–2 for each question).
effect size. Furthermore, there was a strong negative relationship between God belief and the extent to which the respondent relied on non-supernatural causes \((H(2) = 94.64, p = .000, \eta^2 = .25)\).

**Discussion**

*An overview of the findings*

Overall, most science-oriented Finns relied on natural causes in their reflections on human origins, suffering and death (see also Gelman & Raman, 2004; *cf*. Watson-Jones et al., 2015). However, a minority (approximately one in three) also inferred supernatural causation in their reflections on domains of fundamental concern, when ‘supernatural’ was operationalised as violations of cross-cultural expectations regarding the ontological properties of entities (Lindeman & Svedholm, 2012). Supernatural explanations were expressed in several ways. The respondents applied traditional religious or spiritual explanations (e.g. by referring to ‘God’ or ‘karma’), but they also engaged in supernatural reasoning that operated with more secular language (e.g. suffering as a lesson). The studied domains differed in the kinds of supernatural explanations that they elicited. Supernatural explanations for death and what follows mainly relied on a religious framework (see also Pnevmatikos & Georgiadou, 2019), and they often evoked target-dependent reasoning, such as biological explanations for the body and supernatural causation for the persona (Legare & Shtulman, 2018; see Harris & Giménez, 2005). On the other hand, supernatural causes for suffering for the most part did not elicit religious explanations but instead evoked other kinds of teleo-functional reasoning. The participants most frequently integrated supernatural causality with science in their reflections on origins, moulding scientific content into science-oriented supernatural explanations (such as belief in God as the cause of the Big Bang; *cf*. also Hefner, 1997).

Contrary to our expectations, science-oriented Finns did not mainly rely on a secular supernatural. Instead, religious and other ‘traditional’ supernatural explanations were used somewhat equally frequently. Supernatural reasoning was intertwined with religiosity regardless of the cultural backdrop of the terms applied. In other words, the supernatural explanations that referred to science-related or other secular vocabulary were (to some extent) also associated with religious belief. Moreover, of those who at some point inferred supernatural causality in their responses, the majority at least invoked traditionally religious explanations. The results may refer to one of two possibilities: either supernatural reasoning is more likely among those who also hold other supernatural beliefs, or non-religious science-
oriented individuals are attuned to recognise reasoning that might be considered supernatural (cf. Pyysiäinen et al., 2003) and, as this might conflict with their identities, suppress supernatural lines of reasoning in their reflected responses. In either case, our findings provide some support for the suggestion that individuals who endorse one kind of supernatural belief (e.g. belief in God) are more likely to also hold other supernatural beliefs (e.g. purpose in evolution) (Lindeman et al., 2015; Orenstein, 2002; Svedholm et al., 2010; cf. also Pennycook et al., 2012; Wilson, 2018). However, it should be added that the effect sizes show that non-believers (in God) also engaged in supernatural reasoning, especially in their views on why there is suffering. The findings could indicate that science-oriented non-believers have less of a need to invoke supernatural explanations for death and origins compared to human suffering (on non-religious sense-making strategies for death, see Haimila & Muraja, 2021). Still, the results could also relate to the way in which the questions were formulated – something that we will address in the limitations of this study.

One interesting detail in our results concerns how respondents integrated supernatural reasoning with science. The responses of science-oriented Finns mainly integrated science with supernatural belief by referring to the supernatural as the ultimate cause and natural causality as the proximate cause – for instance, by referring to God as the designer of evolutionary origins. This causal strategy has also been noted in prior work on explanatory coexistence (Evans et al., 2009; Legare et al., 2012; Legare & Shtulman, 2018; Watson-Jones et al., 2015). However, some respondents integrated supernatural explanations with science by relying on similarity-based reasoning, that is, by noting features they deem similar in scientific and supernatural content (on the similarity heuristic, see Goulding & Friedman, 2021; cf. also Hammer & Lewis, 2010). In practice, those participants detailed how the law of conservation of energy might entail continuity of the soul, as ‘energy’ does not disappear in either perspective. Hence, there appeared to be two distinct strategies for integrating science and supernatural accounts: 1) integration by locating supernatural and natural causes to distinct (proximate and ultimate) levels of causation and 2) similarity-based integration.

**Limitations and future directions**

There were some limitations in our methodology that should be noted, some of which can inform future research. For one, the questions on origins, death and suffering were not formulated similarly, and this might interfere with the comparisons of supernatural explanations across domains (see also Watson-Jones et al., 2015). Although the use of the same wording for questions pertaining to each domain would
have been demanding to implement in a meaningful manner, this notion is important since in the current study only the domain of suffering contained a ‘why’ question, which some have suggested might function as a catalyst for supernatural belief (see Bering, 2011). Thus, future studies could refine the research design by balancing the ‘why’ questions across domains, if the domains are to be compared.

On a further note, we wish to remark that it was at times challenging to differentiate between the ‘types’ of explanatory coexistence (Watson-Jones et al., 2015, p. 617) and, more specifically, instances that could be perceived as target-dependent and/or integrated reasoning. Previously, some have suggested that target-dependent reasoning equals inferring natural and supernatural causes to distinct aspects of a phenomenon (Watson-Jones et al., 2015), while others have stated that an explanation does not constitute target-dependent reasoning unless it is also specified ‘how the two forms of explanation fit together’. Thus, for instance, Legare et al. (2012, p. 783) and Legare and Shtulman (2018, p. 18) do not qualify ‘biological decay and spiritual metamorphosis’ as a target-dependent explanation of what happens after death. In our analysis, we decided to follow the operationalisation by Watson-Jones et al. (2015). Thus, we referred to the decay of the body and the continuity of the spirit as target-dependent reasoning, even if the interaction of these phenomena was not explicitly specified. In fact, if the interaction was further specified, the response might qualify as ‘well-coordinated’ – a criterion for integrated reasoning used by Watson-Jones et al. (2015, p. 613). To ease the difference between these ‘three different ways’ of explanatory coexistence, we hope that future work would further discuss and specify the characteristics of target-dependent and integrated reasoning (if they are to be applied as concepts in future research, as in the present study and some prior ones; see Watson-Jones et al., 2015; see also Haimila, 2016; Legare & Visala, 2011, p. 171). This would enable consistent application of the concepts across studies and, accordingly, more meaningful comparisons of findings.

19 However, it should be noted that 1) to our knowledge, this claim still needs to be investigated, and 2) although the ‘why’ questions might evoke a reliance on supernatural causality more easily than the ‘how’ questions, we would suspect that people are more prone to ask ‘why’ within certain domains, such as suffering (Bering, 2011) and other events perceived as high impact (Heywood & Bering, 2014).

20 While scholars have not suggested that the different types of coexistence (synthetic, target-dependent and integrated reasoning) are mutually exclusive lines of reasoning, it should be explicitly noted that in our data, some simultaneously applied target-dependent and integrated reasoning. For instance, the belief that there is supernatural design in the evolution of humans, in particular when it comes to the emergence of human consciousness, can be seen as both an integrated account (supernatural design in evolution) and target-dependent reasoning (supernatural design in human consciousness in particular, similar to other target-dependent accounts that differentiate between the mind and the body; see Legare & Shtulman, 2018).
Lastly, as the definition and operationalisation of the supernatural in our study are conceptually close to the idea of supernatural beliefs as minimally counterintuitive (MCI), we wish to note that some of the criticism directed at the MCI literature also applies to the present study. More specifically, Purzycki and Willard (2016) have suggested that anthropomorphism (e.g. adding human-like intentionality to non-intentional entities, such as plants) comes so easily to humans that it might not be meaningful to regard it as a violation of deep inferences, that is, it might not be ‘supernatural’ according to our definition either (contra Lindeman & Svedholm, 2012). Moreover, the same could be argued for some other ways of reasoning traditionally associated with supernatural belief that have been operationalised as supernatural by Lindeman and Svedholm (2012) and the present study. For example, cross-cultural findings suggest that humans may be prone to perceive design in nature (Järnefelt et al., 2015, 2018). It seems relevant, then, to ask what actually constitutes a violation of core knowledge and whether belief in design in nature qualifies as such a ‘violation’. Should investigations of supernatural reasoning exclude, for instance, anthropomorphic beliefs and belief in design in nature? On a further note, scientific content can also run counter to intuitive expectations (Evans et al., 2009; McCauley, 2011; Shtulman, 2015; Spelke & Kinzler, 2007). A field that offers ample examples is quantum mechanics. For instance, findings on the ‘superpositions’ of particles have often been popularised with the notion that particles can be in two places at once (this is done even by scientists; see Hossenfelder, 2022). This (popularised) scientific account not only aligns with some supernatural beliefs but also fits the criteria of supernatural reasoning, since people generally expect physical objects to exist in a singular location (Boyer, 2001). Intriguingly, a strict application of supernatural as core knowledge violations might then lead to a concept of ‘supernatural’ that excludes some traditionally supernatural beliefs (such as design in nature) and includes certain accounts that align with science. It might be tempting to disregard such a concept as non-functional – what use could we have for this kind of definition of ‘supernatural’?

We would argue, at the least, that the aforementioned remarks on ‘supernatural’ indicate directions for future research. First, if supernatural beliefs are operationalised as in the present study (see also Lindeman et al., 2012), it should be acknowledged that the conception of supernatural likely comprises two kinds of beliefs: ones that are attention-grabbing and violate core knowledge (e.g. a person walking through a wall of concrete) and ones that are more likely to be expected and may not violate core knowledge (e.g. design in the symmetry of a snowflake; see Järnefelt, 2013). Second,

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21 Another example of scientific content derived from quantum mechanics that violates deep inferences is the many-worlds theory (Crease, 2019).

22 We wish to thank Dr Aku Visala for challenging us with this thought-provoking question.
the overlap with scientific knowledge and inference violations can indicate that certain scientific accounts might more likely elicit integrated reasoning than others, due to the ‘strange’ content of the scientific findings (at least how they are currently popularised by some scientists).23 In other words, we would argue that the overlap between the concept of ‘supernatural’ and some scientific accounts might inform research on how people reason about science and should thus not be overlooked. This overlap could provide future approaches to further understand, for instance, the appeal of quantum physics in religious and non-religious spirituality (see Lewis, 2007).

Conclusion

In psychology of religion, some have deemed it unlikely that individuals who believe in science would endorse supernatural beliefs (see, e.g., Farias, 2013; Randall & Desrosiers, 1980). The present research found that in a Nordic sample of Finns, a minority of science-oriented individuals also believed in supernatural phenomena. Many who believed in the supernatural integrated their belief with scientific theories. The most common strategy of integration was to describe supernatural agency as an ultimate cause and scientific mechanisms as the proximate cause. However, some also integrated scientific and supernatural explanations by referring to their perceived similarity. The results bolster the suggestion that supernatural and natural explanations coexist across cultural settings (Legare et al., 2012; Legare & Shtulman, 2018). Furthermore, the findings provide new insight into how people integrate their belief in the supernatural and science (Legare & Shtulman, 2018) and add to the body of work on how supernatural explanations, when operationalised as so-called ‘inference violations’, are applied (Purzycki & Willard, 2016, p. 235). In the limitations, we noted some unresolved questions about what exactly qualifies as a violation of ontological core knowledge and, therefore, a supernatural or so-called PSMS belief. As ‘supernatural’ beliefs have also been approached as PSMS beliefs in other recent studies (e.g. Herbert & Bullock, 2020; Lindeman et al., 2019), future work could further clarify the concept of ontological core knowledge and its violations, in order to

23 However, it is important to note that even if any scientific account fit the criteria of ‘supernatural’ as inference violations, it does not follow that the account would be unscientific – or that supernatural reasoning would generally be aligned with science. When ‘supernatural’ is defined from a cognitive perspective, and thus detached from what is currently in accord with science, the concept of ‘supernatural’ merely becomes a tool to extract how people reason about different entities and processes. In other words, it is not applicable to discussions about what lies beyond the domain of naturalistic enquiry but instead helps to reveal how people reason about phenomena.
decipher the extent to which beliefs conceptualised as ‘supernatural’ actually fit their definition.

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A sense of continuity in mortality? Exploring science-oriented Finns’ views on afterdeath

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Abstract

Endorsement of science might entail a belief in “secular death”, in which an individual faces annihilation as the bodily functions cease. In this article, we examine what science-oriented individuals think happens to humans after death. Does endorsement of science entail views on human annihilation or do people also express continuity beliefs? The open-ended responses of 387 Finns were analysed. The respondents were recruited online via organisations that promote science and research. According to our results, science-oriented Finns mainly endorsed annihilation and secular death. However, some also expressed (mostly nonreligious) views on continuation, e.g., in social bonds and nature. Secular forms of continuity were more likely mentioned by unbelievers, while theists primarily relied on afterlife beliefs.

Keywords: death, afterlife, science and religion, atheism, Finland
Introduction

Scholars have long suggested that a religious afterlife belief is comforting for humans (Benore & Park, 2004; Vail et al., 2010). Similarly, some might suggest that science offers a bleak and gloomy reality especially when we consider what happens when people die. Some scholars have associated scientific knowledge with a secular conception of death, in which the individual annihilates as the bodily functions cease (Harris & Giménez, 2005; for discussion, see Hodge, 2016; 2018). Consonantly, individuals who hold science in high regard might perceive death as “the end” and not endorse continuity after dying (Carroll, 2016, p. 216; Dawkins, 2006). However, several issues cast doubt on this view. Although science and religious belief are often portrayed as conflicting, studies have found that people in various cultures utilise both religious and scientific explanations to make sense of death (Legare & Shtulman, 2018; Astuti & Harris, 2008; Watson-Jones et al., 2017; Harris & Giménez, 2005).1

Prior literature also suggests that humans may be prone to supernatural continuity beliefs (Bering, 2002; Hodge, 2016). Therefore, people might hold both supernatural and scientific views on death also in contexts that are often perceived as secular (cf. Bering et al., 2005).2

Furthermore, although beliefs on continuity after death might be supernatural, it is unclear whether this is necessarily so. According to the belief replacement hypothesis, secular beliefs can serve psychological functions that have been associated with religion (Farias, 2002).

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1 Furthermore, people apply also other natural and supernatural explanations, that may (or may not) align with scientific or religious content, such as folk biological accounts (see Legare & Shtulman, 2018; Hodge, 2018).
2 Studies in the cognitive science of religion on reasoning about death have found that some endorse continuity of mental states also in secular settings—albeit people tend to perceive supernatural continuity more after religious primes (Astuti & Harris, 2008; Harris & Giménez, 2005; cf. Watson-Jones et al., 2017). This literature has shed less light on reflected afterdeath beliefs and focused on more implicit views, e.g., the endorsement of supernatural continuity without an explicit belief in an afterlife (Bering, 2002). Despite the frequent use of student samples in psychology of religion, to our knowledge few have investigated reflected afterdeath beliefs in secular contexts, such as pro-science organizations. As an exception, Walker (2000, p. 5) measured the “secular eschatologies” of American healthcare workers and found that most believed in an afterlife.
If humans are inclined to perceive continuity after death (Darrell & Pyszczynski, 2016; Hodge, 2016), they may also hold naturalistic views on continuity that operate with secular terms. What might these be? Some have suggested that people often exceed the finality of death with religious afterlife belief or by attaining *symbolic* immortality, e.g., through one’s children or legacy, or as a part of eternal nature (Darrell & Pyszczynski, 2016; Dechesne et al., 2003; Lifton, 1973; Vail et al., 2010). Still, we know little on whether people have integrated symbolic ways of continuation in their afterdeath imagery. Research on what people think happens after death has focused on the development and diversity of supernatural belief (Bibby, 2017; Lester et al., 2002; cf. also Astuti & Harris, 2008; Watson-Jones et al., 2017). Therefore, views that do not entail continuity of the consciousness have often been classified to a single category, such as “annihilation” (Burris & Bailey, 2009, p. 175) or “extinctionist” (Walker, 2000, p. 15; Singleton, 2012; cf. also Bering, 2002; Thalbourne, 1996). However, there are some data-driven studies that demonstrate the possible versatility of secular death beliefs (Jonsson & Aronsson, 2015; Toscani et al., 2003). For instance, Toscani et al. (2003) found that for individuals who lacked afterlife belief, the loss of individuality upon death did not only signify annihilation—some viewed it as merging oneself with a universal soul or as a return to the biological cycle (see also Manning, 2018).

To summarise, people who hold science in high regard might be expected to endorse the scientific account of death, which some suggest entails the end of existence as the bodily

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3 It should be noted that in prior literature, the term “symbolic immortality” has been applied in various ways. For instance, in terror management theory (TMT), symbolic immortality can refer to 1) the ability of worldviews and beliefs that do not entail a promise of an afterlife to buffer the effects of death reminders, a form of symbolic immortality that does not necessarily entail a logical connection to exceeding the finality of death (e.g., increased trust in evolution following mortality salience, see Tracy et al., 2011), and 2) ways to exceed the finitude of life that contain an explicit connection to continuity after death, e.g., living on in one’s offspring (e.g., Vail et al., 2010; cf. also Florian & Mikulincer, 1998; contra Dechesne et al., 2003). The latter way to discuss symbolic immortality has also been proposed by Lifton (1973).

4 Toscani et al. (2003) interviewed eight Italians, including four unbelievers in a traditional afterlife.
functions cease. However, also science-oriented individuals’ reasoning about death might include a variety of views on annihilation and continuity, including religious afterlife belief. To date, there has been a dearth of studies on afterdeath beliefs of individuals who identify with research (cf. Walker, 2000).

In the present study, we explore the views of science-oriented Finns on death and human (in)finity. More precisely, we ask

- How do science-oriented individuals describe what happens to people after death?
- Does identification with science entail views on human annihilation, or do people also express a belief in continuity after death? If so, what continuity beliefs do the respondents hold?

The study aims to increase our knowledge on death beliefs among individuals who hold science in high regard.\(^5\) Moreover, relatively few have investigated current secular and religious death imagery in the Nordic context (however, see Arnett & Jensen, 2015; Jonsson & Aronsson, 2015; cf. Butters, 2021). The approach of the study is data-driven, although some of the initial categories applied in the analysis were based on previous literature and studies (van Mulukom et al., manuscript).

**Method and participants**

The data were collected with an online questionnaire, implemented on the GDPR-compliant LimeSurvey platform. We recruited the respondents via Finnish pro-research organisations.\(^6\)

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\(^5\) However, it should be noted that in Finnish, the word “science” is often wider in scope than in the Anglo-American context and, for some, includes also the humanities and/or the social sciences (see Haimila, 2020). Therefore, the Finnish word for “science” resembles equivalent terms in other Nordic languages (Hansson, 2015, p. 15).

\(^6\) In the recruitment ad, we mentioned “worldviews that appreciate science” or “hold science in high regard”.

The invitation was first sent via email to research institutions and other research-affiliated organisations, followed by social media recruiting in Twitter, Facebook and selected discussion boards (for additional information, see Supplementary material A). As an incentive, the respondents could participate in a raffle for an Amazon gift card (60€) and request a report on the results. Altogether, 683 respondents answered the questionnaire. In the sample, we included 387 respondents who answered the control question correctly (see Supplementary material B; Oppenheimer et al., 2009). The sample’s respondents were of multiple genders (202 women; 170 men; 15 other/I don’t want to say), and their median age was 31–40 years (range across groups: 18–30, 31–40, 41–50, 51–65, and over 65 years). The respondents were highly educated (years of education $M = 19.6$, $SD = 4.6$), and half of them had worked in research institutions (50%; natural sciences 24%; humanities 14%; social sciences 9% and other research fields 4%). Most were not affiliated with any religious community (70%) and did not believe in God (70%). A minority of respondents were unsure of their God belief (17%) or reported that they believe in God (14%) (see also Haimila, 2020).

**Procedure**

The respondents first answered open-ended questions on human origins, suffering and death. After the open-ended questions, the respondents completed scales measuring the significance of science, followed by items on religious and nonreligious cultural beliefs (see Haimila, 2020), the control question and demographic questions. In this article, we explore the respondents’ answers to the following open-ended questions:
• What do you think happens to us (humans) after death?
• Do you think the existence of an individual is finite or infinite? (Could you tell us why you think this is so?)

For the analysis, we formulated a coding template around the central themes of annihilation and continuity after death. The initial categories were based on the pilot study, prior literature and observations from the first author’s previous study (van Mulukom et al., manuscript). However, we aimed for a data-driven analysis and added categories during the first coding rounds based on recurring themes in the responses. The template was formed and revised throughout three rounds of coding. During these, both authors independently coded the same randomly selected segments of data, after which the interrater reliability was explored, and revisions were made to the template based on mutual discussions. The internal consistency of the coding was good (96% percent agreement, Cohen’s kappa = .79, during the third round which contained 25% of the data). Finally, the first author coded the responses with the established coding template (Campbell et al., 2013; Syed & Nelson, 2015; see also, Legare & Gelman, 2008). The final coding template consisted of 21 categories. Next, we will describe establishing the coding template, starting with the formulation and content of the categories on annihilation and continuity.

**Annihilation – what ceases to exist**

The responses on annihilation upon death often described it in a twofold manner: the body decays and the mind ceases to exist. We therefore established separate categories for cessation of bodily functions and the annihilation of the individual’s mind, conscious

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7 Both questions were applied to gain further details on participants’ views, as it was expected that some might answer the first question in a brief manner.
experience and thoughts. As an example, one respondent described what happens to humans after death by stating that “[t]he body is burnt or it decomposes and at some point nutrients for new life form from it. The mind ceases to exist. [...]” (P2105).

However, many respondents described annihilation without a distinction between the mind and the body. Therefore, we added the category of Annihilation no distinction. In this category, we coded the responses that suggested that humans cease to exist upon death. For instance, one participant wrote: “We cease to be. We no longer exist after that [death]. [...]” (P1942).

Some respondents made sense of annihilation by comparing it to experiences humans have during life. For instance, nonexistence after death was compared to deep sleep or unconsciousness that some respondents had experienced during anaesthesia. We coded these responses to the category Annihilation life metaphor.8

However, none of these categories entail that the respondent did not mention any kind of continuity after death. For instance, some participants stated that “nothing” happens after death (coded as Annihilation no distinction) and then went on to describe something that they do believe happens, e.g., that “we live on in the memories of others” (P1208).

Continuity – what remains

Based on the data and observations during the first author’s prior study, we established the category Social continuity to capture the responses that described continuation through social impact. This included subcategories for continuation in memories of close others

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8 Moreover, some described the experience of annihilation by comparing it to the state before birth (see also Coleman et al., 2016). Although participants that discuss prenatal existence do not refer to life but rather some state preceding it, we also categorized these responses to the category of life metaphors.
We also included continuity in offspring, mainly based on earlier literature (Lifton, 1973; Vail et al., 2010). Due to prior findings on possibly intuitive mind–body dualism (Chudek et al., 2018), we expected that some respondents might mention belief in an afterlife of the mind or the soul. However, we wanted to mark these beliefs to separate categories, as we were interested in whether the science-oriented respondents would apply terminology that is at times associated to religiosity (Continuity soul) or more secular afterlife belief (Continuity mind). During the coding, we noticed that more categories were needed to capture the immortality beliefs. The category Continuity religious/New Age was established for continuity beliefs that did not refer to the soul but mentioned other terminology that might be perceived as religious in the Finnish context (e.g., Heaven) or regarded as spiritual and/or New Age belief (e.g., reincarnation). Due to recurrences in the data, we also created a category Continuity same/new body for an afterlife in the same body or a new animal or human body (e.g., reincarnation, resurrection body). As the first author expected the respondents might believe in circulation of nature based on a prior survey (van Mulukom et al., 2020), we established the category of Continuity in circulation of nature, later widening it to Continuity natural laws. Finally, we created a category for responses that expressed continuation after death but did not fit the criteria of the mentioned categories (Continuity other), e.g., when a respondent mentioned that after death we move on to “other airs” (P1263) or an unspecified place.

More specifically, we first established the categories ‘Continuity close others’ and ‘Continuity societal’ to capture the responses that described continuation in the memories of others. However, some occurrences were difficult to code since many did not specify whether the deceased live on in the memories of loved ones or people more generally, as in the case of celebrities. Therefore, all continuity in social impact was coded to the main category ‘Social continuity’ and further specified with close/distant proximity, when applicable.

Furthermore, some studies suggest that people conceptualize the mind and the soul differently (Harris & Richert, 2008; in the Finnish context, see Lindeman et al., 2015).
Categories on attitudes and the role of science

To further describe the responses, we created categories on attitudes that seemed to recur in the data. Therefore, we established a category for responses that mention continuity after death merely to reject the belief or otherwise criticise it (Continuity rejection). However, some people mentioned belief in continuity to express their conflicted feelings, e.g., if they were not sure whether or not to believe in an afterlife. These responses were categorised with the code Conflicted. In addition, we formulated codes for suggestions that belief in continuity is (or would be) comforting in face of mortality for the respondents themselves (Comfort continuity) and for responses that expressed something positive about mortality (Death good/beneficial). As we were interested in the possible role of science in annihilation and continuity beliefs, we also added the code Science for any mentions of science-related terminology (e.g., science, research, neurology, physiological, atom). Furthermore, responses that speculated on the ability of science to someday overcome mortality were categorised as Potential of science. Finally, we created the category Ambiguous for responses that were difficult to interpret or did not correspond to the criteria of any category. All the categories are listed in Table 1. The detailed coding instructions are archived in the supplementary material.

During the analysis, we noticed that some participants stated their response in a more conditional manner, while others seemed assured in their views. Additionally, a respondent might express one belief with certainty but hold another less firmly. To take this into account, we coded the annihilation and continuity categories on the scale 0–2, when 0 = no belief, 1 = hesitant wording and 2 = belief. For instance, one of the respondents stated that after death “[w]e cease to exist in the human form. Insofar as everything is ‘conscious’ to a certain extent, consciousness may continue in an altered state of being that is beyond the human
imagination” (P19). This response was assigned the following codes and values: Annihilation no distinction 2, Continuity mind/consciousness 1.\textsuperscript{11}

*Insert table 1 here*

\textsuperscript{11} Another participant wrote that: “[...] Once the brain functions cease the material substrate of consciousness will perish. If the consciousness is based solely on brain functions, it seems highly unlikely that any information would be transferred anywhere else or otherwise remain. However, if the brain in some way interacts with some conscious or “spiritual” dimension, it is possible that some information proceeds outside the human body or otherwise remains. This information could be called e.g., the Soul [...]” (P680). This response was categorised with the following codes and values: Annihilation body/bodily functions 2; Annihilation mind/consciousness 1; Continuity soul/spirit 1 and Continuity religious/New Age 1.
### Table 1

*The categories of the coding template.*

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity social</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death socially (in other humans or communities).</td>
</tr>
<tr>
<td>Continuity close others</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death in people that personally knew the deceased, e.g., in memories of friends or family.</td>
</tr>
<tr>
<td>Continuity offspring</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death in their offspring.</td>
</tr>
<tr>
<td>Continuity societal</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death in their societal contributions, e.g., through their work.</td>
</tr>
<tr>
<td>Continuity mind/consciousness</td>
<td>0–2</td>
<td>The respondent expresses that the human mind/consciousness exists after death.</td>
</tr>
<tr>
<td>Continuity soul</td>
<td></td>
<td>The respondent expresses that the human soul or part of it exists after death.</td>
</tr>
<tr>
<td>Continuity other religious/New Age</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death and applies terminology that is often associated to religion or New Age beliefs (excluding soul).</td>
</tr>
<tr>
<td>Continuity same/new body</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death in a [human or animal] body.</td>
</tr>
<tr>
<td>Continuity natural laws</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death and expresses this as a law of nature or justifies this view with a natural law, such as the regularities in physics or biology.</td>
</tr>
<tr>
<td>Continuity other</td>
<td></td>
<td>The respondent expresses that humans or some part of them exists after death but does not specify his/her view, or the view does not fit the criteria of any other continuity category.</td>
</tr>
<tr>
<td>Annihilation body/bodily functions</td>
<td>0–2</td>
<td>The respondent expresses that the human body or bodily functions cease/annihilate after death.</td>
</tr>
<tr>
<td>Annihilation mind/consciousness</td>
<td></td>
<td>The respondent expresses that the mind/thought/consciousness annihilates after death.</td>
</tr>
<tr>
<td>Annihilation no distinction</td>
<td></td>
<td>The respondent states that humans or some part of them is annihilated after death but they do not distinguish between the mind and the body.</td>
</tr>
<tr>
<td>Annihilation life metaphor (e.g., sleep, before birth)</td>
<td>0–2</td>
<td>The respondent describes annihilation after death with a life metaphor, such as deep sleep.</td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>The respondent mentions a science-related term (e.g., “science”, “research”, “biology”, “physiological” or “pharmacological”).</td>
</tr>
<tr>
<td>Potential of science</td>
<td></td>
<td>According to the respondent, science and/or technology might offer continuity after death as science/technology develops.</td>
</tr>
<tr>
<td>Death good/beneficial</td>
<td>0–1</td>
<td>The respondent expresses that there is something good, e.g., comforting or beneficial, about death or dying.</td>
</tr>
<tr>
<td>Conflicted</td>
<td></td>
<td>The respondent expresses that they experience conflicting feelings or thoughts on what happens after death.</td>
</tr>
<tr>
<td>Continuity comfort</td>
<td></td>
<td>The respondent expresses that a continuity belief is comforting (for themselves).</td>
</tr>
<tr>
<td>Continuity rejection</td>
<td></td>
<td>The respondent mentions continuity after death only to reject it. The responses were not coded in the continuity categories.</td>
</tr>
<tr>
<td>Ambiguous</td>
<td></td>
<td>It is difficult to read what the respondent means or the response does not fit the criteria of any other category.</td>
</tr>
</tbody>
</table>

Note. Annihilation and continuity categories were rated on the scale 0–2 (0 = does not fit the criteria, 1 = ambiguous wording such as “might”, 2 = fits the criteria) and other categories on the scale 0–1 (0 = does not fit the criteria and 1 = fits the criteria).
Results

In the following sections, we describe the results. First, we introduce the frequencies of responses that refer to annihilation and/or continuity after death, followed by frequencies of the categories that mapped attitudes and the role of science in afterdeath beliefs. Secondly, we present our analysis of the response patterns. We also examined the relationship between the response categories and demographic information (gender, age, education, work affiliation to research, religious affiliation, self-described spirituality and God belief). The respondents’ age, education, and current or prior work in a research institution were not related to afterdeath beliefs. However, there were some differences in responses across other demographic variables and we describe these in the final section on the results.

Frequencies of annihilation and continuity beliefs

The content of the responses was explored by investigating which beliefs were mentioned most frequently. Overall, the majority of respondents emphasised that something annihilates upon death; for example, 76% (293 participants) mentioned some kind of annihilation when asked what happens to humans after death (response categorised as Annihilation no distinction, Annihilation body, and/or Annihilation mind). On the other hand, 35% (135) of respondents endorsed some kind of continuity in their response on what happens after death. A similar pattern could be found in the responses concerning human (in)finity, as 82% (316) mentioned annihilation and 37% (143) endorsed secular or supernatural continuity after death. It should be noted that the responses most likely do not contain all the afterdeath beliefs of the participants. For instance, even if some respondents did not mention annihilation, they might still agree that something of human existence ends in death; however, these participants have focused on something else in their response. Overall, 89%
(345) mentioned some kind of annihilation in at least either of their responses and 53% (205) described continuity of humans (or some part of them) after death.

The most frequently mentioned view on what happens after death was annihilation without distinction between the mind and the body (60%, see Table 2). Many simply described that humans cease to exist or that nothing happens after death. However, some went on to describe continuity after they had mentioned annihilation without a mind–body distinction.

Table 2
Most frequently mentioned categories on annihilation and continuity (percentage and number of respondents, N = 387)

<table>
<thead>
<tr>
<th>Order</th>
<th>Category</th>
<th>Endorsement % (n)</th>
<th>Uncertain endorsement % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Annihilation no distinction</td>
<td>60% (234)</td>
<td>1% (5)</td>
</tr>
<tr>
<td>2</td>
<td>Annihilation body/bodily functions</td>
<td>55% (214)</td>
<td>0% (1)</td>
</tr>
<tr>
<td>3</td>
<td>Annihilation mind/consciousness</td>
<td>38% (146)</td>
<td>1% (5)</td>
</tr>
<tr>
<td>4</td>
<td>Continuity social</td>
<td>24% (92)</td>
<td>4% (15)</td>
</tr>
<tr>
<td>5</td>
<td>Continuity natural laws</td>
<td>20% (79)</td>
<td>3% (15)</td>
</tr>
<tr>
<td>6</td>
<td>Continuity close others</td>
<td>19% (73)</td>
<td>4% (15)</td>
</tr>
<tr>
<td>7</td>
<td>Continuity societal</td>
<td>17% (65)</td>
<td>1% (3)</td>
</tr>
<tr>
<td>8</td>
<td>Continuity religious/New Age</td>
<td>14% (53)</td>
<td>2% (7)</td>
</tr>
<tr>
<td>9</td>
<td>Continuity soul/spirit</td>
<td>8% (31)</td>
<td>4% (15)</td>
</tr>
<tr>
<td>10</td>
<td>Annihilation life metaphor (e.g., sleep)</td>
<td>6% (23)</td>
<td>0% (1)</td>
</tr>
</tbody>
</table>

Note. Respondents who mentioned the category with the same score in both questions were only calculated once.¹²

The second most frequently mentioned view was annihilation of bodily functions, as this was described in one or more responses by 55% of participants. Many stated that after death one’s body decomposes. Annihilation of the body was often paired with the third most

¹² The top ten categories listed in Table 2 were followed by ‘Continuity offspring’ (4% endorsement, 1% uncertain); ‘Continuity other’ (4% endorsement, 3% uncertain); ‘Continuity mind/consciousness’ (3% endorsement, 3% uncertain); and ‘Continuity same/new body’ (1% endorsement, 2% uncertain endorsement).
frequently mentioned category, annihilation of the mind, consciousness or thought (38%). As one respondent stated “[w]hen we die the brain functions cease; therefore, all thinking stops” (P765). However, not all participants were eager to link bodily decay to annihilation of the mind. Some mentioned bodily demise but found it more difficult to decipher what happens to the consciousness. One respondent stated, “[a]t least our physical body decomposes and disintegrates. Disappears. Consciousness is a tough one. I hope that it continues living in some way [...]” (P1284). Overall, the respondents were more assured in their annihilation beliefs and expressed uncertainty mainly concerning continuity after death (see Table 2).

The fourth most frequent afterdeath belief was continuity in social relations and legacy, which was mentioned by 24% of participants (28% when we include uncertain responses). The participants often described that although something ends in death, people or parts of them continue in memories. Some further specified that humans exist in the memories of loved ones, family or friends (‘Social continuity close others’). Others described continuity in societal legacy, such as scientific work, art or the impact a person had on the environment; these responses were also categorised as ‘Social continuity societal’. Some mentioned both kinds of social continuity, as the respondent who described what happens after death in the following manner:

The body starts to decompose. [My] own life continues in children and close relatives. Humans remain in memories of others only as long as they [the others] live. If one has accomplished something more permanent, like a book or a house, people can remember you longer. I think of myself as a link in a never-ending chain that reformulates itself, with the eldest parts slowly disappearing from sight. (P2160)

Many wrote that merely a part of the person remains in memories; therefore, humans continue only in a limited sense. The respondents that described social continuity along these
lines often defined existence through consciousness, making continuation in memories a pale substitute for biological life. As one respondent stated, “[w]hen a person dies, they no longer exist. The history of the human can live on in the memories of loved ones for some time but the story of the deceased will not continue” (P2664). Another respondent suggested that upon death, the person does not disappear, as

[...] their essence, looks, experience of their laughter, temperament and smell has transferred to the memory of many living humans and continue their life in the memory of other people for a few more generations. In fact, nowadays perhaps even forever to the extent that these features have been uploaded to Cloud storage around the world [...] (P2678).

However, the same participant also emphasised annihilation in death, stating that even if someone lived on in memories “[...] the person’s unique consciousness, tied to the unique body, can never reoccur as a subjective experience [...]”. On the other hand, some placed higher value on continuing in social bonds. As one respondent wrote, “[...] humans can live in memories as long as someone remembers them. In this sense, the community is more important than the individual” (P2011).\(^{13}\)

Another frequently mentioned continuity belief was continuation in natural laws, described by 20% (79) of the participants. Also in these responses, continuity after death retained merely parts of humans. Many referred to a process the respondents call the circulation of nature or life. Some discussed death as a return, or more specifically that “the ingredients that we consist of return back to the circulation of life” (P2036). In most of these

\(^{13}\) Another described continued human existence through legacy or societal impact: “[...] If you are an artist, author or some historical figure of importance or for instance our ancestor Lucy that was found in Africa or iceman Ötzi, existence can continue for hundreds of thousands of years. Then existence is not the existence of individual’s own consciousness but shared cultural experience of a person that once was” (P2594).
views, the individual is annihilated and the body remains after death. Through the decomposing process, annihilation enables continuation of more long-lasting parts in nature.¹⁴ Unlike in the descriptions on social continuity, the physical remnants do not retain the individual persona. As one participant wrote, “[a]fter death the consciousness and the persona cease to exist and the body ends up like all organic material. We therefore continue forward in the circulation of nature” (P348). Some respondents mentioned atoms in an analogous manner stating that although the consciousness annihilates, the atoms continue. Several respondents also discussed the continuity of energy, referring to thermodynamics and the law of conservation of energy. Some specified that energy “leaves” the human body upon death. As the law of conservation of energy posits that energy does not disappear, the respondents associated this with the continuity of human parts or even the human spirit. For instance, one participant wrote,

I think that everything here is energy, originating from the Big Bang. Physically we consist of stardust, as any other matter here on Earth. The body decomposes or burns, the mind and the spirit are released. Energy changes its form but surely [or: as we know] its quantity is constant. The energy that remained in a human is released; [it] changes and proceeds.

(P1844)

Several respondents suggested that if the body decomposes or otherwise “returns” to nature, its parts will form new life. Some discussed the forms that human parts may eventually take, as one participant described human (in)finity:

[...] what humans are made of circulates on in some form. When pieces, atoms etc., reunite a human is reverted but not as the same but as different. The building blocks

¹⁴ As one respondent stated, “[a]fter death we decompose so our ingredients continue their circulation in the universe” (P796).
[rakennusaineet] can also form something other than a human... for instance, an animal or a tree. (P2108)

Like social continuity beliefs, the importance that the respondents placed on continuity in natural laws varied. Many paired individual existence with consciousness and separated this from the nonindividual continuity in nature. In the words of one participant, even if atoms are infinite “an individual human is not only atoms” (P1076).

Although most respondents in our science-oriented sample referred to annihilation and/or nonsupernatural continuity after death, some endorsed an afterlife that could be viewed as religious or spiritual in a traditional sense (‘Continuity religious/New Age’). However, these beliefs were less frequent and only mentioned by 14% (53) of the respondents. In the responses, participants often referred to “God” or “Heaven”. Some discussed the body and the spirit separately, as in the following description on what happens after death:

Physiologically we probably just decay and, if buried, decompose. Spiritually—and this is just my own view—we continue [our] life somewhere else. I do not consider myself as religious but the religious teaching I got in my childhood and youth have maintained an idea of Heaven. [...] (P1004)

Although the author of the quote did not regard themselves as religious, some explicitly identified with religion. For instance, another participant discussed afterdeath by describing bodily decay and concluding that “[...] I am religious and believe in an afterlife of the soul in Heaven. However, this does not exclude that I believe in science” (P23). Several respondents mentioned the soul and (other) religious or spiritual belief in the same response. Overall, immortality of the soul or spirit was expressed by 8% (31) of the respondents. Additionally, as with other continuity categories, some leaned towards an afterlife of the soul but
expressed some uncertainty (4%, 15). Other kinds of supernatural continuity were even less endorsed; only 4% (15) responded that humans continue after death in an unspecified place or form and 3% (12) expressed belief in the continuity of mind or “consciousness” after death.

**Frequencies of other categories**

In addition to descriptions on what remains after death, respondents also specified their relation to continuity beliefs in other ways (see Table 3). Most frequently, the respondents emphasised that they do not believe in continuity (22%, 86). This manifested mainly as rejection of supernatural beliefs and (other) views that are often perceived as religious. Many underlined that they do not believe in “Heaven etc.” (P1694) or an afterlife. As one respondent wrote, “I don’t believe in life after death. When a person dies, bodily functions cease and consciousness disappears. The person ceases to exist in all possible ways” (P174). However, rejecting a supernatural afterlife did not necessarily exclude endorsement of continuation of other kinds. For instance, one participant wrote that they do not believe in any other reality, yet the deceased individuals “[…] are present in the thoughts of those who still live, and I think that in a way it is very valuable life after death” (P806). Therefore, the responses coded as rejection of continuity mainly criticise supernatural or religious belief, rather than secular forms of continuation.

On the other hand, 9% (34) of the respondents expressed conflicted views, in which they often wanted to believe in supernatural (or similar) continuity after death. For instance, one respondent wrote that they would “[…] very much want to believe in going to the ‘home in Heaven’ but unfortunately reason stumps [this] belief” (P1763). Also some others divided their experiences into conflicting parts (e.g., reason and wishes) that could come to different conclusions. As one participant stated, after death “[t]he electronic brain functions cease,
consciousness flames out. Against cold logic, I would like to believe in the law of thermodynamics, which states that energy never disappears from the system but merely changes its form” (P1839). However, conflicted responses also reflected uncertainty; some respondents felt torn, as they did not know what to believe about human’s existence after death. One participant described this feeling as being “[...] undecided, between two options. Either consciousness simply flames out or we get to return to our loved ones” (P2533).\(^{15}\) However, whereas some felt conflicted or overwhelmed, others found a “silver-lining” in death and described mortality as comforting or beneficial (‘Death good/beneficial’ 8%, 31). This category contained several somewhat differing beliefs. Death as comforting was mostly related with the expectation of a pleasant state that follows. For instance, one respondent expected rest and perhaps a reunion with close others:

> I believe, and hope, that after death we get to rest. I cannot guess the exact nature of that rest, but in the best case scenario it is like coming home after a long, hard day and falling asleep in the warm gloaming with your loved ones. (P1105)

Similarly, some emphasised that death marks the end of suffering, whether it be a pleasant feeling or lack of experience whatsoever. Another line of responses saw positive aspects in death mainly in how bodily decay benefits nature, e.g., by producing nutrients for new life. Similarly, some described their preference for disposal of the body as merging into nature was preferred to artificial preservation. For instance, one respondent wrote about death in the following manner:

> [...] After that [death] the human body remains; it disintegrates into chemical elements, either slowly or with accelerated speed (cremation). At its best, the ashes will not be

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\(^{15}\) Also other respondents discussed the importance of social relations in these responses. As one participant wrote, humans “[...] probably cease to exist. But for the sake of my own psyche, I must think that my late mother is somewhere safe (in a safe place)” (P2097).
packed in a non-biodegradable urn but they are spread back to nature, where they can still benefit the ecosystem. [...] (P489)

Table 3
Frequencies of attitude categories and the categories mapping the role of science in responses (percentage and number of respondents, \(N = 387\))

<table>
<thead>
<tr>
<th>Category</th>
<th>Endorsement % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity rejection</td>
<td>22% (86)</td>
</tr>
<tr>
<td>Conflicted</td>
<td>9% (34)</td>
</tr>
<tr>
<td>Death good/beneficial</td>
<td>8% (31)</td>
</tr>
<tr>
<td>Continuity comfort</td>
<td>3% (13)</td>
</tr>
<tr>
<td>Science-related terminology</td>
<td>35% (135)</td>
</tr>
<tr>
<td>Potential of science</td>
<td>5% (19)</td>
</tr>
</tbody>
</table>

More than one third of the respondents applied science-related terminology in their depictions of death and what follows. However, few respondents discussed the ability of science to eventually eliminate human mortality, e.g., with technological enhancement of the body and/or mind uploading (5%, 19). Overall, the meaning of science-related terms in afterdeath can better be understood by examining what kind of responses applied them. Next, we will describe overall patterns on how afterdeath beliefs, attitude categories and science-related terminology were associated in the responses.

Response patterns
To explore which beliefs were often mentioned together, we conducted a principal component analysis on the responses. For the analysis, we formulated variables for each category that contained the sum value of the participant’s responses for both questions
analysed in this study. However, we excluded the category ‘Continuity close others’ from the analysis, as it was strongly correlated with the overall category ‘Social continuity’. The analysis isolated eight components with eigenvalues > 1.0 that accounted for 64% of the variance. All the components are listed in Table 4. Here, we will briefly describe the five patterns in the responses that explained the most variance in the data.

*Insert Table 4 here*

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16 Further rotation of the model with Varimax (Kaiser normalization) yielded more simplified components. In this footnote, we list the content of these components, in case the reader would like more information on the rotated model: C1: Annihilation mind, Annihilation body, Annihilation no distinction [R]; C2: Continuity social, Continuity societal; C3: Continuity religious/New Age, Continuity soul, Continuity same/new body; C4: Continuity natural laws, Science, Continuity offspring; C5: Continuity comfort, Conflicted; C6: Continuity other, Continuity mind; C7: Potential of science, Science; C8: Death good/beneficial, Annihilation life metaphor. Somewhat similar patterns were found also with Oblimin rotation method. As the two questions the participants answered were formulated differently, we also analysed the responses to both questions separately to check for differing patterns between categories.
Table 4
Component matrix of the PCA on response patterns

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eigenvalue</td>
<td>2.39</td>
<td>1.89</td>
<td>1.68</td>
<td>1.50</td>
<td>1.39</td>
<td>1.12</td>
<td>1.09</td>
<td>1.03</td>
</tr>
<tr>
<td>% of the variance explained</td>
<td>13%</td>
<td>10%</td>
<td>9%</td>
<td>8%</td>
<td>7%</td>
<td>6%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Annihilation mind</td>
<td>.591</td>
<td>.207</td>
<td>.415</td>
<td>-.366</td>
<td>.017</td>
<td>-.139</td>
<td>.123</td>
<td>-.008</td>
</tr>
<tr>
<td>Continuity religious/New Age</td>
<td>-.543</td>
<td>.497</td>
<td>-.027</td>
<td>.048</td>
<td>-.223</td>
<td>.195</td>
<td>.072</td>
<td>-.097</td>
</tr>
<tr>
<td>Annihilation body</td>
<td>.529</td>
<td>.475</td>
<td>.149</td>
<td>.085</td>
<td>-.055</td>
<td>-.013</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>Annihilation no distinction</td>
<td>-.198</td>
<td>-.782</td>
<td>-.157</td>
<td>.194</td>
<td>.025</td>
<td>.236</td>
<td>.081</td>
<td>.043</td>
</tr>
<tr>
<td>Continuity soul</td>
<td>-.414</td>
<td>.510</td>
<td>.043</td>
<td>.201</td>
<td>-.123</td>
<td>.229</td>
<td>.201</td>
<td>-.039</td>
</tr>
<tr>
<td>Continuity mind</td>
<td>-.230</td>
<td>.344</td>
<td>-.052</td>
<td>.113</td>
<td>-.040</td>
<td>-.072</td>
<td>-.224</td>
<td>.341</td>
</tr>
<tr>
<td>Continuity same/new body</td>
<td>-.292</td>
<td>.328</td>
<td>-.012</td>
<td>-.118</td>
<td>-.096</td>
<td>.195</td>
<td>.324</td>
<td>.002</td>
</tr>
<tr>
<td>Continuity social</td>
<td>.601</td>
<td>.162</td>
<td>-.668</td>
<td>.150</td>
<td>-.103</td>
<td>.022</td>
<td>.052</td>
<td>.007</td>
</tr>
<tr>
<td>Continuity societal</td>
<td>.572</td>
<td>.121</td>
<td>-.643</td>
<td>.130</td>
<td>-.210</td>
<td>.117</td>
<td>.090</td>
<td>.030</td>
</tr>
<tr>
<td>Continuity natural laws</td>
<td>.169</td>
<td>.054</td>
<td>.438</td>
<td>.651</td>
<td>.100</td>
<td>-.142</td>
<td>.017</td>
<td>-.116</td>
</tr>
<tr>
<td>Continuity offspring</td>
<td>.155</td>
<td>.104</td>
<td>-.142</td>
<td>.501</td>
<td>.290</td>
<td>-.162</td>
<td>.021</td>
<td>-.059</td>
</tr>
<tr>
<td>Science</td>
<td>.388</td>
<td>.140</td>
<td>.458</td>
<td>.474</td>
<td>.017</td>
<td>.284</td>
<td>-.216</td>
<td>.114</td>
</tr>
<tr>
<td>Conflicted</td>
<td>-.078</td>
<td>.074</td>
<td>-.169</td>
<td>-.021</td>
<td>.782</td>
<td>.086</td>
<td>-.055</td>
<td>.138</td>
</tr>
<tr>
<td>Continuity comfort</td>
<td>-.127</td>
<td>.185</td>
<td>-.122</td>
<td>-.150</td>
<td>.667</td>
<td>.157</td>
<td>.090</td>
<td>.263</td>
</tr>
<tr>
<td>Potential of science</td>
<td>.271</td>
<td>-.051</td>
<td>.156</td>
<td>-.037</td>
<td>-.196</td>
<td>.605</td>
<td>-.340</td>
<td>.418</td>
</tr>
<tr>
<td>Death good/beneficial</td>
<td>.127</td>
<td>.028</td>
<td>.128</td>
<td>.315</td>
<td>-.059</td>
<td>-.239</td>
<td>.573</td>
<td>.397</td>
</tr>
<tr>
<td>Continuity other</td>
<td>-.232</td>
<td>.129</td>
<td>-.118</td>
<td>.022</td>
<td>-.121</td>
<td>-.524</td>
<td>-.536</td>
<td>.205</td>
</tr>
<tr>
<td>Annihilation life metaphor</td>
<td>-.013</td>
<td>-.305</td>
<td>.149</td>
<td>-.202</td>
<td>-.169</td>
<td>-.159</td>
<td>.257</td>
<td>.554</td>
</tr>
<tr>
<td>Continuity rejection</td>
<td>.245</td>
<td>-.217</td>
<td>.241</td>
<td>-.154</td>
<td>.122</td>
<td>.113</td>
<td>.068</td>
<td>-.324</td>
</tr>
</tbody>
</table>

Note. Component loading > .400 in bold. The PCA was based on the correlation matrix.

The first component reflected a cluster of responses that suggested that humans may live on in social relations and legacy (‘Continuity social’, ‘Continuity societal’), although the consciousness ceases to exist (‘Annihilation mind’) and the body decays (‘Annihilation body’). In this component, participants were less likely to mention belief in the soul or other religious afterlife (‘Continuity religious’, ‘Continuity soul’). Instead, an emphasis on religious belief
comprised the second component. In this pattern, the religious responses often entailed that death signifies the annihilation of the body (‘Continuity religious’, Continuity soul’, ‘Annihilation body’). As one respondent stated, “[o]ur body decays and decomposes. We no longer actively influence the world. I believe and hope that after death there is the hope of resurrection […]” (P526). Similarly, the component was negatively associated with descriptions of annihilation that did not separate between the mind and the body (‘Annihilation no distinction’), e.g., that “[…] there is nothing” after death (P312). The third response pattern reflected responses where after death, parts of humans continue in nature (‘Continuity natural laws’), although the mind ceases to exist (‘Annihilation mind’). The participants who described death in this manner often applied science-related terminology (‘Science’). As one respondent wrote, “[b]iologically we start to decompose and continue in the circulation of nature. The consciousness flames out instantly […]” (P2766). In this cluster of responses, those who mentioned symbolic continuation in nature were less likely to describe continuity in memories or legacy (‘Continuity social’, Continuity societal’).

Also the fourth pattern comprised descriptions of something of humans remaining in physical or biological processes (‘Continuity natural laws’). More specifically, the component reflected descriptions of continuation in descendants (‘Continuity offspring’), as some stated that genes might extend the human existence (‘Science’). As one respondent put it, “I think the existence of a human can be infinite. Our genes are passed forward to our children” (P1307). Finally, the fifth component comprised the respondents’ accounts that belief in

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17 On resurrection, the respondent continued that “[i]ts essence is a mystery, but is a comforting thought that my restless heart would gain peace in the Christ […]” (P526). As a further note, the response was not coded as ‘Continuity same/new body’ as we were not entirely sure what exactly the respondent referred to as “resurrection”.

18 Some other science-related terminology in similar responses included “infinite components, such as the subatomic particles” (P2349) or “chemical elements”, that are “eternally circulating” (P2090).
(mainly religious) continuity would be a comforting way to tackle the mortality of self or others (‘Continuity comfort’); yet they were not able to rely on it but reported ambivalent feelings or thoughts (‘Conflicted’), as discussed in the descriptions of frequencies of the categories.19

Although the components do not describe patterns in the data exhaustively, they shed light on which categories could be grouped together in a model that retains the most significant differences between the respondents. To summarise, all the components contained a category that either exceeds the finality of death (continuity categories), discusses whether death could be deferred in the future (‘Potential of science’), contains the wish to believe in an afterlife (‘Continuity Comfort’) or engages in benefit-finding (‘Death good/beneficial’) (see Table 4). Therefore, the respondents mainly seemed to differ in their strategies to exceed or make meaning of mortality. The top three response patterns also loaded onto annihilation categories (> .400). Among these, the component that comprised religious belief clustered with the annihilation of mere body, whereas patterns that reflected nonsupernatural continuity comprised the cessation of the mind.

The role of unbelief and gender

As mentioned, there were some differences across demographic groups in afterdeath beliefs. Firstly, women were more likely to express conflicted feelings over what happens after death than other gender groups ($p = .054$, Fisher’s Exact Test, FET) and less likely to mention that

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19 The remaining three components accounted for the least differences between respondents and comprised of afterdeath beliefs that were mentioned less. The sixth component reflected some of the responses that discussed the potential of science at some point to eliminate mortality concerns--these were less likely to contain supernatural continuity without religious terminology. In the seventh component, the aforementioned (lack of) afterlife belief was associated with accounts on death as good or beneficial. In the eighth component, speculation on the potential of science to conquer human mortality was coined with comparing death with something that happens during life (e.g., deep sleep) or precedes it (the state before birth), a possible strategy to make sense of nonexistence of the consciousness.
the mind ceases to exist \((p = .002, \text{FET})\). Furthermore, gender was associated with describing the annihilation of the body; a relationship we cannot quite decipher \((\text{Kruskal-Wallis } H[2] = 7.585, p = .023)\).^{20}

However, the demographic variables the most associated with afterdeath beliefs were religious affiliation, self-described spirituality and belief in God. God belief was associated with descriptions of conflicted feelings about afterdeath \((p = .035, \text{Fisher’s Exact Test})\), as those unsure of their theism/atheism mentioned inner conflict more frequently than others. Theists and those unsure of their God belief were more likely to endorse a supernatural afterlife, such as the immortality of the soul, than atheists. Furthermore, secular (nonsupernatural) continuity beliefs were most often mentioned by those who did not believe in God. More specifically, continuity in natural laws appeared as mainly an atheist belief in our sample \((\text{Kruskal-Wallis } H[2] = 6.915, p = .032)\) and also the endorsement of social continuity was negatively associated with God belief \((p = .033, \text{FET})\). Moreover, God belief was associated with the annihilation categories, as atheists were most likely to refer to mortality of the consciousness \((p < .001, \text{FET})\), bodily annihilation \((H[2] = 14.224, p = .001)\), and annihilation without distinction between the mind and the body \((H[2] = 23.238, p < .001)\).^{21} On the other hand, theists applied less science-related terminology in their views on afterdeath than atheists and those unsure of their God belief \((p = .037, \text{FET})\). The relationship between the respondents’ religious affiliation and the belief categories followed a somewhat

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20 More specifically, there was a significant difference between men and respondents who chose “Other/I don’t want to say” \((p = .022)\), with “Other/I don’t want to say” group mentioning bodily annihilation the most (mean rank 258.43) and men the least (mean rank 184.72). The association between annihilation of the body and gender might be related to the small group size in the “Other/I don’t want to say” category \((n = 15)\). The “Other/I don’t want to say” group was less spiritual than other gender groups \((H[2] = 6.355, p = .042, \text{mean rank women} = 205.15, \text{men} = 185.23, \text{and Other/I don’t want to say} = 143.27)\). However, there was only a slight negative correlation between spirituality and descriptions of bodily annihilation \((r_{s} = -.15, p = .004)\).

21 Lack of God belief was also related to the rejection of (mainly religious) continuity \((p < .001, \text{Fisher’s Exact Test})\).
similar pattern, although religiosity was less associated with conceptions on after death than God belief. Similar to God belief and religiosity, self-described spirituality was positively associated with supernatural belief categories.

Discussion

In this study, we explored how science-oriented individuals describe what happens to humans after death and whether identification with science entails views on “secular death”, in which an individual is annihilated as the bodily functions cease. In our sample, science-oriented Finns mainly believed in this kind of a secular conception of death. However, most also expressed that something of humans remains post-mortem. The responses on continuity after death contained supernatural and naturalistic (nonsupernatural) views, and these remained as somewhat distinct sense-making strategies. Supernatural afterlife was more likely mentioned by God-believers, and it mostly applied religious terminology (e.g., referring to the immortality of the soul instead of the mind). On the other hand, nonsupernatural continuity was more likely endorsed by respondents who were atheists or unsure of their God belief. Furthermore, unbelievers were more likely than theists to mention science-related terminology. Science-related terms were applied to describe annihilation—but also in discussions on continuation, e.g., in nature through bodily decay (see also Manning, 2018). These views are interesting, as studies have often associated the biological conception of death with lack of continuity (or more precisely, cessation of bodily and mental states; see Georgiadou & Pnevmatikos, 2019; Harris & Giménez, 2005). However, as we extend the

22 Moreover, religious belief and most frequently mentioned forms of nonsupernatural continuity seemed to entail different kinds of annihilation views; endorsement of religious afterlife clustered together with annihilation of (mere) body, whereas, in our PCA model, symbolic continuity was more likely paired with descriptions of the mind ceasing to exist.
investigation of biological views beyond the level of individual functionality and explore people’s reflected notions, biological knowledge (or interpretations of it) can facilitate the belief that upon death, humans merge into something meaningful that outlasts them (see also Toscani et al., 2003; Manning, 2018).\(^{23}\) In addition to the nonindividual continuation in nature, some respondents discussed the possibility of continuity in memories of others—a symbolic form of existence which, to a limited extent, could retain parts of individuality.

Previously, naturalistic continuation has mainly been discussed in the literature on symbolic immortality, and our results align with prior suggestions that humans may gain a sense of continuation, e.g., from nature or social legacy (e.g., Lifton, 1973; Florian & Mikulincer, 1998; Vail et al., 2010). However, prior empirical investigations on whether people actually endorse or discuss symbolic immortality (and who does so) have been scarce. For instance, few studies have described people’s secular notions of living on in memories (however, see Coleman & Arrowood, 2015; cf. Jonsson & Aronsson, 2015).\(^{24}\) Also the role of belief in natural laws in (atheists’) views on afterdeath has received very little attention (although see Manning, 2018; Toscani et al., 2003).\(^{25}\) One explanation might be the focus of prior studies on beliefs that retain the consciousness, leaving a gap in the research for more secular afterdeath imagery. For instance, Burris and Bailey (2009, p. 174) argue that “if consciousness does not survive the death event, then the perseveration of identity and

\(^{23}\) In other words, whereas folk biological reasoning about death focuses on annihilation, reflected views on biological processes may, for some science-oriented individuals, complement this with one form of symbolic immortality (cf. Lifton, 1973).

\(^{24}\) Continuity in memories has also been discussed in the literature on continuing bonds or continued attachment (Klass et al., 1996; Jonsson & Aronsson, 2015), which some perceive mainly as a religious phenomenon (Benore & Park, 2004). Nevertheless, in our sample, living on in memories did not contain any continued experience of the deceased (see also Coleman & Arrowood, 2015; cf. Burris and Bailey (2009)).

\(^{25}\) However, some have noted the possible importance of somewhat similar beliefs for Finns more generally. In a recent representative survey, 26% of Finns at least somewhat agreed that after death, we “blend back into the universe” (Ketola et al., 2018, p. 46–47). Furthermore, the return to the circulation or cycle of nature was also mentioned by some of the Finnish hospice patients interviewed by Butters (2021).
physicality is not meaningful: the self experiences Annihilation”. However, even if some scholars deem nonsupernatural continuity insignificant, our results suggest that naturalistic annihilation/continuity beliefs might still be meaningful for some science-oriented individuals.\(^{26}\)

Overall, as some respondents endorsed religious and/or spiritual afterlife beliefs in their descriptions (e.g., belief in Heaven), our findings add to the body of research suggesting that scientific and religious orientations are not mutually exclusive, as people apply both scientific and religious explanations to make sense of death (Legare et al., 2012; Legare & Shtulman, 2018). However, the results also suggest that secular sense-making is of primary importance in questions concerning death for science-oriented individuals in the Finnish context (cf. Walker, 2000).

Furthermore, the findings on unbelievers’ nonsupernatural views on continuation after death raise the question whether these continuity accounts may be secular equivalents for afterlife belief, in the sense that they might serve similar needs (Vail et al., 2010; Florian & Mikulincer, 1998; cf. Farias, 2013) and/or reflect the same cognitive tendencies (cf. Hodge 2018) as religious belief. Also this question is bound with the literature on symbolic immortality—and one that our study is not apt to answer. Next, we will review this and other limitations of our work and suggest directions for future research.

\(^{26}\) However, the respondents had a variety of ideas about what counts as existence. Many, like Burris and Bailey (2009), focused on the annihilation or continuity of conscious self and in these accounts other possible forms of continuity, if mentioned, were valued less (individualistic or egocentric perspective). Still, some determined existence also or primarily as socially defined (social perspective) and a few others focused on continued existence of smaller particles in a way that made annihilation of consciousness matter less (physical or biological perspective). However, our research design was not able to further investigate these varying views on existence; the importance of different types of annihilation and continuity beliefs could be explored in future studies (cf. Florian & Mikulincer, 1998).
Limitations and future questions

The limitations of our study could be discussed in three parts. Firstly, although we assumed, partly based on the belief replacement hypothesis, that the respondents might also express forms of nonsupernatural continuity, our study did not decipher whether naturalistic continuation might serve the same psychological functions as supernatural afterlife belief or whether continuity in general holds a similar importance for atheists as it does for God believers. Recent findings suggest that the hope of secular immortality can function similarly to afterlife belief for less religious individuals (Lifshin et al., 2018; Vail et al., 2020). However, studies also indicate that some atheists derive comfort and/or an enhanced sense of meaning from the finity of life, at least according to their self-reports (Coleman et al., 2016; Haimila, 2020). We hope that future research sheds light on this discussion. Studies could further investigate the significance of the forms of symbolic immortality described here (and as discussed by scholars such as Lifton (1973) and Florian and Mikulincer (1998), contra, e.g., Tracy et al., 2011), for instance, whether endorsement of living on in memories or merging into nature alleviates the effects of death reminders (Florian & Mikulincer, 1998; Wojtkowiak and Rutjens, 2011). If naturalistic continuity is more than “a footnote” for atheists, it might be beneficial for coping during bereavement, as has been suggested for afterlife belief (Smith et al., 1992).

Secondly, although we aimed for a data-driven analysis, we began with a researcher-based divide between annihilation and continuity. Overall, we found this division as

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27 The importance of the well-being and/or location of the decedent was evident in some of the conflicted responses that included the hope of an afterlife, and it is difficult to say whether secular continuity (which does not entail continuation of experience of the deceased) could alleviate grief in a similar manner. However, upholding social continuity might help maintain a sense of connection (cf. social death in e.g., Hodge, 2018; Koski, 2014) and expected continuation in nature might provide a way to perceive the deceased “somewhere” and as a part of something meaningful (cf. Jonsson & Aronsson, 2015, p. 53; Pyszczynski et al., 1999; Hodge, 2018).
functional. However, it did provide some challenges for coding. More specifically, continuity in natural laws was at times difficult to categorise, as the responses on circulation of nature often focused on annihilation and some also referred to continuity, often crossing our annihilation—continuity divide. Therefore, although our coding focused on continuity in circulation of nature, based on the data the overall concept might mainly overlap with continuation; the aspect of annihilation in circulation might be equally important (for similar notes on belief in “cycle of nature”, see Butters 2021, p. 175).28

Finally, it should be noted that although we discuss “the beliefs” of the participants, the results mainly reflect what the respondents thought about while answering our questions and experienced as worth mentioning. It is therefore difficult to say to what extent similar descriptions extend to other contexts. Would the participants describe annihilation and/or continuity in similar ways in other situations? It is possible that as the question “What happens to us after death?” is often associated with religious afterlife belief, the question in itself, on the one hand, might increase the mentions of continuity of some kind and, on the other hand, produce reactions in which participants disassociate themselves from traditional afterlife belief (responses that we categorised as rejection of continuity). However, as we are not equipped to examine this in the current study, we hope that future research will extend to articulated and/or enacted death conceptions in more varying contexts (cf. Taves et al., 2018).29

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28 During the template development, we considered categories for both ‘Continuity natural laws’ and ‘Annihilation natural laws’. However, this created challenges as many responses contained both and the boundary between these seemed slippery (and at times artificial) in the views on circulation of nature. However, other beliefs in ‘Continuity natural laws’ were more clearly focused on continuation. For instance, referring to thermodynamics usually entailed the hope of continuity of “energy” that some associated with a personal essence or soul.

29 Studies have found that people endorse continuation of mental states more in religious contexts compared to situations that remind them of science (Astuti & Harris, 2008; Harris & Giménez, 2005). Therefore, recruiting participants to a survey on “worldviews that appreciate science” might have decreased mentions of supernatural afterlife and bolstered secular death narratives.
Conclusion

According to Gire (2014, 2), “death imitates life”, in the sense that cultural surroundings impact our views on dying. This study explored the afterdeath beliefs of science-oriented Finns. In the analysis, we investigated the responses of 387 Finnish adults recruited via pro-research organisations. According to the results, science-oriented Finns mainly believed that consciousness annihilates as bodily functions cease. However, many also expressed that humans continue in some form after death. The continuity beliefs were mainly naturalistic (nonsupernatural) as they mostly described continuation that merely retains parts of the deceased, e.g., in memories or circulation of nature. The results suggest that also secular and science-oriented afterdeath conceptions may contain a sense of continuity that some people endorse in (or alongside) their annihilation beliefs. Naturalistic continuity after death was mainly mentioned by atheists, while theist respondents relied more on supernatural afterlife. However, further research is needed to examine the importance of annihilation and continuity beliefs among different demographic groups and to investigate whether secular continuity after death can serve similar psychological functions as afterlife belief. The current research provides knowledge on the versatility of contemporary views on afterdeath in the Finnish context.

Ethics and consent

Research has been performed in accordance with the Declaration of Helsinki. The University of Helsinki Ethical Review Board has stated that the study design follows the ethical principles of research in the humanities and social and behavioural sciences issued by the Finnish Advisory Board on Research Integrity (statement number: 56/2019). Informed consent has
been obtained from the participants, and the identity of the respondents has been anonymised.

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1 Appendices for study 1 (Article I)

1.1 List of sources for participant recruitment

**General**

- Facebook groups
  - Secular Society (https://www.facebook.com/groups/670714003090302/)
  - Atheist, Agnostic, and Non-Religious (https://www.facebook.com/groups/OAANR/)
  - World Secular Humanist Movement (https://www.facebook.com/groups/332377947232004/)

  Reddit: https://www.reddit.com/
  - r/humanism/
  - r/atheism/
  - r/secularism/
  - r/SecularHumanism/
  - r/agnostic/
  - r/agnosticism/
  - r/skeptic/

- Other
  - Center for Inquiry (https://centerforinquiry.org/)
  - The Friendly Atheist, Hemant Mehta (https://friendlyatheist.patheos.com/)

**Australia**

See General, and:
- Rationalist Society of Australia (e-mail newsletter)

**Brazil**

- Associação Brasileira de Ateus e Agnósticos / Brazilian Association of Atheists and Agnostics (https://www.facebook.com/atea.org.br and e-mail newsletter)
- Universo Racionalista / Rationalist Universe (https://www.facebook.com/groups/universoracionalista)
Canada

See General, and:
- Canadian Secular Alliance (e-mail newsletter)
- Winnipeg Skeptics Discussion Group
  (https://www.facebook.com/groups/winnipegskeptics/)

Czech Republic

Facebook pages:
- Vědátor / Scienator (https://www.facebook.com/VedatorCZ/)
- Ateisté ČR / Atheists CZ (https://www.facebook.com/ateiste/)

Facebook groups:
- Český klub skeptiků Sisyfos / Czech Skeptic Club Sisyfos
  (https://www.facebook.com/cesky.klub.skeptiku.SISYFOS/)
- Ateisté / Atheist (https://www.facebook.com/groups/ateiste/)
- Nekomerční esoterika / Noncommercial esotericism
  (https://www.facebook.com/groups/nekomercni.esoterika/)
  - Very few people from here, if anybody at all, participated.

Denmark

Facebook:
- Ateistisk Selskab – Debatgruppe / Atheistic Society – Debating Forum
  (https://www.facebook.com/groups/ateistiskselskab/)

Other:
- Ateistisk Selskab [Atheistic Society]'s official members mailing list

Finland

Facebook:
- Suomen Humanistiliitto / Finnish Humanist Association
  (https://www.facebook.com/humanistiliitto/)
- Sunday Assembly Helsinki / Sunday Assembly Helsinki Facebook group
  (https://www.facebook.com/groups/1507052702951128/)
  - There is no Sunday Assembly in Helsinki, but the group has discussed
    founding a local section
- Vapaa-ajattelijain Liitto / Union of Freethinkers of Finland
  (https://www.facebook.com/groups/vapariliitto/)
- Skepsis ry / Finnish Association of Skeptics
  (https://www.facebook.com/groups/skepsisry/)
Twitter:
- Vapaa-ajattelijain Liitto / Union of Freethinkers of Finland (https://twitter.com/VapariLiitto)
- Helsingin seudun vapaa-ajattelijat ry / Freethinkers Helsinki Region Association (https://twitter.com/HelVaparit)

Other:
- Suomen Ateistiyhdistys / Finnish Atheist Association
  - The invitation was also sent to this very small organisation.

Great Britain

See General, and:
- Secularism org UK (https://www.reddit.com/r/SecularismOrgUK/)
- Atheism UK (https://www.facebook.com/groups/atheismUKclosedgroup/)

Netherlands

Twitter:
- Atheistisch Verbond / Atheist Alliance (https://twitter.com/AtheistischVerb)
- Atheïstisch Seculiere Partij / Atheistic Secular Party (https://twitter.com/ASPDeventer)
- Positief Atheïsme / Positive Atheism (https://twitter.com/positiefatheism)
- Universiteit van de Humanistiek / University of Humanistic Studies (https://twitter.com/uvh)

Facebook groups:
- Filosofie en spiritualiteit / Philosophy and spirituality (https://www.facebook.com/groups/filosofieenspiritualiteit/)
- Filosofie, seculiere spiritualiteit & levenskunst / Philosophy, secular spirituality & the art of living (https://www.facebook.com/groups/293678130745900/)
- Duurzaam minimaliseren - verklein je ecologische voetafdruk / Minimalising sustainably – reduce your ecological footprint (https://www.facebook.com/groups/1385593141454921/)
- Duurzaam leven met kinderen / Living sustainably with children (https://www.facebook.com/groups/101527510414114/)
- Groep Duurzaam Nederland / Group Sustainable Netherlands (https://www.facebook.com/groups/425441314470743/)
- Duurzame mannen en vrouwen / Sustainable men and women (https://www.facebook.com/groups/Duurzamemannennenvrouwen/)
Turkey

Facebook:
• Ateizm Derneği / The Atheism Association
  (https://www.facebook.com/ateizmdernegi/)
• Free-Thinking Movement of Turkey
• Research on Belief (https://www.facebook.com/Rbelief/)

United States

See General.
### 1.2 The coding instructions

Table 1. The coding instructions for the final coding round with examples from the data

<table>
<thead>
<tr>
<th>Category (label)</th>
<th>Short description</th>
<th>Original category labels</th>
<th>Example</th>
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</thead>
<tbody>
<tr>
<td><strong>Agency &amp; control</strong></td>
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<tr>
<td><strong>Determinism</strong></td>
<td>This category encompasses responses that show belief in determinism and fate (opposite of 'Random').</td>
<td>- Determinism</td>
<td>“Life just is.”</td>
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<tr>
<td>Determinism</td>
<td></td>
<td></td>
<td>“Accepting that we have no control, all we can do is react as the matter in our body predisposes us to act - we are the product of chemical reactions.”</td>
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<tr>
<td><strong>Existentialism</strong></td>
<td>This category encompasses responses that advocate that life has no inherent meaning, and/or that it is up to each individual to create meaning for themselves.</td>
<td>- Self-generated meaning/no intrinsic meaning to life</td>
<td>“I believe that human existence ends with death and that our lives' meanings come from our actions in life.”</td>
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<tr>
<td>Existent</td>
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<tr>
<td><strong>Individualism &amp; Freedom</strong></td>
<td>This category encompasses responses that emphasise the importance of individual liberty, and/or advocate resisting the imposition of excess constraints on behaviour. Incl. &quot;freedom of speech&quot;.</td>
<td>- Freedom/Individualism (live and let live) - Individualism - Libertarianism</td>
<td>“Social liberty, human rights, freedom of expression and belief. The right to privacy.”</td>
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<tr>
<td>IndivFreedom</td>
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<td></td>
<td>“I believe [...] that all people have the right to live as they choose as long as in</td>
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<td>Category (label)</td>
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</table>
| Karma & Purpose     | This category encompasses responses that are based on the notion that people get   | - Karma / 'what goes around comes around'  
- Purpose: Everything happens for a reason | “I believe that what goes around comes around.”  
“Things happen for a reason.”                                                                                                                                                                                                                                                      |
| KarmaPurp           | what they deserve due to some underlying force or metaphysical principle, or that all things can be understood to have happened ‘for a reason’ (other than complex chains of prior physical events). |                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                       |
| Psychology          | Answers which reflect a belief in psychology, neuroscience, therapy, psychoanalysis, and other mental health concepts, and/or which draw attention to the material basis of the mind, including those responses which describe the neurochemical basis of mental illness. | - Consciousness/cognition: materialist view (neuroscience, functionalism, etc)  
- NeuroDeterm | “Ideas and other mental phenomena are emergent properties of a physical brain.”  
“The self is a neurological phenomenon.”  
“Psychology. Therapy.”                                                                                                                                                                                                                                                                 |
| Psych               |                                                                                                                                                                  |                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                       |
| Random              | This category encompasses responses that are the opposite of the Karma & Purpose category: events in the world very often are random, happen by chance, and do not relate to the moral character of the person to whom they happen. | - Determinism  
- OppositeKarma/ 'Shit happens' (bad things happen to good people)  
- Randomn/Chance/ Nihilist | “There are many events that don't have a deeper cause or meaning other than the random interaction of various physical systems.”  
“I believe in the randomness of life.”                                                                                                                                                                                                                                                                                   |
| Randomn             |                                                                                                                                                                  |                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                       |
| ResponsFreeWill     | This category encompasses responses that emphasise personal control over behaviour and/or responsibility for one’s actions. | - Pragmatism  
- Pragm/AreWhatW eDo/Actions/Resp onsible  
- Free Will | “We are responsible for our own actions.”  
“We are what we do.”  
“Shit happens, life is unfair, and it is up to us alone to try to bring some justice to this world.”                                                                                                                                                                                                                                                           |
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<tr>
<td><strong>Collaboration &amp; peace</strong></td>
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<tr>
<td><strong>Aggregate flourishing</strong></td>
<td>This category encompasses responses that espouse a utilitarian moral perspective (do minimal harm, maximum good), or some related idea concerning the general improvement of human wellbeing.</td>
<td>- Moral Progress&lt;br&gt;- Improve general human wellbeing (unspecified)&lt;br&gt;- MinHarm/MaxGood&lt;br&gt;- Animal Rights&lt;br&gt;- Care/Respect for all Flora &amp; Fauna&lt;br&gt;- CareForEarth/Future/Environmental legacy</td>
<td>“We have to act in ways that improve life for everyone, often sacrificing our own comfort or privilege.”&lt;br&gt;“We should strive to make it as good as possible for everyone and everything.”&lt;br&gt;“Value and respect the earth and its living beings/flora/fauna.”&lt;br&gt;“My overall philosophy is along the lines of “live and let live” with protection for vulnerable people and animals. [...] I’m [...] opposed to killing or mistreating animals for food (if alternatives are available) or entertainment.”&lt;br&gt;“Preserving the environment for future generations.”</td>
</tr>
<tr>
<td><strong>Care for Earth</strong></td>
<td>This category encompasses responses that emphasise the importance of environmentalism, looking after the planet, and respecting and caring for other species.</td>
<td>- FamFriendCommu&lt;br&gt;- Community wellbeing is more important than being rich. Family is everything.</td>
<td>“We are all connected. Community wellbeing is more important than being rich. Family is everything.”</td>
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<tr>
<td><strong>Golden Rule</strong></td>
<td>This category encompasses responses that espouse the Golden Rule (do unto others) or some similar guiding axiom (such as the Silver Rule, or the injunction to Do No Harm).</td>
<td>- Golden Rule (do unto others)/do no harm</td>
<td>“I believe the best guiding principle is to treat other people the way you would like to be treated (Golden Rule).” “Not engaging in acts that would harm or otherwise endanger other people.”</td>
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<td></td>
<td></td>
<td>- Peace/harmony/tolerance/cooperation</td>
<td>“We must all practice empathy, tolerance, and compassion for all to strive for global harmony.” “We should [...] live cooperatively and in harmony of those around us, show respect to others (cooperation and respect will lead to a happy life for all, compared with the alternatives).”</td>
</tr>
<tr>
<td><strong>Peace &amp; Collaboration</strong></td>
<td>This category encompasses responses that espouse the value of cooperation, harmony, tolerance and peace between all people, and/or of placing differences to one side for the common good.</td>
<td>- PeaceCollab</td>
<td></td>
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<tr>
<td><strong>Equality &amp; kindness</strong></td>
<td></td>
<td>- Equality/Inequality/UnivHealthcare/HumanRights/Justice</td>
<td>“Treating people of all races, religions and socioeconomic status with dignity and respect.” “I believe that governments should prioritise equal opportunity for health, education and wellbeing for all groups of people on the planet.”</td>
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<td></td>
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<td>- Democracy</td>
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<td></td>
<td>- Equal/Inequal/Respect/CareHumans/HumanRights (Rational care)</td>
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<tr>
<td><strong>Humanism</strong></td>
<td>This category encompasses responses that fall under the general umbrella of humanism or related</td>
<td>- Humanism</td>
<td>“An appreciation of the common nature of human existence and the</td>
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<td>worldviews: for example, beliefs that human beings are special, that human history is inherently progressive, that human reason or ingenuity can overcome all problems, and so on.</td>
<td>HumanRelativism - Teleological (progress/tech/future) - Liberal/Enlightenment</td>
<td>evolved moral and ethical standards that differentiate populations.”</td>
<td></td>
</tr>
<tr>
<td><strong>Kindness &amp; Caring</strong></td>
<td>This category encompasses responses that extoll (/praise) the importance of empathy or concern for others, and/or the importance of caring actions, and helping and supporting others.</td>
<td>HumGoodness/Kindness - Compass/Empath/BeKindLoving/Love/NurtureRelships (Intuitive care) - Human Prosociality</td>
<td>“I believe that compassion is paramount in guiding everyday actions and in deciding on public policy.”</td>
</tr>
<tr>
<td><strong>Left-wing political causes</strong></td>
<td>This category encompasses responses that mention a cause or worldview associated with left-wing politics (regardless of actual mentioning of leftwing politics). Includes: “Feminism” + “LGBTQ” + “Socialism” + “Marxism” + “Anarchism”.</td>
<td>Leftwing politics/socialism/progressivism - Vegetarian - Pro-Choice - Pro-Euthanasia</td>
<td>“I also believe that as a society we should strive to make sure that a minimal standard of living - housing, food, healthcare - is available to everyone.”</td>
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“I believe in the right to be free of gender roles, sex discrimination, and the rights of children not to be "owned", mis-used, or abused.”
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<tbody>
<tr>
<td><strong>Acquired Morality</strong></td>
<td>This category encompasses responses that emphasise that moral behaviour is the result of the cultural or social transmission of norms, or processes of cultural evolution. This includes learning morality from your parents, at school, or from the law.</td>
<td>- Moral Truths: ontogenetic (life experience and cultural transmission)</td>
<td>“Morality is relative and framed by cultural norms.” “Ethical and moral behaviours are social rather than religious conceptions.” “My belief [is] that social norms and situations are constructed.”</td>
</tr>
<tr>
<td><strong>Intuitive Morality</strong></td>
<td>This category encompasses responses that espouse the idea that moral behaviour or cooperation is an inherent feature of the human species.</td>
<td>- Moral Truths: Intuitive</td>
<td>“I believe in intrinsic right and wrong.” “I do believe in good and evil, and I believe that either of these traits are inherent in all of us.”</td>
</tr>
<tr>
<td><strong>Morality unspecified</strong></td>
<td>This category encompasses responses that emphasise the importance of doing good/not doing bad, but without specifying what that means. This should also include responses of people who say they believe in ‘morality’ or ‘ethics’ without further specifying what/how exactly.</td>
<td>- Doing good (unspecified)/ Don’t do bad things (unspecified) - Do good (unspecified)</td>
<td>“A sense of right and wrong and my attempts to right wrongs.” “I try to do good.”</td>
</tr>
<tr>
<td><strong>Rational Morality</strong></td>
<td>This category encompasses responses that propound the idea that moral behaviour is based on explicit philosophical or scientific or rational reflection. This includes learning from history, but not from personal experience (PersRef).</td>
<td>- Moral Truths: Philosophical/ reflective/scientific</td>
<td>“Science and reason can help inform decisions about what is right and wrong.” “We can try to make the world better according to moral principles arrived at by evidence and the best of human thought.”</td>
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<tr>
<td><strong>Secular Morality</strong></td>
<td>This category encompasses responses that emphasise that one does not need to be religious to be moral.</td>
<td>- Morality without religion</td>
<td>“Being moral is not owned by religion. Good people will always do the right thing.”</td>
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<td></td>
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<td>“We do not need a virtual spirit in the sky to tell us what we should be doing.”</td>
</tr>
<tr>
<td><strong>Natural laws &amp; the here and now</strong></td>
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</tbody>
</table>
| **Gratitude & Awe**     | Responses that describe the awe one feels for nature, the universe, existence, and the emotional succour (/comfort) derived from thoughts of personal or species-level insignificance. | - Awe at nature/universe/consciousness  
- Gratitude for fluke of existence | “I [...] believe in feeling intense joy and wonder at the world and its people.” |
|                         |                                                                                    |                          | “I am grateful every morning I awake.”                                  |
| **Human Insignificance** | This category encompasses responses that describe human beings as insignificant on a cosmic (or other) scale. | - Human Insignificance | “I believe we are all a tiny part of the cosmos and life is fleeting.” |
|                         |                                                                                    |                          | “Realisation of how insignificant I am.”                                 |
| **Just One Life**       | This category encompasses responses that emphasise the fleeting nature of life, and/or how it is important to make the most of it. | - OneLife  
- Happiness/Joy  
- EnjoyHappy | “Without an afterlife, I also feel that the only legacy one can have is through good works to better the world.” |
|                         |                                                                                    |                          | “We have one life and you have to make the most of it.” |
| **Natural Laws**        | This category encompasses responses that talk about the laws underlying biological or physical systems, and/or emphasise that humans are subject to the same laws as the rest of the physical universe. Includes “Big Bang”, and “Evolution”. | - Nature  
- Evolution/BigBang  
- NaturalLaws/Order/Naturalism/Biology | “I believe in the Big Bang theory of the universe and evolution of life and mankind.” |
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<th>Original category labels</th>
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<tbody>
<tr>
<td><strong>Philosophical materialism</strong></td>
<td>This category encompasses responses that there is only one reality – the natural, physical world.</td>
<td>- Stardust/Particles (disintegration as ‘return’)</td>
<td>“The certainty that there is no afterlife; death means back to the stardust we came from.”</td>
</tr>
<tr>
<td>PhilMaterialism</td>
<td></td>
<td>- Materialism/naturalism</td>
<td>“I believe in the laws of physics.”</td>
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<td>- This world only/materialist ontology</td>
<td>“We only have this physical world.”</td>
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<td></td>
<td></td>
<td></td>
<td>“I believe in what can be objectively observed.”</td>
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<tr>
<td><strong>Non-religiosity</strong></td>
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<tr>
<td><strong>Antitheism</strong></td>
<td>This category encompasses responses that explicitly reject religion, and have negative views on religion/religious beliefs.</td>
<td>- Antitheist/anti-religion</td>
<td>“I believe that religion is basically a form of mass mind-control and that it is exercising an increasingly detrimental influence on the human race in terms of peace and scientific progress. In my opinion, religions neither deserve nor should be given any special respect (e.g. &quot;blasphemy&quot;) or privilege (e.g. tax exemption) and should be treated as the nonsense that they are.”</td>
</tr>
<tr>
<td>(Antitheism)</td>
<td></td>
<td>- Elimination of culture/beliefs/attitudes impeding human rights/moral progress</td>
<td>“Lastly I find religion to be a millstone around the neck of human progression. It is distasteful in it’s primitive, violent, and brutal stories and justifications. The primary purpose of religion is to control others.”</td>
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<tr>
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<tr>
<td><strong>Atheism</strong> (Atheism)</td>
<td>This category encompasses responses that reject religious belief, but do not necessarily adopt a negative or critical stance.</td>
<td>- Atheism</td>
<td>“I believe that [...] there is no God or any other being that created life.” “There is not a God, nor is there an afterlife.”</td>
</tr>
<tr>
<td><strong>No afterlife</strong> NoAfterlife</td>
<td>This category encompasses responses that explicitly disavow (/deny) the notion of an afterlife, and some of those responses take solace in this idea (there will be no punishment after death, etc.).</td>
<td>- No life after death/afterlife</td>
<td>“I have a humanist understanding of the world, that [...] when we die there is no afterlife.” “Without an afterlife, I also feel that the only legacy one can have is through good works to better the world.”</td>
</tr>
<tr>
<td><strong>Reject Superstition</strong> (Reject Superstition)</td>
<td>This category encompasses responses that link the rejection of superstitious or religious propositions to mental growth or the acquisition of accurate knowledge.</td>
<td>- Reject unsubstantiated beliefs (myths/fairytales/superstitious)</td>
<td>“I don’t believe in luck, fate, a greater power of any description. I think that people use these constructs to make life more palatable.” “There is no god, there never was a god, the myths created by humans in regard to god(s) are just that, myths.”</td>
</tr>
<tr>
<td><strong>Secularism</strong> Secularism</td>
<td>This category encompasses responses that emphasise the separation of church and state, advocate resisting religious influence on law and policy, or argue against a special place for religious institutions.</td>
<td>- Institutional secularism/ Separation of Church</td>
<td>“A secular state, including state funded education.” “I am also strongly opposed to religious indoctrination/infiltration of government entities (schools, police stations, government facilities, etc.) and of medical facilities (&quot;women’s centers&quot;, pharmacies, hospitals, etc.).”</td>
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<tr>
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<tr>
<td><strong>Reflection</strong></td>
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<tr>
<td>Death is natural</td>
<td>This category encompasses responses that emphasise accepting the inevitability of death, acknowledge that nothingness is coming for us, and underline the finitude of all biological beings.</td>
<td>Face mortality honestly (death stoicism)</td>
<td>“Everyone dies and we all go to the same place (or rather, we all go nowhere).”</td>
</tr>
<tr>
<td>Detachment &amp; Acceptance</td>
<td>This category encompasses responses that advocate the benefits of some form of detachment from lived experience, whether this be achieved through Buddhist philosophy (though see ‘Buddhism’), Stoicism, meditation, a personal stance, or something else. This also includes responses that emphasise the unreality of the self.</td>
<td>MindfulBuddh Stoicism</td>
<td>“Buddhist ideas of non-attachment.”</td>
</tr>
<tr>
<td>Optimism &amp; Relief</td>
<td>This category encompasses responses that show belief in optimism and positive thinking, and belief in a relief from suffering (for death), or, hope, and other forms of optimism. “Things will get better”.</td>
<td>N/A</td>
<td>“I subscribe to positive psychology principles like appreciating the little things and telling people when you are grateful for something they have done.” “That thing are always moving that things will get better.”</td>
</tr>
<tr>
<td>Personal Reflection</td>
<td>This category encompasses responses that emphasise the lessons learned from personal experience. “Looking inwards”, “Self-examination”.</td>
<td>Personal Reflection</td>
<td>“Listening to myself, leaning into my pain, and acknowledging my feelings.”</td>
</tr>
<tr>
<td>Category (label)</td>
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<tr>
<td>Treasured Memories TreasMem</td>
<td>This category encompasses responses that describe treasuring memoires of other people, leaving positive memories behind, or living on in the minds of those left behind after one dies.</td>
<td>- Treasure memories</td>
<td>“It is natural to feel badly immediately after a close relative dies but that feeling will transform into fond memory as one realises death is a natural part of human life.” “We light a candle nightly for those who have passed that we love.”</td>
</tr>
<tr>
<td>Critical Scepticism CriticScepticism</td>
<td>This category encompasses responses that espouse the value of a questioning, critical disposition towards information.</td>
<td>- Skepticism - Rationalism - Critical thinking/logic/reason - Philosophical reasoning/philosophy/mathematics - OpenMindedness/ChangeBeliefs</td>
<td>“I believe in weighing available evidence and coming to the most reasonable conclusion.” “Know the importance of facts, the difference between empirical and anecdotal evidence.”</td>
</tr>
<tr>
<td>Science Science</td>
<td>This category encompasses responses that endorse science in general, scientific methodology or perspectives, or scientific expertise and authority.</td>
<td>- Science - Scientific Method/Evidence/Observations/Methodological Naturalism - Trust scientific/medical experts</td>
<td>“I believe in the power of science and the scientific method.” “My primary way of understanding the world is based on science and reasoning.”</td>
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<tr>
<td><strong>Spirituality</strong></td>
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<td><strong>Afterlife</strong></td>
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<tr>
<td>Afterlife</td>
<td>This category encompasses responses that show belief in an afterlife (not necessarily specifying anything more about the matter).</td>
<td>- Afterlife (unspecified)</td>
<td>“I feel so connected to nature on a deeper level than anything else, I just feel that we do have a soul or whatever we want to call it, and that it moves on into a next life.”</td>
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<tr>
<td><strong>Aliens</strong></td>
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<tr>
<td>Aliens</td>
<td>This category encompasses responses that emphasise how we are not alone in the universe, and/or in some cases suggest that aliens have intervened in life on earth.</td>
<td>- Alien life (extra-terrestrial or interdimensional)</td>
<td>“I believe based on the overwhelming number of planets in the universe that there is life of some type on many of them.” “I believe in multiple dimensions and that life in all sorts of forms exists in those dimensions but that life may resemble nothing like we experience here.”</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirituality</td>
<td>This category encompasses responses that espouse some kind of worldview that would usually be categorised as religious or spiritual.</td>
<td>- SpirOther - Paganism</td>
<td>“I believe in energy. I believe that energy is affected by energy. I believe I am made of the same energy as the planets and the stars and the plants and the animals and when any of those energies shift or are out of balance they affect everything else including my physical body and my emotional/mental state or connectivity. Pagan-type beliefs mixed with some science.”</td>
</tr>
<tr>
<td>Category (label)</td>
<td>Short description</td>
<td>Original category labels</td>
<td>Example</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Scientific Mysticism (& Unity with Universe) | This category encompasses responses that emphasise some sense of unity with the universe in scientific terms, mainly as a result of some as-yet-undiscovered scientific breakthrough (quantum something-ism), that describe some non-physical, non-scientific source binding people, living things or the universe together, such as energy, reincarnation, and so on. | Scientific mysticism ('quantum' etc) - Collective unconscious - Energy/essence/vitalism/force - Reincarnation | “There is a creative force. After all, I exist and I didn’t bring myself into existence. That does not mean that the force is intelligent or is concerned with me or anything else.”  
“I believe in a collective super-conscious, that our consciousness transcends space and time but that this is not a “creator” force. I look to advancements in quantum physics to understand how this may work (entanglement etc). I believe this consciousness can exist outside of our physical bodies.” |

**Truth**

| Attainable Truth                         | This category encompasses responses that hold that human beings can, eventually, come to possess absolute knowledge of the nature of reality.                                                                                                                                  | Truth is out there/We can know the truth eventually | “I believe in the Big Bang theory of the universe and evolution of life and mankind. Although not all the I’s are dotted I believe they eventually will be (e.g. how did life begin?)”  
“I understand that science is our best tool for understanding the universe and that it will help provide answers to our most profound questions.”  
“Understand the truth can be illusive and liquid.” |
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Relativism</td>
<td>This category encompasses responses that disavow (/deny) notions of absolute truth.</td>
<td>Truth is liquid/Relative/Postmodern</td>
<td></td>
</tr>
<tr>
<td>Category (label)</td>
<td>Short description</td>
<td>Original category labels</td>
<td>Example</td>
</tr>
<tr>
<td>-----------------</td>
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<td>---------</td>
</tr>
<tr>
<td><strong>Unattainable Truth</strong>&lt;br&gt;TruthUnattain</td>
<td>This category encompasses responses that, while not relativist, nevertheless believe that absolute knowledge may ultimately be beyond human attainment.</td>
<td>- Truth/Reality is unknown&lt;br&gt;- TruthMayStay Unknown/Cogn limitation OnKnowledge</td>
<td>“Even scientific facts change over time.”&lt;br&gt;“That there are things (forces, dimensions, other forms of &quot;life&quot;) within the universe that we don’t yet and may never be able to comprehend.”&lt;br&gt;“Having evolved for other things (survival, persuasion), our brains may not be capable of understanding all the truths of how the universe works.”</td>
</tr>
</tbody>
</table>

**Other**

| **Art**<br>Art | This category encompasses responses that espouse the value of practicing, consuming, or appreciating the arts in all their forms. | - The Value of Art/Aesthetic experience<br>- Artistic achievement/aesthetic experience | “I believe that finding stillness, like being in nature or spending time with art or music, is essential to emotional wellness.”<br>“An appreciation of the art, literature, music and crafts that are our heritage from the past and of the creativity that, if nourished, can continuously enrich our lives.” |

| **Buddhism**<br>Buddhism | This category encompasses responses that state belief in Buddhism, but also Buddhist concepts such as ‘there is no self’, ‘there is no reality’, and of course meditation. | - Meditate<br>- No self | “I lean towards Buddhism to help me navigate the world around me. [...] Listening to ourselves (through meditation) can guide us forward.” |

<p>| <strong>Conservatism</strong>&lt;br&gt;Conservatism | This category encompasses responses that indicate they are conservative. | - Resist political correctness/ | “I am a conservatist.” |</p>
<table>
<thead>
<tr>
<th>Category (label)</th>
<th>Short description</th>
<th>Original category labels</th>
<th>Example</th>
</tr>
</thead>
</table>
| **Negative Humanity** | This category encompasses responses that draw attention to or include reference to negative aspects of human nature, such as selfishness, destructiveness, corruption, foolishness and so on. “Flawed human nature”. This also includes answers such as “Disconnect from others” and “Trust no one”. | - FallibleHumans/BothGood&Bad  
- Apocalyptic/We are doomed | “I believe that [...] selfishness is innate.”  
“I believe in the innate kindness of humanity but accept this can be damaged or distorted in individuals by event or example.”  
“Getting it wrong is human. Being nasty or horrible is human.” |
| **Self**              | This category encompasses responses that emphasise the importance of the self in some way, such as self-belief or personal potency. | - Self                                                                                   | “Belief in yourself and your own abilities is [...] important.”  
“I have an inherent purpose in life merely by existing - it is up to me to be effective in my life if I want any more 'purpose' than that. Nice to be loved by others, but ultimately my only true obligation in life - on a very deep level - is my loyalty to love myself by to be answerable to myself.” |

*Note. Categories and subcategories ordered alphabetically, with the exception of the Other category which is listed last. Examples are from English-speaking countries (AUS, CAN, GBR, USA), so as not to have translations influence the wording.*
1.3 List of sources for participant recruitment

The recruitment started in December 2019 and ended in February 2020. To ensure participants from research organisations would have the opportunity to participate, I first contacted the organisations in tables 2 and 3, followed by the social media recruitment (tables 4 and 5).

Table 2: Research organisations included in the recruitment

<table>
<thead>
<tr>
<th>Name</th>
<th>Section</th>
<th>Field</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Humanities staff: all sections</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Doctoral School in Humanities and Social Sciences doctoral students</td>
<td>Humanities and Social Sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Medicine Research Programme Unit staff</td>
<td>Medicine</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Science Chemistry staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Science Mathematics and Statistics staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Science Geoscience and Geography staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Science Physics staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Science Institute for Atmospheric and Earth System Research (INAR) staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Faculty of Law staff</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td>Logopedics students</td>
<td>Medicine</td>
<td>Email</td>
</tr>
<tr>
<td>Aalto University</td>
<td>School of Science researchers, including doctoral students</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Eastern Finland</td>
<td>Faculty of Health Sciences staff and doctoral students</td>
<td>Natural sciences</td>
<td>Yammer</td>
</tr>
<tr>
<td>University of Eastern Finland</td>
<td>Philosophical Faculty staff</td>
<td>Humanities</td>
<td>Yammer</td>
</tr>
<tr>
<td>Tampere University</td>
<td>Faculty of Information Technology and Communication Sciences</td>
<td>Natural sciences, Humanities, Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>University of Turku</td>
<td>Doctoral Programme in History, Culture and Arts Studies doctoral students</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>University of Turku</td>
<td>Study of Religion doctoral students and staff</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>University of Turku</td>
<td>Finland Futures Research Centre</td>
<td>Humanities, Social sciences</td>
<td>Employees intranet</td>
</tr>
<tr>
<td>University of Jyväskylä</td>
<td>Faculty of Humanities and Social Sciences staff and doctoral students</td>
<td>Humanities, Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------</td>
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<td>-------</td>
</tr>
<tr>
<td>University of Oulu</td>
<td>Faculty of Humanities doctoral students</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>University of Lapland</td>
<td>Faculty of Social Sciences staff</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>VTT Technical Research Centre of Finland</td>
<td>Technical Research Centre staff</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
</tbody>
</table>

Table 3: Organisations affiliated to research institutions included in the recruitment

<table>
<thead>
<tr>
<th>Name</th>
<th>Additional information</th>
<th>Research organisation</th>
<th>Field</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mana ry</td>
<td>Student organisation for social and cultural anthropology students</td>
<td>University of Helsinki</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>HAO ry</td>
<td>Student organisation for subject teacher trainees</td>
<td>University of Helsinki</td>
<td>Humanities/Other</td>
<td>Email</td>
</tr>
<tr>
<td>Dilemma ry</td>
<td>Student organisation for philosophy students</td>
<td>University of Helsinki</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>Matlu ry</td>
<td>Student organisation for Faculty of Science students</td>
<td>University of Helsinki</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Meridiaani ry</td>
<td>Student organisation for astronomy students</td>
<td>University of Helsinki</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Synop ry</td>
<td>Student organisation for meteorology students</td>
<td>University of Helsinki</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Vasara ry</td>
<td>Student organisation for geology students</td>
<td>University of Helsinki</td>
<td>Natural sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Status ry</td>
<td>Student organisation for social psychology students</td>
<td>University of Helsinki</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Konstruktio ry</td>
<td>Student organisation for students of social sciences</td>
<td>University of Helsinki</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Teema ry</td>
<td>Student organisation for literature students</td>
<td>Tampere University</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>Lexica ry</td>
<td>Student organisation for foreign languages students</td>
<td>Tampere University</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>Patina ry</td>
<td>Student organisation for history students</td>
<td>Tampere University</td>
<td>Humanities</td>
<td>Email</td>
</tr>
<tr>
<td>Fiskus ry</td>
<td>Student organisation for public financial management students</td>
<td>Tampere University</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Vostok ry</td>
<td>Student organisation for journalism and mass communication students</td>
<td>Tampere University</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Interaktio ry</td>
<td>Student organisation for students of social sciences</td>
<td>Tampere University</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Iltakoulu ry</td>
<td>Student organisation for science and international relations</td>
<td>Tampere University</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Kosmos Buran ry</td>
<td>Student organisation for political science and sociology students</td>
<td>University of Lapland</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Fokus ry</td>
<td>Student organisation for students of social sciences</td>
<td>University of Jyväskylä</td>
<td>Social sciences</td>
<td>Email</td>
</tr>
<tr>
<td>Name</td>
<td>Additional information</td>
<td>URL</td>
<td>Medium</td>
<td>Followers</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<td>-----------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Yle Tiede</td>
<td>Finnish public media broadcaster's section for news on science and research. Yle Tiede retweeted the invitation 12/02/2020.</td>
<td><a href="https://twitter.com/yletiede">https://twitter.com/yletiede</a></td>
<td>Twitter</td>
<td>&gt; 58 k</td>
</tr>
<tr>
<td>Tiede.fi</td>
<td>Finnish science magazine. The invite was posted 12/2/2020 on three discussion boards: 1) Biology and environment, 2) History, cultures, and society, and 3) Other science topics. The invitation raised active discussion in discussion board 3) Other science topics. Therefore, the invitation remained in the front page of Tiede discussion for the two-day period of social media recruitment.</td>
<td><a href="https://www.tiede.fi/keskustelu">https://www.tiede.fi/keskustelu</a></td>
<td>Internet discussion forum</td>
<td></td>
</tr>
<tr>
<td>Skepsis ry</td>
<td>Finnish skeptics’ association, a ‘scientific organisation’ that promotes a worldview ‘based on science and reason’. Invitation was shared in the Facebook group 14/02/2020.</td>
<td><a href="https://www.facebook.com/groups/skepsisry/">https://www.facebook.com/groups/skepsisry/</a></td>
<td>Facebook</td>
<td>&gt; 23 k</td>
</tr>
<tr>
<td>Name</td>
<td>Additional information</td>
<td>URL</td>
<td>Medium</td>
<td>Followers</td>
</tr>
<tr>
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</tr>
<tr>
<td>Silakkaliike</td>
<td>A movement that aims to advance human dignity, nature, science, equality and non-discrimination and stand in opposition to fascism and climate change denialism (<a href="https://silakkaliike.fi/">https://silakkaliike.fi/</a>). Invitation was shared in the Facebook group 14/02/2020.</td>
<td><a href="https://www.facebook.com/groups/Silakkaliike/">https://www.facebook.com/groups/Silakkaliike/</a></td>
<td>Facebook</td>
<td>&gt; 28 k</td>
</tr>
<tr>
<td>Geek Women Unite! (Finland)</td>
<td>A networking group for those that identify as geek/geekish women. Invitation was shared in the Facebook group 14/02/2020.</td>
<td><a href="https://www.facebook.com/groups/207664933742/">https://www.facebook.com/groups/207664933742/</a></td>
<td>Facebook</td>
<td>&gt; 5200</td>
</tr>
<tr>
<td>Ursa ry</td>
<td>Finnish astronomy association. Invitation was retweeted 12/02/2020.</td>
<td><a href="https://twitter.com/Ursa_ry">https://twitter.com/Ursa_ry</a></td>
<td>Twitter</td>
<td>&gt; 3700</td>
</tr>
<tr>
<td>Union of Freethinkers of Finland</td>
<td>Finnish freethinkers association that aims to advance the rights of non-religious in Finland and promote a ‘science-based worldview’. Invitation was shared 13/02/2020.</td>
<td><a href="https://www.facebook.com/groups/vapariliitto/">https://www.facebook.com/groups/vapariliitto/</a></td>
<td>Facebook</td>
<td>&gt; 2400</td>
</tr>
<tr>
<td>Areiopagi</td>
<td>Finnish journal on the intersections of natural sciences, philosophy and theology.</td>
<td><a href="https://twitter.com/areiopagi">https://twitter.com/areiopagi</a></td>
<td>Twitter</td>
<td>&gt; 800</td>
</tr>
<tr>
<td>Young Academy Finland/Nuorten Tiedekatemia</td>
<td>An association that promotes science and scholarships of young researchers.</td>
<td><a href="https://twitter.com/yaf_fi">https://twitter.com/yaf_fi</a></td>
<td>Twitter</td>
<td>&gt; 400</td>
</tr>
<tr>
<td>Jyväskylän Sirius ry</td>
<td>Astronomy association in Central Finland.</td>
<td><a href="https://twitter.com/jklsirius">https://twitter.com/jklsirius</a></td>
<td>Twitter</td>
<td>&gt; 100</td>
</tr>
<tr>
<td>Geohouse/Geotalo/Geohuset</td>
<td>‘Home to geologists and archaeologists’ at the University of Turku and Åbo Akademi.</td>
<td><a href="https://twitter.com/Geohouse_Turku">https://twitter.com/Geohouse_Turku</a></td>
<td>Twitter</td>
<td>&gt; 100</td>
</tr>
</tbody>
</table>
1.4 Measures

Instructional manipulation check (articles II-IV)

The questionnaire included the following control question (in Finnish):

‘Next, we will present human-related statements. With these statements, we check that the respondents read the instructions carefully. We ask you to leave the options of Q12 blank and proceed to the next page.

Q12: What is your opinion on the following statements? On the scale of 1–5, when 1 = fully disagree, and 5 = fully agree. We ask you to leave the options blank and proceed to the next page.

Most people try to apply the Golden Rule (do unto others as you would have them do unto you).
Every person has his or her own unique personality.
People are largely the masters of their own fate.
Most people would sneak into a movie without paying, if they could not get caught.
People usually tell the truth, even when they would be better off lying.
Our success in life is pretty much determined by forces outside our control.
Most people can control what happens in their lives.
Most of us would stop and help a person whose car is disabled at the side of the road.
People would act more responsibly if their living conditions improved.’

The items were drawn from Philosophies of Human Nature subscales (Wrightsman 1974) as presented by Lupfer and Wald (1985). Some of the items were abbreviated.

The participants who answered all the items of the control question were excluded from the sample, with the exception of a few individuals who stated in an open-ended comment below that they had accidentally answered the question yet noticed the instructions. We wish to note that the instructional manipulation check resulted in a relatively high exclusion rate (43%). One factor underlying the exclusion rate might be the length of the questionnaire: prior to answering the structured questions (including the control question), the participants had responded to seven open-ended questions. Another factor that might contribute to the exclusion rate was a technical feature of the LimeSurvey platform: the participants could not withdraw their choices from the multiple-choice question. Despite these factors, the exclusion rate is still similar to that of many previous studies (e.g. Järnefelt et al., 2018; Morren & Paas, 2020; Oppenheimer et al., 2009, study 1).
Belief in Supernatural Agency and Purpose Measure (articles II–III)

Below I have included the English translations of all items utilised for the scale formation in order of appearance. These include the filler items and the control items. The belief items are followed by their original sources and comments on possible modifications. In the study, I introduced the items in two questions that were separated by the control question. The first question contained items 1–13 and the second question items 14–30. The statements were rated on a scale of 1–5 (when 1 = fully disagree, and 5 = fully agree). The items that were excluded from the measure and the analyses have been marked with lighter colour.

What is your opinion on the following statements? On a scale of 1–5, where 1 = fully disagree and 5 = fully agree.

1. The world is a fair place. (Lipkus, 1991: ‘I basically feel that the world is a fair place.’)
2. Everything happens for a reason. [literally in Finnish: purpose] (Davis et al., 2011)
3. People mostly have good intentions. [Filler item]
4. People eventually get what they deserve. (Lipkus 1991: ‘I feel that people get what they deserve.’ The expression ‘eventually’ was added to measure endorsement of ultimate justice (cf. Maes, 1998; Maes & Schmitt, 1999).)
5. The essence of a human survives their death.
6. Life events are random in the sense that they do not have a purpose. [Reversed item]
7. The human mind is somewhat separate from bodily functions. (Cf. Stanovich, 1989)
8. Humans have a soul. (Cf. Tobacyk, 2004: ‘The soul continues to exist though the body may die.’; Jong et al., 2013: ‘Human beings have immaterial, immortal souls.’ Since soul belief does not necessarily contain an expectation of immortality (Harris & Richert, 2008; Lindeman et al., 2015), mere belief in ‘soul’ is explored.)
9. Humans have free will that is somewhat independent of the body. [Literally in Finnish: that does not depend on the body]
10. A sufficiently developed AI could in principle think like a human. (Cf. Stanovich 1989: ‘Perhaps it will never make sense to talk about computers having emotions, but sometime in the future it may be the case that computers will think as well as humans.’) [Reversed item] [Excluded from analysis]
11. I believe in fate.
12. I believe in life after death.
13. Events have a purpose determined by God.

____________________________________

1 Instead of measuring disagreement with dualism, the reversed item might measure endorsement of uniqueness of the mental capacity of humans, since some could conceptualise ‘sufficiently developed AI’ as an algorithm without a body (mind capacity without a body, a belief resembling dualism). Additionally, the item did not load strongly to extracted components.
What is your opinion on the following statements? On a scale of 1-5, where 1 = fully disagree and 5 = fully agree.

14. Nature is a living creature. (Järnefelt et al., 2018: ‘I believe that Earth is alive.’ and ‘I believe that Nature is a powerful being.’)

15. Some kind of greater force created the Earth and living things (animals, plants) and continues to have an influence on them. (Järnefelt et al., 2018: ‘I believe that some kind of higher powers/spirits/forces created the Earth and living things (animals, plants) and continues/continue to have an influence on them.’ The expression ‘I believe’ was left out and ‘higher’ was modified into ‘greater’ to avoid a religious connotation in the Finnish translation.)

16. Some kind of greater force created the Earth and living things (animals, plants) but does not currently have any influence on them. (Järnefelt et al. 2018: ‘I believe that some kind of higher powers/spirits/forces created the Earth and living things (animals, plants) but does not currently have any influence on them.’ The expression ‘I believe’ was left out, and ‘higher’ was modified into ‘greater’ to avoid a religious connotation in the Finnish translation.) [The item was excluded from analysis due to low loadings to the extracted components in the principal component analysis.]

17. God created the Earth and living things (animals, plants).

18. The Earth and the living things (animals, plants) came to be solely due to a chain of physical events. [Filler item]

19. Humans have evolved from other, prior species of animals. (Science Barometer, 2016: ‘Humans have evolved in the course of millions of years from other, prior species of animals.’) [Filler item]

20. Due to natural selection, weak individuals decrease in the population [in Finnish: fall off the population]. The item was included to ensure that item 21 measures the view that ‘weak’ individuals would fall off the population for a purpose.

21. The purpose of natural selection is to decrease weak individuals in the population [in Finnish: to fall off the population]. (Cf. Haimila, 2016.) [The item was excluded from analysis due to a somewhat moderate correlation with item 20.]

22. It is most likely that we live in a reality created by an agent (such as AI) [in Finnish: agent/actor]


24. Everything in the world can be reduced to matter/energy. [Filler item]

25. Animal species can change their own biological traits in order to survive. (Järnefelt et al. 2018: ‘I believe that animals have the power to change their own biological traits in order to survive.’ The expression ‘I believe’ has been left out to avoid a religious connotation in the Finnish translation, and ‘species’ has been added to exclude some possible borderline cases that might not fill the criteria of supernatural causality, such as an individual animal changing camouflage colour.)

26. In the world, there is some purposeful force (e.g., a life force). (Cf. Bullivant et al., 2019; Special Eurobarometer, 2005)

27. All humans consist of the same matter (for instance, matter /energy, stardust). [The item was included to ensure that item 28 measures the view that humans are made of the same material instead of item 28 measuring the naturalistic view that humans consist of the same matter. The correlation between items 27 and 28 was weak, suggesting that the items measure differing beliefs.]

28. All humans are made of the same material (for instance, matter/energy, stardust).
Table 6: The Belief in Supernatural Agency and Purpose Measure

<table>
<thead>
<tr>
<th>Item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The world is a fair place.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>2. Everything happens for a reason [in Finnish: purpose].</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>3. People eventually get what they deserve.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>4. The essence of a human survives his/her death.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>5. Life events are random in the sense that they don’t have a purpose. [Reversed score]</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>6. The human mind is somewhat separate from bodily functions.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>7. Humans have a soul.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>8. Humans have free will that is independent of the body.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>9. I believe in fate.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>10. I believe in life after death.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>11. Events have a purpose determined by God.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>12. Nature is a living creature.</td>
<td>3</td>
<td>1–5</td>
</tr>
<tr>
<td>13. Some kind of greater force created the Earth and living things (animals, plants) and continues to have an influence on them.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>14. God created the Earth and living things (animals, plants).</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>15. It is most likely we live in a reality created by an agent (such as AI) (in Finnish: agent/actor)</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>17. Animal species can change their own biological traits in order to survive.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>18. In the world, there is some purposeful force (e.g. a life force).</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>19. All humans are made of the same material (for instance, matter/energy, stardust).*</td>
<td>3</td>
<td>1–5</td>
</tr>
</tbody>
</table>

Note. N = 387. To ensure that item 19 measures belief in humans as ‘made’ of the same ‘material’, the item was preceded by the control item ‘All humans consist of the same matter (for instance, [synonym for matter]/energy, stardust)’, Mdn = 5, range 1–5. The overall endorsement of the scale was low in the science-oriented sample (Mdn = 2).
Science-Oriented Worldview Measure (articles II-III)

Below, the science-oriented worldview items are listed in order of appearance (translated into English). The measure was formulated as follows: The internal validity of each subscale was investigated with principal component analysis and the items that were the least related to the extracted component(s) (loading < .35) or other items of the subscale (all correlations r < 0.35) were deleted. Additionally, reverse items that only correlated each other were deleted, since it was suspected that the correlation was mainly due to reverse wording. This procedure was followed by an internal consistency analysis utilising the Cronbach’s alpha (see article II). The items that were excluded have been marked with lighter colour.

What is your opinion on the following statements? On the scale of 1–5, where 1 = fully disagree and 5 = fully agree.

1. Science tells how we can know, what is true.
2. Science increases the feeling of purpose and meaning in my life.
3. Scientific research strengthens my identity.
4. Science explains the [this] world’s phenomena.
5. Science makes me feel [literally in Finnish provides me with the experience] that my life is useless. [Reversed]
7. Science makes my life more valuable [or: significant].
8. Science motivates me.
9. Science makes it more difficult to understand my own life. [Reversed]
10. Science makes it more difficult to understand that I exist. [Literally in Finnish: Science makes it more difficult to understand my own existence.] [Reversed]

What is your opinion on the following statements? On the scale of 1–5, where 1 = fully disagree and 5 = fully agree.

1. Scientific research is irrelevant to moral decision-making. [Reversed]
2. I evaluate human’s moral character with science. [Or: I use science to evaluate people’s moral character]
3. Science provides ingredients for my moral views.
4. Science provides me with a framework for evaluating the actions of humankind.
5. Science provides me with a framework for evaluating my own actions.
6. Scientific research tells me what actions we should take. [Literally in Finnish: how we should act]
7. Science tells me what is good and bad.
8. Science helps to evaluate whether humankind has succeeded or failed.

What is your opinion on the following statements? On a scale of 1–5, where 1 = fully disagree and 5 = fully agree.

1. Scientific research decreases the hope of immortality of humans. [Reversed]
2. Scientific research decreases the hope of my consciousness surviving death. [Reversed]
3. Science makes extending my life possible.
4. Science provides hope that my loved ones can avoid death.
5. Science provides hope that I can avoid death.
6. Scientific research provides a feeling of my own continuity after death.
7. Science makes it possible that my essence survives death.

What is your opinion on the following statements? On the scale of 1–5, where 1 = fully disagree and 5 = fully agree.

1. I feel that science connects me to the chain of prior generations.
2. I feel that science connects me to animals [to be a part of the animal kingdom].
3. I feel that scientific research connects me to humankind.
4. I feel that science connects me to the circulation of nature.
5. Science increases my experience that existence is limited.
6. Science increases the odds of me being remembered after my death.
7. Science offers me an experience of respectful wonder (a so-called ‘awe experience’).
8. I feel that science separates me from other history of the humankind. [Reversed]
9. Science makes me feel like I am a part of the universe.
10. Science makes me feel like I am a part of something else, what:

*Table 7: SOW measure: Sense of meaning from science*

<table>
<thead>
<tr>
<th>Item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science increases the feeling of purpose and meaning in my life.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>2. Scientific research strengthens my identity.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>3. Science gives my life direction.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>4. Science makes my life more valuable.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>5. Science motivates me.</td>
<td>5</td>
<td>1–5</td>
</tr>
<tr>
<td>6. Science and research increase the sense that my life is meaningful.</td>
<td>3</td>
<td>1–5</td>
</tr>
</tbody>
</table>

*Note. N = 387, scale 1–5 (1 = fully disagree, 5 = fully agree).*
Table 8: SOW measure: Standards for assessing human behaviour from science

<table>
<thead>
<tr>
<th>Item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Scientific research is irrelevant to moral decision–making. [R]</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>2. I evaluate people's [or human's] moral character with science.</td>
<td>3</td>
<td>1–5</td>
</tr>
<tr>
<td>3. Science provides ingredients for my moral views.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>4. Science provides me with a framework for evaluating the actions of humankind.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>5. Science provides me with a framework for evaluating my own actions.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>6. Scientific research tells me what actions we should take.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>7. Science tells me what is good and bad.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>8. Science helps to evaluate whether humankind has succeeded or failed.</td>
<td>4</td>
<td>1–5</td>
</tr>
<tr>
<td>9. Science tells us what is valuable.</td>
<td>3</td>
<td>1–5</td>
</tr>
</tbody>
</table>

Note. N = 387, scale 1–5 (1 = fully disagree, 5 = fully agree). The median of item 1 is a reversed score (original Mdn = 2).

Table 9: SOW measure: Literal immortality from science

<table>
<thead>
<tr>
<th>Item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science provides hope that my loved ones can avoid death.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>2. Science provides hope that I can avoid death.</td>
<td>1</td>
<td>1–5</td>
</tr>
<tr>
<td>3. Scientific research provides a feeling of my own continuity after death.</td>
<td>2</td>
<td>1–5</td>
</tr>
<tr>
<td>4. Science makes it possible that my essence survives death.</td>
<td>1</td>
<td>1–5</td>
</tr>
</tbody>
</table>

Note. N = 387, scale 1–5 (1 = fully disagree, 5 = fully agree).
Table 10: SOW measure: Symbolic immortality from science

<table>
<thead>
<tr>
<th>SOW Symbolic continuity item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel that science connects me to a chain of generations.</td>
<td>4</td>
<td>1−5</td>
</tr>
<tr>
<td>2. I feel that science connects me to animals [part of the animal kingdom].</td>
<td>5</td>
<td>1−5</td>
</tr>
<tr>
<td>3. I feel that scientific research attaches me to humankind.</td>
<td>4</td>
<td>1−5</td>
</tr>
<tr>
<td>4. I feel that science connects me to the circulation of nature.</td>
<td>5</td>
<td>1−5</td>
</tr>
<tr>
<td>5. Science offers me an experience of respectful wonder (awe experience).</td>
<td>5</td>
<td>1−5</td>
</tr>
<tr>
<td>6. Science makes me feel like I am a part of the universe.</td>
<td>4</td>
<td>1−5</td>
</tr>
</tbody>
</table>

Note. N = 387, scale 1−5 (1 = fully disagree, 5 = fully agree).

Belief in Science Scale (articles II-III)

Table 11: Belief in Science Scale (Farias et al., 2013)

<table>
<thead>
<tr>
<th>Item</th>
<th>Mdn</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science provides us with a better understanding of the universe than does religion.</td>
<td>6</td>
<td>1−6</td>
</tr>
<tr>
<td>2. ‘In a demon–haunted world, science is a candle in the dark.’ (Carl Sagan)</td>
<td>5</td>
<td>1−6</td>
</tr>
<tr>
<td>3. We can only rationally believe in what is scientifically provable.</td>
<td>5</td>
<td>1−6</td>
</tr>
<tr>
<td>4. Science tells us everything there is to know about what reality consists of.</td>
<td>4</td>
<td>1−6</td>
</tr>
<tr>
<td>5. All the tasks human beings face are soluble by science.</td>
<td>2</td>
<td>1−6</td>
</tr>
<tr>
<td>6. The scientific method is the only reliable path to knowledge.</td>
<td>5</td>
<td>1−6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7. The only real kind of knowledge we can have is scientific knowledge.</td>
<td>4</td>
<td>1–6</td>
</tr>
<tr>
<td>8. Science is the most valuable part of human culture.</td>
<td>4</td>
<td>1–6</td>
</tr>
<tr>
<td>9. Science is the most efficient means of attaining truth.</td>
<td>5</td>
<td>1–6</td>
</tr>
<tr>
<td>10. Scientists and science should be given more respect in modern society.</td>
<td>6</td>
<td>1–6</td>
</tr>
</tbody>
</table>

*Note. n =386, scale 1–6 (1 = fully disagree, 6 = fully agree).*
1.6 Coding instructions

1.6.1 Coding instructions for article III

Table 12: The coding instructions of article III (translated into English).

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Definition</th>
<th>What fits the criteria?</th>
<th>What does not fit the criteria?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main categories</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 = does not fit the criteria</td>
<td>Non-MCK</td>
<td>The participant expresses a view that does not mix core knowledge (that is separate from any possible MCK conceptions in the response).</td>
<td>Examples:</td>
<td>Responses that do not contain an explanation or a view about the phenomenon mentioned in the question.</td>
</tr>
<tr>
<td>1 = fits the criteria, hesitant wording</td>
<td></td>
<td></td>
<td>‘The universe originated from the Big Bang.’ (2)</td>
<td>Example:</td>
</tr>
<tr>
<td>2 = fits the criteria</td>
<td></td>
<td></td>
<td>‘When a human dies, consciousness flames out and the body starts to decompose.’ (2)</td>
<td>‘Difficult to say. The question should be delegated to a philosopher or a scholar in the study of religion.’</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘Suffering is due to chance and genes. On the other hand, one’s own deeds can also affect suffering, I believe in some kind of karma.’ (2) (Note: The response is also categorised as MCK religious/spiritual.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘The consciousness originates from biology. This doesn’t exclude the supernatural, however.’ (Note: The response is also categorised as MCK other)</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Code</td>
<td>Definition</td>
<td>What fits the criteria?</td>
<td>What does not fit the criteria?</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>MCK incl. religious or spiritual terminology</td>
<td>MCK incl. religious or spiritual terminology</td>
<td>A conception that mixes core knowledge and contains a term that refers to religion or spirituality. This means expressions that are commonly associated with religion or spirituality in the Finnish context.</td>
<td>Examples: 'One cannot help but think that in other dimensions, we might discover what we conceive of as God.' (1) 'Evolution is a part of God’s plan.' (2) 'Humans have a soul.' (2) 'Karma can kick one hard.' (2)</td>
<td>Responses that mention an MCK with a religious/spiritual term merely to reject it. Example: 'At least I do not believe in Heaven or Hell. Life ends in death.' (The response is coded into the category: MCK mere rejection)</td>
</tr>
<tr>
<td>MCK incl. science terminology</td>
<td>MCK incl. science terminology</td>
<td>A conception that mixes core knowledge and contains terminology associated with scientific research in Finnish culture.</td>
<td>Examples: 'God could have created the Big Bang.' (1) 'The purpose of evolution is to develop humanity.' (2)</td>
<td>Responses where MCK is integrated with a scientific account merely to reject the view. Example: 'At least I don't believe in any purpose in evolution.' (The response is coded into the category: MCK mere rejection)</td>
</tr>
<tr>
<td>MCK other</td>
<td>MCK other</td>
<td>A conception that mixes core knowledge and operates with expressions that are not traditionally associated with religion/spirituality or science, or that would</td>
<td>Examples: 'Consciousness is everywhere.' (2) 'Of course, it could be that our essence survives death in some form.' (1) 'It comes to mind that some being could have created the universe.' (1)</td>
<td>Responses that contain MCK merely to reject the view. Example: 'At least I don’t believe that there is any external purpose for my life.'</td>
</tr>
<tr>
<td>Category</td>
<td>Code</td>
<td>Definition</td>
<td>What fits the criteria?</td>
<td>What does not fit the criteria?</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>------------</td>
<td>-------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Additional categories</td>
<td></td>
<td></td>
<td></td>
<td>(The response is coded into the category: MCK mere rejection)</td>
</tr>
<tr>
<td>Scale 0-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 = does not fit the criteria</td>
<td></td>
<td></td>
<td></td>
<td>Responses that describe intentionality in evolution without bringing up a change at the individual level.</td>
</tr>
<tr>
<td>1 = fits the criteria</td>
<td></td>
<td></td>
<td></td>
<td>Example: 'The purpose of evolution is to eliminate the weak individuals.' (- MCK science)</td>
</tr>
<tr>
<td>MCK conflicted</td>
<td></td>
<td></td>
<td></td>
<td>Responses that discuss species but simply use the singular form of the noun.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Examples:</td>
<td>Example: 'Human and chimpanzee developed from a common ancestor through evolution.' (- Non-MCK)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The respondent expresses a sense of conflict over a conception that mixes core knowledge. (In addition to this category, the MCK categories can be)</td>
<td>'The thought of an afterlife feels comforting, but I can’t bring myself to believe it.' (1)</td>
<td>Responses that are hesitant but do not contain a conflict.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>'It comes to mind that some being could have created the universe. But I do not consider this as likely at all.' (1)</td>
<td>Example: 'It comes to mind that some being could have created the universe.' (- MCK other (1))</td>
</tr>
<tr>
<td>MCK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>evolution species as an individual</td>
<td>MCK</td>
<td>be difficult to categorise as either of them.</td>
<td>'I don’t believe in God, but I think our life doesn’t stop at death. After death we are reborn.' (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The respondent discusses speciation like the species would be an individual [psychological or biological] entity.</td>
<td>Example:</td>
<td>Responses that describe species but simply use the singular form of the noun.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>'Some ancestors changed into chimpanzees and some into humans.'</td>
<td>Example: 'Human and chimpanzee developed from a common ancestor through evolution.' (- Non-MCK)</td>
</tr>
<tr>
<td>Category</td>
<td>Code</td>
<td>Definition</td>
<td>What fits the criteria?</td>
<td>What does not fit the criteria?</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------</td>
<td>----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>MCK mere rejection</td>
<td></td>
<td>The respondent expresses a conception that mixes core knowledge merely to reject it.</td>
<td>Example: 'At least there is no purpose to suffering. Things just happen.' (1)</td>
<td>Responses that reject an MCK conception but also express that this same conception is plausible -&gt; MCK conflicted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Example: 'I don’t think I believe that the universe was created by God. Still, I find myself pondering whether this might be so.’</td>
</tr>
<tr>
<td>MCK ambiguous</td>
<td></td>
<td>It is unclear whether the conception fills the MCK criteria (or whether it is used e.g. as a metaphor).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The coders were also given the below instructions.

**Table 13: Instructions on what qualifies as an MCK concept (translated into English)**

<table>
<thead>
<tr>
<th>MCK conceptions contain some of the following:</th>
<th>What fits the MCK criteria?</th>
<th>What does not fit the MCK criteria?</th>
</tr>
</thead>
</table>
| Adding psychological properties to biological/physical entities or processes | - Purpose in life events, nature or evolution (purpose as the cause the phenomenon exists)  
- Design in life events, nature or evolution  
- Nature, evolution or life events as created  
- Creationism  
- Fate  
- The world as a just place  
Examples:  
‘Everything happens for a purpose.’ (About suffering or death)  
‘Nature tries to achieve a balance.’  
‘Sometimes I think that the re aspires a state of balance.’  
‘People who don’t adapt to their surroundings are meant to die out. That is how nature works.’  
‘I believe that there is some kind of purpose and reason [rationality] behind all of this.’  
‘Some intelligent agent has created us.’  
‘I am not entirely sure, but I find it possible that we were created by an intelligent designer.’  
‘Evolution directs speciation towards its rightful course.’  
‘The nature takes but the nature also gives.’ | - Purpose in life events that people express they have themselves made  
- Expressions that are merely metaphorical  
- The respondent mentions an MCK conception merely to reject it (-> MCK mere rejection)  
- The respondent expresses conflicted feelings/thoughts over the MCK concept but does not find it plausible (-> merely the category MCK conflicted)  
- The respondent expresses a view where a dead human lacks psychological properties: this will be categorised as non-MCK in accordance with prior work (although people might be prone to also perceive that psychological functions
<table>
<thead>
<tr>
<th>MCK conceptions contain some of the following:</th>
<th>What fits the MCK criteria?</th>
<th>What does not fit the MCK criteria?</th>
</tr>
</thead>
</table>
| Adding biological properties to physical entities or processes | - Energy as a living being  
- Nature as a living being  
- Amulet that provides good luck by contagion | continue after death, making this a theoretically interesting case) |
|   | Examples:  |
|   | 'Nature is a being that we all live in. We are all part of the same being.' |
| Psychological properties lacking from psychological entities or processes | - Mind lacking from a moving (seemingly living) human body |  |
| Biological or physical properties lacking from psychological entities or processes | - Mind separate from the body  
- Soul belief  
- Levitation | Examples:  
'The purpose of my future death will be that it will remind those closest to me that life is fleeting. I've even planned my funeral to manifest this.'  
'Death comes for all of us.' [Literally: 'Death harvests/reaps all of us', a common Finnish metaphor]  
'At least I do not believe in Heaven or Hell. Life ends in death.' (The response is coded into the category: MCK mere rejection)  
'The thought of an afterlife feels comforting, but I can't bring myself to believe it.' (\(\rightarrow\) mere MCK confl) |
| Biological or physical properties lacking from biological entities or processes | - A tree that cannot be harmed  
- An invisible tree | 'After death the consciousness disappears and the body decomposes little by little.' (\(\rightarrow\) mere Non-MCK) |
### MCK Conceptions Contain Some of the Following:

<table>
<thead>
<tr>
<th>What Fits the MCK Criteria?</th>
<th>What Does Not Fit the MCK Criteria?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical properties lacking from physical entities or processes</td>
<td>Examples:</td>
</tr>
<tr>
<td>- Pushing someone down with the power of thought (without physical contact)</td>
<td></td>
</tr>
<tr>
<td>- Moving objects with the power of thought</td>
<td></td>
</tr>
<tr>
<td>- An invisible statue</td>
<td></td>
</tr>
</tbody>
</table>

### ‘When Do I Apply the Term Categories? What is the Purpose of the Term Categories?’

The purpose of the term categories is to identify whether participants also apply so-called supernatural explanations without terms that are commonly associated with supernatural – or whether MCK conceptions are generally expressed with religious and spiritual terms.

Additionally, we investigate whether scientific terms are applied to express MCK conceptions, that is, whether people integrate science with MCK conceptions. The analysis increases the knowledge on whether MCK [in these lines of responses] is a religious phenomenon or a more general feature of reasoning about these domains. Belief in science has often been conceptualised as distinct from beliefs that contain MCK.

The term categories are applied in the following way:

The MCK religious/spiritual cell will be filled with the value 1-2 when an MCK conception contains a religious or a spiritual term. We will do this even if the participant applies the term differently from the most common religious views.

Similarly, the MCK science cell will be filled with the value 1-2 when an MCK conception is integrated with a term that commonly refers to science.

For example, the quote ‘Quantum theories might enable us to catch a glimpse of some kind of a God’ would be coded as MCK religious/spiritual (1), MCK science (1).

We will use the MCK other category when the MCK conception does not refer to science or religion/spirituality.
'What if the participant mentions more than one view that fit the same category, but one is expressed with hesitant terms and the other with more assured terms?'

We will code the view that the participant expresses with more assured terms.

For example: 'I believe that the universe began with some kind of thermal expansion. This may have been something like the Big Bang.'

The view with more assured terms is coded -> We will mark '2' in the category Non-MCK.

We will also use the following categories: MCK species as an individual; MCK conflicted; MCK mere rejection; and MCK ambiguous.

For these categories, we will use the scale 0-1 (0 = does not fit the criteria, 1 = fits the criteria).

If a response is difficult to categorise, it's good to write about this in the analysis diary (in my experience, this also eases the coding decisions. :)


1.6.2 Coding instructions for article IV

Below I introduce the coding instructions and the coding template, translated into English. The examples introduced in the coding template are fictive but contain expressions from responses of the pilot study and the data applied in the analysis. The coders also had a reference table with example coding and notes on why the responses had been coded with the values in the table.

Instructions for coding

The aim of the analysis is to estimate whether the responses fit the category criteria. This is estimated on a scale of 0–2.

0 = the response does not fit the criteria of the category
1 = the response fits the criteria of the category, but the respondent applies uncertain terminology
2 = the response fits the criteria of the category

We will add value ‘1’ or ‘2’ to the category if the response fits the criteria.

If the response does not fit the criteria of any category, we will add value ‘1’ to the category Ambiguous.

The responses that express annihilation after death are coded to at least one of the following: Annihilation body, Annihilation mind, Annihilation no distinction.

If the response is difficult to categorise, it is good to write this down in the coding diary. Diary notes are written to the outmost right column of the template during the coding process.
Table 14: Coding template for article IV

<table>
<thead>
<tr>
<th>Code</th>
<th>Scale</th>
<th>Definition</th>
<th>Examples</th>
<th>Examples: What is not included?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity social</td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death socially (in other humans or community).</td>
<td>‘In a way one could think that even after death we live on in the memories of our loved ones.’ (1)</td>
<td>‘In death we cease to exist.’ (This response is coded merely to Annihilation no distinction.)</td>
</tr>
<tr>
<td>Continuity close others</td>
<td>Value: 0–2</td>
<td>The respondent expresses that a human or some part of them exists after death in close others, e.g., in their memories.</td>
<td>‘A part of us continues in the thoughts of our loved ones.’ (2)</td>
<td>‘At least I don’t believe in any life after death.’ (The response is coded merely to Continuity rejection.)</td>
</tr>
<tr>
<td>Continuity offspring</td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death in their offspring.</td>
<td>‘A part of me continues in my children and grandchildren.’ (2)</td>
<td>‘The thought of an afterlife feels comforting, but I just cannot believe it.’ (The response goes to the categories Conflicted and Continuity good/comforting/beneficial.)</td>
</tr>
<tr>
<td>Continuity societal</td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death in their societal contribution, e.g., through work.</td>
<td>‘My scientific work will be remembered even after I am gone.’ (2)</td>
<td></td>
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<tr>
<td>Code</td>
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<td>Definition</td>
<td>Examples</td>
<td>Examples: What is not included?</td>
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<tr>
<td>Continuity mind/consciousness</td>
<td></td>
<td>The respondent expresses that a human’s mind/consciousness or some part of it exists after death.</td>
<td>‘Our body decomposes, but our mind continues.’ (2)</td>
<td></td>
</tr>
<tr>
<td>Continuity soul</td>
<td></td>
<td>The respondent expresses that a human’s soul or some part of it exists after death.</td>
<td>‘The body decays, but the soul moves on.’ (2) [We also included ‘spirit’ in this category.]</td>
<td></td>
</tr>
<tr>
<td>Continuity other religious/New Age</td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death and the respondent applies terminology that is often associated with religiosity or New Age.</td>
<td>‘I believe we return to God, in Heaven.’ (2)</td>
<td>‘The body decays, but the soul moves on.’ (-&gt; Continuity soul)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘We continue [our existence] through reincarnation.’ (2)</td>
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<td></td>
<td></td>
<td></td>
<td>‘I believe that God provides us with new bodies.’ (2)</td>
<td></td>
</tr>
<tr>
<td>Continuity same/new body</td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death in some kind of a body.</td>
<td>‘We continue [our existence] through reincarnation.’ (2)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>‘I believe that God provides us with new bodies.’ (2)</td>
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<td>Code</td>
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<td>Examples</td>
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<tr>
<td><strong>Continuity natural laws</strong></td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death and states this as a natural law or regularity, or associates this with a natural law, such as regularities of physics or biology.</td>
<td>‘Our atoms return to the circulation of nature.’ (2)</td>
<td>‘Each one of us dies. That’s how nature works.’ (-&gt; Annihilation no distinction)</td>
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<td></td>
<td></td>
<td></td>
<td>‘Our body disintegrates. However, nothing disappears fully, see the law of conservation of energy.’ (2)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>‘I cease to exist as a conscious individual, but someone could think that my genes continue.’ (1)</td>
<td></td>
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<tr>
<td><strong>Continuity other</strong></td>
<td></td>
<td>The respondent expresses that a human or some part of them exists after death, but they do not specify their view or it does not fit any other continuity category.</td>
<td>‘We continue somewhere else.’ (2)</td>
<td>‘I believe we return to God, in Heaven.’ (-&gt; Continuity other religious/New Age)</td>
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<td></td>
<td></td>
<td></td>
<td>‘We’ll be reunited in an afterlife.’ (2)</td>
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<td></td>
<td></td>
<td></td>
<td>‘Death likely isn’t the end.’ (1)</td>
<td>‘The thought of an afterlife feels comforting, but I just cannot believe it.’ (The respondent isn’t insecure of the view but do not believe in it and experience conflict -&gt; Conflicted and Continuity good/comforting/beneficial.)</td>
</tr>
<tr>
<td><strong>Annihilation body/bodily functions</strong></td>
<td></td>
<td>The respondent expresses that the body or bodily functions disintegrate/end after death.</td>
<td>‘Our body disintegrates. However, nothing disappears fully, see the law of conservation of energy.’ (2)</td>
<td></td>
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<tr>
<td>Annihilation mind/thoughts/ consciousness</td>
<td></td>
<td>The respondent expresses that the mind annihilates after death.</td>
<td>‘Our bodily functions cease and our consciousness ends.’ (2)</td>
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<td></td>
<td></td>
<td></td>
<td>‘Our bodily functions cease and our consciousness ends.’ (2)</td>
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<td></td>
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<td></td>
<td>‘The mind ceases to exist.’ (2)</td>
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<td></td>
<td>‘Our body starts to disintegrate and our experiences cease.’ (2)</td>
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<td></td>
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<td></td>
<td>‘Our consciousness may be lost forever in death, but we can’t know.’ (1)</td>
<td></td>
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<tr>
<td>Annihilation No distinction</td>
<td></td>
<td>The respondent expresses that a human or some part of them annihilates/decomposes after death, but they do not separate the mind and the body.</td>
<td>‘We cease to exist.’ (2)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>‘Human flames out.’ (2)</td>
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<td>Code</td>
<td>Scale</td>
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<td>Examples</td>
<td>Examples: What is not included?</td>
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<tr>
<td>Annihilation</td>
<td></td>
<td>The respondent describes annihilation after death by applying a metaphor that refers to biological life.</td>
<td>‘After death there's nothing, it's like an eternal sleep.’ (2)</td>
<td>‘As the brain functions cease, the consciousness ends.’</td>
</tr>
<tr>
<td>Life metaphor (e.g. sleep, prenatal state)</td>
<td></td>
<td></td>
<td>‘Death is like returning to non-existence, the state before birth.’ (2)</td>
<td>‘Our physical body rots.’ [We decided to exclude ‘physical’ but include ‘physiological’, as ‘physical’ is a quite common expression in everyday Finnish when discussing the body.]</td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>The respondent mentions a science-related term.</td>
<td>‘Our body disintegrates. However, nothing disappears fully, see the law of conservation of energy.’ (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘I cease to exist as a conscious individual, but someone could think that my genes continue.’ (1)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>‘In accordance with current research, our existence is most likely limited, and at some point my consciousness likely ceases to exist.’ (1)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>‘If science was more developed, human existence could be unlimited [in time].’ (1)</td>
<td></td>
</tr>
<tr>
<td>Potential of science</td>
<td>Value: 0–1</td>
<td>The respondent expresses that science/technology offers continuity as it develops.</td>
<td>‘If science was more developed, human existence could be unlimited [in time].’ (1)</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Scale</td>
<td>Definition</td>
<td>Examples</td>
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<tr>
<td><strong>Death good/comforting/beneficial</strong></td>
<td></td>
<td>The respondent expresses that there is something positive in death.</td>
<td>‘We decompose and in this way make room for future generations.’ (1)</td>
<td></td>
</tr>
<tr>
<td><strong>Conflicted</strong></td>
<td></td>
<td>The respondent expresses that they experience conflicted feelings/thoughts over afterdeath. If the respondent does not deem the view they mention as plausible: the response is not coded as Continuity/Annihilation.</td>
<td>‘The thought of an afterlife feels comforting, but I just cannot believe it.’ (1)</td>
<td>‘In death, our mind may be annihilated for good.’ (The respondent does not express conflict.)</td>
</tr>
<tr>
<td><strong>Continuity comfort</strong></td>
<td></td>
<td>The respondent expresses that belief in continuity is or would be comforting (for themselves). If the respondent does not deem the view they mention as plausible: the response is not coded as Continuity/Annihilation.</td>
<td>‘The thought of an afterlife feels comforting.’ (1)</td>
<td></td>
</tr>
<tr>
<td><strong>Continuity rejection</strong></td>
<td></td>
<td>The respondent mentions continuity after death just to denounce it. The view is not coded as continuity.</td>
<td>‘At least I do not believe in Heaven.’ (1)</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Scale</td>
<td>Definition</td>
<td>Examples</td>
<td>Examples: What is not included?</td>
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</tr>
<tr>
<td>Ambiguous</td>
<td></td>
<td>The response is difficult to interpret or it does not fit the criteria of any category. The response is coded only in this category.</td>
<td>‘Get buried.’ (1)</td>
<td></td>
</tr>
</tbody>
</table>
1.6.3 Study questionnaire (in Finnish)

Tutkimus maailmankuvista

Kutsu tutkimukseen

Kutsumme Sinut tutkimukseen, joka kartoittaa suomalaisten tiedettä arvostavia maailmankuvia. Tutkimus on osa Helsingin yliopistoon toteutettavaa väitöstutkimusta, jonka rahoittaa Suomen Kulttuurirahasto.

Kiitos siitä, että perehdyt vastaajille tarkoitettuun tietoon. Tämän sivun huolellinen lukeminen on tärkeää, jotta voit tehdä päätöksen osallistumisestasi.

Tietoa tutkimuksen osallistujalle

1. Tutkimuksen tarkoitus

Tutkimuksen tarkoitus on lisätä ymmärrystä tieteen merkityksestä suomalaisille. Tutkimus kartoittaa, millaisia maailmankuvia ja uskomuksia tieteeseen arvostamiseen liittyy.

2. Mitä minun tarvitsee tehdä?


3. Kerätyt tiedot ja tietojen säilytys


4. Mitä hyötyä osallistumisestani on?


5. Mitä tutkimustuloksille tapahtuu?

Vastauksesi koodataan ja yhdistetään muiden antamiin vastauksiin analyysia varten. Tulokset voidaan julkaisemaan tutkimusartikkeleina sekä muina julkaisuina, ja niitä voidaan hyödyntää konferenssiesittelemissä. Tutkimuksen tietoja ei käytetä tavalla, joka mahdollistaisi yksittäisten vastaajien tunnistamisen.

6. Kuka on arvioinut tutkimuksen eettisyyden?

Helsingin yliopiston ihmistieteiden eettisen ennakkoarvioinnin toimikunta on antanut lausunnon tutkimuksen eettisyystestä. Tutkimus on suunniteltu yliopiston eettisten suositusten mukaisesti.
Arvostamme kutsun lukemiseen käyttämääsi aikaa. Halutessasi voit kysyä lisätietoja minulta sähköpostitse: roosa.haimila@helsinki.fi. Tutkimuksen tietosuojaselosteen löydät täältä.

Parhain terveisin,

Roosa Haimila, FM, uskontotieteen tohtorikoulutettava
Helsingin yliopisto
Humanistinen tiedekunta
Kulttuurien osasto
roosa.haimila@helsinki.fi

Voit ottaa yhteyttä myös väitöstutkimukseni ohjaajaan, yliopistonlehtori, FT Teemu Tairaan: teemu.taira@helsinki.fi

Suostumus tutkimukseen

- Vahvistan, että olen lukenut tutkimuksen osallistujille tarkoitetun tiedon.
- Ymmärrän, että monivalintakysymyksillä kerätty anonyymi tieto voidaan tallentaa tietoarkistoon, jossa se on muiden tutkijoiden käytettävissä.
- Suostun osallistumaan tähän tutkimukseen.

Avoimet kysymykset

Seuraavaksi kysymme sinulta 1-2 kysymystä seuraavista teemoista: ihmisen alkuperä, kärsimys, elämän rajallisuus ja maailman alkuperä.


Käsitykset omasta alkuperästämme 1/2

K1: Suomalaisilla on useita käsityksiä siitä, miten ihmisen tietoisuus on syntynyt. Myös tiedeyhteisöissä kiistellään tästä kysymyksestä.

Millaisia käsityksiä sinulla on tietoisuutemme syntymisestä? (Yksilö- tai lajitasolla.)*

Käsitykset omasta alkuperästämme 2/2

K2: Tutkimusten mukaan ihmiset ja simpanssit polveutuvat yhteisistä esivanhemmista. Nämä esivanhemmat elivät vielä niinkin hiljattain kuin noin viisi miljoonaa vuotta sitten.

Pyydämme sinua kuvailemaan, miten ihmiset ja simpanssilla on ollut yhteiset esivanhemmat.*

Käsitykset kärsimyksestä 1/2

Seuraavaksi pyydämme sinua kertomaan kärsimyksen liittyvistä näkemyksistäsi.
K3: Miksi pahoja asioita (esim. vakava sairaus) tapahtuu joillekin ihmisille enemmän kuin toisille?

Käsitykset kärsimyksestä 2/2
K4: Miksi elämässämme mielestäsi on kärsimystä?

Käsitykset kuolemasta 1/1
Seuraavaksi kysymme kuolemaan liittyvistä näkemyksistäsi.

K5: Mitä meille (ihmisille) mielestäsi tapahtuu kuoleman jälkeen?
K6: Onko yksittäisen ihmisen olemassaolo mielestäsi ajallisesti rajallinen vai rajaton?
(Voisitko kertoa meille, miksi ajattelet näin?)

Käsitykset maailmankaikkeuden alkuperästä 1/1
Ennen tieteeseen liittyviä monivalintakysymyksiä kysymme sinulta vielä maailmankaikkeuden alkuperästä.

K7: Nykykeskusteluessa on esitetty useita näkemyksiä maailmankaikkeuden synnystä.
Miten näet maailmankaikkeuden saaneen alkunsa?

Tiedekäsitykset 1/2
Pyydämme sinua arvioimaan tieteeseen liittyviä vääritteitä.

K8a. Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.

  Tiede kertoo miten voimme tietää, mikä on totta.
  Tiede lisää tarkoituksen ja merkityksen tunnetta elämässäni.
  Tieteellinen tutkimus vahvistaa omaa identiteettiäni.
  Tiede selittää maailman ilmiöitä.
  Tiede antaa minulle kokemuksen, että elämänä on hyödytön.
  Tiede antaa elämälleni suuntaa.
  Tiede tekee elämästäni arvokkaamman.
  Tiede motivoi minua.
  Tiede vaikeuttaa oman elämänä ymmärtämistä.
  Tiede vaikeuttaa oman olemassaoloni ymmärtämistä.
  Tiede ja tutkimus lisäävät kokemustani siitä, että elämälläni on merkitystä.
K8b. Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.*

Tieteellinen tutkimus on epäolennaista moraaliselle päätöksenteolle.
Arvioin ihmisten moraalisista luonnetta tieteen avulla.
Tiede tarjoaa aineksia moraalisiin näkemyksiini.
Tiede tarjoaa minulle kehikon, jolla arvioida ihmiskunnan toimia.
Tiede tarjoaa minulle kehikon, jolla arvioida omia toimiani.
Tieteellinen tutkimus kertoo minulle, miten meidän tulisi toimia.
Tiede kertoo minulle, mikä on hyvä ja paha.
Tiede auttaa arvioimaan, onko ihmiskunta onnistunut vai epäonnistunut.
Tiede kertoo meille, mikä on arvokasta.

**K9a. Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.*

Tieteellinen tutkimus vähentää toivoa ihmisen kuolemattomuudesta.
Tieteellinen tutkimus vähentää toivoa tietoisuuteni säilymisestä kuoleman jälkeen.
Tiede mahdollistaa elinikäni pitkittämisen.
Tiede antaa toivoa siitä, että lähiseinä voivat välttää kuoleman.
Tiede antaa toivoa siitä, että voin itse välttää kuoleman.
Tieteellinen tutkimus tarjoaa tunteen omasta jatkuvuudestani kuoleman jälkeen.
Tiede mahdollistaa sen, että olemukseni säilyy kuoleman jälkeen.

**K9b. Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.*

Koen, että tiede yhdistää minut sukupolvien ketjuun.
Koen, että tiede yhdistää minut osaksi eläinkuntaa.
Koen, että tieteellinen tutkimus kiinnittää minut ihmiskuntaan.
Koen, että tiede yhdistää minut luonnon kiertokulkun.
Tiede lisää kokemustani olemassaolon rajallisuudesta.
Tiede lisää sen todennäköisyyttä, että minut muistetaan kuoleman jälkeen.
Tiede tarjoaa minulle kunnioittavan ihmettelyn kokemuksen (ns. ”awe-kokemuksen”).
Koen, että tiede erottaa minut ihmiskunnan muusta historiasta.
Tiede saa minut tuntemaan itseni osaksi maailmankaikkeutta.
Tiede saa minut tuntemaan itseni osaksi jotain muuta kokonaisuutta, mitä:

**K10: Voisitko kertoa lyhyesti, millaista tiedettä ajattelit vastatessasi kysymyksiin?**
Maailmankuvamittari ja taustatiedot

Pyydämme sinua vielä vastaamaan monivalintakysymyksiin maailmankuvastasi. Lisäksi kysymme sinulta muutaman yleisluentoisen taustatiedon.

Lopuksi voit osallistua arvontaan ja näet tutkimuksen vastaajille tarkoitetun tiedon.

Maailmankuvamittari 1/2

K11: Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.*

Maailma on oikeudenmukainen paikka.
Kaikella on tarkoituksensa.
Ihmisillä on pääosin hyvät tarkoitusperät.
Ihmiset saavat lopulta ansionsa mukaan.
Ihmisen olemus säilyy hänen kuolemansa jälkeen.
Elämäntapahtumat ovat satunnaisia siinä mielessä, ettei niillä ole tarkoitusta.
Ihmisen mieli on jokseenkin erillinen kehon toiminnasta.
Ihmisellä on sielu.
Ihmisellä on vapaa tahto, joka ei riipu hänen kehostaan.
Riittävän kehitetty kone elää, joka ei riipu hänen kehostaan.
Uskon kohtalon.
Uskon kuolemanjälkeiseen elämään.
Tapahtumilla on Jumalan määräämä tarkoitus.


K12: Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä. Pyydämme jättämään vaihtoehdot tyhjiksi ja siirtymään seuraavalle sivulle.

Suurin osa ihmisiä pyrkii noudattamaan kultaa saantöä (tee kuten haluaisit itseesi tehtävän).
Jokaisella ihmisellä on ainutlaatuinen peroonansa.
Ihmiset ovat pitkäaikoina oman onnensa seppiä.
Enemmistö ihmisiä livahtaisi elokuvateatteriin maksamatta, jos ei jätä siitä kiinni.
Ihmiset puhuvat usein totta silloinkin, kun se ei hyödytä.
Menestyksemme elämää rihppuu pitkälti tekijöistä, joihin emme voi vaikuttaa.
Enemmistö ihmisiä voi hallita sitä, mitä heidän elämäänsä tapahtuu.
Suurin osa meistä pysähtyisi auttamaan ihmistä, jonka auto on hajonnut tienposkeen. Ihmiset käyttäytyisivät vastuullisemmin, jos heidän elinolosuhteensa kohenisivat.

Halutessasi voit kommentoida vastauksiasi tähän:

**Maailmankuvamittari 2/2**

Seuraavaksi pyydämme sinua arvioimaan luontoa koskevia väitteitä.

K13: Mitä mieltä olet seuraavista väittämistä? Asteikolla 1-5, kun 1 = täysin eri mieltä, ja 5 = täysin samaa mieltä.*

Luonto on elävä olento.
Jokin suurempi voima loi maapallon ja elävät olennot (eläimet, kasvit) ja vaikuttaa näihin edelleen.
Jokin suurempi voima loi maapallon ja elävät olennot (eläimet, kasvit), muttei enää vaikuta näihin.
Jumala loi maapallon ja elävät olennot (eläimet, kasvit).
Maapallon ja elävien olentojen (eläimet, kasvit) synty on pelkästään fysikaalisten tapahtumien ketju.
Ihminen on kehitetty muista, varhaisemmista eläinlajeista.
Luonnnonvalinnan seurauksena heikot yksilöt karsiutuvat populaatiosta.
Luonnnonvalinnan tarkoitus on karsia heikot yksilöt populaatiosta.
Elämme todennäköisimmin jonkun toimijan (kuten koneälyn) luomassa todellisuudessa.
Luonto ylläpitää tasapainoa itsesäätelyllä.
Kaikki maailmassa koostuu materiasta tai palautuu materiaan/energiaan.
Eläinlajit voivat muuttaa biologisia ominaisuuksiaan selviytykseen.
Maailmassa on jokin tarkoituksellinen voima (esim. elämänvoima).
Kaikki ihmiset koostuvat samasta materiasta (esim. aine/energia, tähtipöly).
Kaikki ihmiset on tehty samasta materiaalista (esim. aine/energia, tähtipöly).

Halutessasi voit kommentoida vastauksiasi tähän:

Ennen taustatietoja kysymme sinulta vielä yhden tieteeseen liittyvän kysymyksen.
K14: Mitä mieltä olet seuraavista tieteeseen liittyvistä näkemyksistä? Asteikolla 1-6, kun 1 = täysin eri mieltä, 6 = täysin samaa mieltä.*

Tiede tarjoaa meille paremman ymmärryksen maailmankaikkeudesta kuin uskonto.
"Demonien riivaamassa maailmassa tiede on kynttilä pimeydessä.” (Carl Sagan)
Rationaalisesti voimme uskoa vain siihen, mikä on tieteellisesti todistettavissa.
Tiede kertoo kaiken tarvittavan siitä, mistä todellisuus koostuu.
Kaikki ihmisten kohtaamat haasteet voidaan ratkaista tieteellä.
Tieteellinen metodi on ainoa luotettava polku tietoon.
Tieteellinen tieto on ainoaa todellista tietoa, jota meillä voi olla.
Tiede on inhimillisen kulttuurin arvokkain osa.
Tiede on tehokkain keino saavuttaa totuus.
Tutkijoita ja tiedettä tulisi kunnioittaa enemmän nyky-yhteiskunnassa.

Voit halutessasi kommentoida vastauksiasi tähän:

**Taustatiedot**
Tämä on kyselyn viimeinen sivu. Toivomme sinun vastaavan taustatietojakartoittaviin kysymyksiin, jotta voimme tarkastella näiden mahdollista yhteyttä vastauksiin.

K15: Mikä on sukupuolesi?*
- Nainen
- Mies
- Muu / En halua vastata

K16: Minkä ikäinen olet?*
- Alle 18 vuotta
- 18–30 vuotta
- 31–40 vuotta
- 41–50 vuotta
- 51–65 vuotta
- Yli 65 vuotta

K17: Kuinka monta vuotta olet opiskellut (alkaen ala-asteen ensimmäiseltä luokalta)?*
Opiskelulla tarkoitamme opintoja oppilaitoksissa.

K18: Kuinka henkisenä pidät itseäsi? 0 = ei yhtään henkisenä, 6 = erittäin henkisenä
Tässä käytetty henkisyyden käsite olisi englanniksi 'spiritual'.

K19: Kuulutko uskonnolliseen yhdyskuntaan?*
- Kyllä
- En
K20: Uskotko Jumalaan?*
- Kyllä
- En
- En osaa sanoa

K21: Mikä seuraavista kuvaa katsomustasi parhaiten?*
- Ateisti
- Agnostikko
- Ei uskontoa
- Välinpitämätön/neutraali
- Henkinen, muttei uskonnollinen
- Uskonnollinen
- Muu, mikä?

K22: Työskenteletkö tai oletko työskennellyt tutkimuslaitoksessa (esim. yliopistolla)?*
- Kyllä
- En

K23: Millä tutkimusalalla olet työskennellyt?*
[Vastaus oli 'Kyllä' kysymyksessä '36 [Tutkimustyö1]' (K22: Työskenteletkö tai oletko työskennellyt tutkimuslaitoksessa (esim. yliopistolla)?)]
- Humanistiset tieteet
- Yhteiskunta- ja sosiaalitieteet
- Matemaattiset tieteet ja luonnontieteet
- Muu

Halutessasi voit kommentoida vastauksiisi tähän:
[Vastaus oli 'Kyllä' kysymyksessä '36 [Tutkimustyö1]' (K22: Työskenteletkö tai oletko työskennellyt tutkimuslaitoksessa (esim. yliopistolla)?)]

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**Arvontaan osallistuminen ja palaute**

Vastaajien kesken arvotaan yksi Amazon-lahjakortti (arvo 60 euroa). Toimitamme lahjakortin voittajalle sähköpostilla. Jos haluat osallistua arvontaan, pyydämme sinua lähettämään alla olevan tunnukseen sähköpostitse osoitteeseen: roosa.haimila@helsinki.fi. Viestin otsikoksi voit merkitä: "Maailmankuvatutkimuksen arvonta".

Arvonnan tunnus: 4g678

Arvostamme kyselystä antamaasi palautetta. Halutessasi voit kirjoittaa palautetta alla olevaan kenttään:

Voit siirtyä osallistujille tarkoitettuun tietoon painamalla "Lähetä".

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**[Osallistujien viimeinen sivu]**

{if(Suostumus1_SQ001 == "" OR Suostumus1_SQ002 == "" OR Suostumus1_SQ003 == "", "Kiitos kiinnostuksestasi tutkimusta kohtaan. Valitettavasti tutkimukseen voivat osallistua vain ne, jotka 1) vahvistavat lukeneensa osallistujille tarkoitetun tiedon, 2) suostuvat anonymymin tiedon arkistoimiseen, ja 3) antavat suostumuksensa tutkimukseen.", "Lämmin kiitos vastauksistasi!")}

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Voit halutessasi saada tutkimusraportin tuloksista sähköpostiisi, kun tulokset julkaistaan. Jos haluat raportin, pyydän sinua lähettämään tiedon tästä sähköpostitse osoitteeseen: roosa.haimila@helsinki.fi

Vastaan mielelläni kaikkiin tutkimusta koskeviin kysymyksiin.

Parhain terveisin,

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Halutessasi voit ottaa yhteyttä myös väitöstutkimuksen ohjaajaan, yliopistonlehtori, FT Teemu Tairaan:
teemu.taira@helsinki.fi

Tutkimuksen tietosuojaselosteen löydät täältä.

***

Pyydämme nyt sulkemaan selaimesi. Huom! Mikäli täytit kyselyn yhteiskäytössä olevalla tietokoneella (kirjastot, oppilaitokset, nettikahvilat jne.) tyhjennä selaimen välimuisti ja sivuhistoria.
References


