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GOD-LIKE ROBOTS: THE SEMANTIC OVERLAP BETWEEN REPRESENTATION OF DIVINE AND ARTIFICIAL ENTITIES

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Abstract

Artificial intelligence and robots may progressively take a more and more prominent place in our daily environment. Interestingly, in the study of how humans perceive these artificial entities, science has mainly taken an anthropocentric perspective (i.e. how distant from humans are these agents). Considering people's fears and expectations from robots and artificial intelligence, they tend to be simultaneously afraid and allured to them, much as they would be to the conceptualisations related to the divine entities (e.g. gods). In two experiments, we investigated the proximity of representation between artificial entities (i.e. artificial intelligence and robots), divine entities, and natural entities (i.e. humans and other animals) at both an explicit (Study 1) and an implicit level (Study 2). In the first study, participants evaluated these entities explicitly on positive and negative attitudes. Hierarchical clustering analysis showed that participants' representation of artificial intelligence, robots, and divine entities were similar, while the representation of humans tended to be associated with that of animals. In the second study, participants carried out a word/non-word decision task including religious semantic-related words and neutral words after the presentation of a masked prime referring to divine entities, artificial entities, and natural entities –(or a control prime). Results showed that after divine and artificial entity primes, participants were faster to identify religious words as words compared to neutral words arguing for a semantic activation. We conclude that people make sense of the new entities by relying on already familiar entities and in the case of artificial intelligence and robots, people appear to draw parallels to divine entities.

Highlights:

- **Artificial Intelligence and robots share common representations with divine entities (e.g. gods)**
- **Artificial Intelligence and robots, similar to divine entities, are conceptualized as non-natural entities with high power over human life.**
- **These common representations relies on conceptual semantic proximity at the explicit and implicit level**

Keywords: artificial intelligence, robots, gods, semantic representation, perception of robots

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God-like robots: The semantic overlap between representation of divine and artificial entities

1. Introduction

Along with the evolution of artificial intelligence (AI) and robotic technology, behaviours and public beliefs toward these new entities are also constantly being refined. Despite this, social sciences have been slower to answer some of the key questions regarding human-machine interactions questions, which may not be a priority to the same extent as the developers of the new technologies. The purpose of the present research, then, is to advance our knowledge of how people perceive AI and robots and how these entities may be represented in people's minds. In line with Eypley, Waytz and Cacciopo (2006), we propose that because both AI and robots are a relatively new addition to our societies, people may use their existing knowledge of other non-human figures to build a cognitive representation of AI in their minds. Specifically, the present research investigated whether people's experiences of anger, disappointment, and positive affect towards AI and robots are cognitively linked to already accessible representations of other figures, such as gods, animals, and humans. Both AI and God are abstract in their existence and are not bound by physical architecture of human bodies, allowing them to have powers beyond human abilities. AI technology is increasingly eager to transcend human boundaries (Segal, 1998). Robots, on the other hand, although they are artificial in the same way as the AI, may be cognitively represented similar to other embodied creatures, such as humans or animals. Further evidence for this association is tested by investigating the semantic link between those entities. In sum, the present research advances knowledge on the ways in which AI and robots, despite both being products of the same wave of technological progress, may be represented distinctly in human minds.

1.1 Thinking about entities

Surrounded by an abundance of information, human mind has a limited attention to process all of the social stimuli available (Greenwald & Banaji, 1995). For this reason, people simplify the world and use proxy information to guide their thoughts and behaviour. When meeting new individuals, stereotypes within a certain social category become a primary source of information to allow people to make more rapid decisions and infer attitudes instantly (Krauss & Hopper, 2001). As such, knowing some general characteristics of these groups is an adaptive way of navigating complex environments. These stereotypes may be ambivalent in a way that a member of a certain social group can be evaluated positively on one trait, but negatively on another (Fiske, Cuddy, & Glick, 2007).

However, psychological sciences are not just concerned with human-human relations, but increasingly interested in how people think about other non-human entities, such as gods (Gervais, 2013) or animals (Caviola, Everett, & Faber, 2018). When encountering figures or phenomena other than humans, people rely on schemas to organise their experience to guide their thoughts and behaviours (Fiske & Neuberg, 1990). People naturally attempt to create new meanings by associating people, objects, and even ideas (Krystal, 2006). Crucially, if these happen to be new elements that do not have a place in the current understanding of the world, people reaffirm their existing meaning-providing frameworks (Heine, Proulx, & Vohs, 2006). With technological objects like robots or AIs, people may find it unsettling when they work in unpredicted ways. The solution to this unpredictability appears to be resolved by attributing human characteristics and stereotypes to assert robots or AIs intentionality (Epley, Waytz, & Cacioppo, 2007; Hegel, Krach, Kircher, Wrede, & Sagerer, 2008; Nass & Moon, 2000).

Given that the everyday direct exposure to technological agents is somewhat limited and certainly not a salient part of people’s lives, conceptual knowledge about these entities is not necessarily formed from prior experiences but rather from fictional stories like films and TV shows (Polkinghorne, 2013; Rossiter, 1999). For this reason, the uncertainty surrounding these entities can be high and people may use the only representation available at their disposal: fictional representations to reduce unpredictability (Appel, 2008; Appel & Mara, 2013). Over time, these fictional representations may become stable and reliable depictions when they have to think about AIs and robots (Epley et al., 2007).

1.2 Artificial intelligence: Salvation and destruction

Lay people and experts have a varied understanding of what AI consists of (Lawless, Mittu, Russell, & Sofge, 2017). Lay people's beliefs regarding AI's capacities, control, or limits tend to be driven by popular culture more so than the current state of knowledge on the topic (Mara & Appel, 2015), which is not the case for the experts. Despite this, there are various attitudes towards what sort of contribution AI brings to our societies. Prominent scientists have expressed their doubts regarding the bright future of humans co-existing with the AIs. For example, Stephen Hawking referred to "the development of full artificial intelligence [as the potential] end of the human race" - which could take over its own destiny without the input of humans (Stephen Hawking at the BBC, 2014) - as a cataclysmic invention (Geraci, 2008). Conversely, more optimistic scientists pursue a rhetoric portraying the AIs as an extension of humanity, arguing that AI is a way to transcend the human nature (Geraci, 2008; Helbing et al., 2019). One example of this would be by enhancing human's cognitive capacities (Salomon, Perkins, & Globerson, 2007).

This ambivalence of seeing technology both as a threat and as a contribution to our societies is reflected in findings regarding public perceptions of AI: while they remain largely optimistic and positive, there is some concern over loss of control over AI (Bostrom, 2003; Vimonses, Lei, Jin, Chow, & Saint, 2009). Therefore, on one hand, the development of AI may be perceived as a positive addition to our civilisation, but on the other hand, there are clearly fears surrounding these developments. Given the power and appeal of AI, their mental representations in the human mind could resemble those of divine entities in that sense (Geraci, 2008). The author proposed that when thinking about divine entities, the fear of the omnipotent nature of gods and the simultaneous allure of their omnipotence exist side by side. Notably, these two concepts are not opposition to each other, but rather enforce one another as the perceived power of the gods is increased. Indeed, people tend to view God as punitive on one hand, having power over the ultimate fate of humans, and benevolent on the other hand (Adee, 2018; Stroope, Draper, & Whitehead, 2013). Moreover, people ascribe agency to gods, possessing power which exceeds human abilities (Menary, 2010). The nature of this power, much like in the case of AIs, is ambiguous as gods could potentially use it either for the benefit of humans or against them (Gray & Wegner, 2010). It would be expected that because of the close conceptual overlap between divine entities and AI, people may be inclined to attribute similarly ambivalent constructs of power of divine figures to AI. Likewise, simultaneous fear of and attraction towards this perceived power outside human ability could implicitly enable cognitive associations of AI to divine figures. In 1912, Durkheim proposed a dichotomy between the concepts of profane and sacred. One might be tempted to define concepts belonging to the "sacred" by the place generally assigned to them in the hierarchy of beings (Durkheim, 1912). According to Durkheim, while this hierarchical distinction is a criterion that seems too general and imprecise, there remains a significant conceptual heterogeneity. What makes this heterogeneity sufficient to characterize this classification of things is its absolute character. Indeed, there is no other example in the history of human thought of two such profoundly different categories of things so fundamentally opposed to each other. The “sacred” is readily considered superior to secular things and particularly to man that has, by himself, nothing sacred. While Durkheim has discussed religion and divinity as sacred, the AI, too, does not follow the mundane physical constraints placed onto human beings. Another claim of Durkheim is that if the human depends on the sacred through the hierarchical relationship, this dependence is reciprocal and the sacred is made by the human which create it as sacred. This approach is transcribable to AI that are perceived, in the general audience, with a potential power superior to humans but still dependent on human bodies. For these reasons, AI, more so than other non-human entities such as animals could be more readily perceived to be associated to the sacred similar to divine entities. However, whether such an association exists has not been tested by the research to date.

1.3 Robots: an embodied technology

Similar to AI, the perception of the impact of robots on our society is ambiguous as it is mainly driven by science fiction (Sundar, Waddell, & Jung, 2016) and the media (Bartneck, Suzuki, Kanda, & Nomura, 2007; Mara & Appel, 2015; Tatsuya Nomura, Suzuki, Kanda, & Kato, 2006). While there is a fear of being replaced, for example, via automatisation (Syrdal, Dautenhahn, Koay, & Walters, 2009), people also see robots as companions, carers, and new social partners (Walters, Syrdal, Dautenhahn, Te Boekhorst, & Koay, 2008). However, in contrast to AI, robots tend to have an embodied structure that could liken them to humans (Bainbridge, Hart, Kim, & Scassellati, 2011; Mara & Appel, 2015). Therefore, robots, can be considered like AI in an interactive physical body and as more grounded, and consequently, in less abstract terms (Nyangoma et al., 2017). A physical body itself does not guarantee positive attitudes, as robots that are too human-like can be disturbing (Kaplan, 2004). This embodied structure encourages people to attribute more human characteristics to robots than other non-embodied entities (Breazeal, 2004). The process of attributing human characteristics to a piece of technology but also to animals or divine entities is called anthropomorphism (Epley et al., 2007; Martin, 1997; Nass & Moon, 2000; Nass, Reeves, & Leshner, 1996). Under certain conditions, however, robots are seen more as tools than human-like. An example of this is when robots are not involved in an interaction or when they behave in a predictable manner (Epley et al., 2007; Häring, Kuchenbrandt, & André, 2014; Riether, Hegel, Wrede, & Horstmann, 2012; Spatola et al., 2018).

Thus, it is the social interaction with robots that enables people to attribute uniquely human traits to robots, thereby granting them a moral status (Spatola et al., 2018; Waytz, Cacioppo, & Epley, 2010; Waytz, Gray, Epley, & Wegner, 2010). Indeed, when people deprive others of their human qualities, they can do so in two distinctive ways: mechanistic and animalistic (Haslam, 2006; Haslam & Loughnan, 2014). In the case of attributing someone with mechanistic qualities, they resemble more general characteristics associated with robots and technology. In this way, there may be some overlap between how some people can be perceived as cold or superficial in the same way that robots are considered. Animalistic qualities, on the other hand, can be attributed to people who appear to lack civility in the same ways that animals do. Research has shown that robots were dehumanised in mechanical and not animalistic ways (Spatola et al., 2019). Dehumanisation of humans, however, is achievable in both ways. At the same time, it is not clear whether people’s representations of robots necessarily overlap with those of humans in general and of animals. Thus, we propose to investigate whether robots are perceived by lay people as closer to AI (and potentially divine entities) on the two dimensions of fear and allure because of their artificial origin (Mara & Appel, 2015) or closer to human and animals in a more naturalistic perspective because of their embodied structure and humanlike conceptual representation (Goetz, Kiesler, & Powers, 2003; Wainer, Feil-Seifer, Shell, & Matarić, 2006). It has been shown that the physical embodiment of a robot compared to an avatar enhances social presence, especially in a face-to-face interaction (Bainbridge et al., 2011; Sirkin & Ju, 2012; Tanaka, Nakanishi, & Ishiguro, 2014). Also, the physical presence of a socially interactive robot seems to elicit the same effect on human cognition that the presence of a human does, increasing the level of perceived anthropomorphism of the robot (Eyssel & Kuchenbrandt, 2012; Riether et al., 2012; Spatola et al., 2019, 2018). This further demonstrates that robots can be seen as physical agents close to humans, which is not the case for AI that are rather characterized by intangibility.

1.4 The present research

The aim of the present research was to investigate the respective overlap between artificial entities (AI and robots) and natural entities (i.e., humans and animals) or divine entities (i.e., gods). Study 1 used correlational methods to establish the nature of the representations across these five entities and was explorative in nature. Using the data from Study 1, we then constructed hypotheses for Study 2 to verify the overlap in semantic representation between gods and artificial entities. Data for Study 1 and 2 are available via Open Science Framework: https://osf.io/uzpjn/?view_only=d60c61b847a14d1cb3a0aa8ef6172391

2. Study 1

In the first study, we aimed to evaluate the extent to which similar positive and negative traits are attributed to divine entities, artificial intelligences, robots, humans, and animals. Given the conceptual similarities of divine entities and AI, we expect that people may evaluate these two entities similarly and that robots and AI should be comparable due to their shared technological origin. Humans and animals should be perceived as different from the three others entities because of their natural and embodied aspects. Finally, because of the robots' anthropomorphism process, robots should be seen as relatively close to humans.

Importantly, as we were concerned with artificial entities (AI and robots), we included a measure of technological readiness. Technology can be a source of anxiety (Heerink, Kröse, Evers, & Wielinga, 2010) or positive expectations (Wiederhold, Baños, Botella, Gaggioli, & Riva, 2011) depending on the general attitude towards technology (Bartneck et al., 2007; Heerink et al., 2010; Parasuraman, 2007). As such, people's general attitude towards technology could affect their positive or negative evaluation of AIs and robots. We expected that people declaring optimism towards technology would be more willing to develop positive attitudes toward AIs and robots while a high technological discomfort would be related to more negative evaluations (Lin & Hsieh, 2007; Parasuraman, 2007).

2.1 Methods[1]

2.1.1 Participants. Participants were 76 psychology students at a French university (8 male, 63 female and 5 others, M_{age} = 19.07, SD = 2.30) who completed an online survey.[2]. Items within each scale were presented randomly and each of the following measures were further randomised.

2.1.2 Positive and Disappointment/Anger attitudes. To evaluate positive and disappointment/anger attitudes towards (1) divine entities, (2) artificial intelligence, (3) robots, (4) humans, and (5) animals, we used an adapted version of the Attitudes toward God Scale (Exline et al., 2010). To measure the positive attitudes, participants responded to six items (such as "Could you trust [the entity] to protect you and take care of you?") on a scale from 1 (*not at all*) to 7 (*completely*). A further four items (such as "Could you see [entity] as bad?") measured feelings of disappointment and anger attitudes towards those entities. Disappointment and anger emotions were a part of the same subscale and thus, we refer to them as 'negative emotions' more generally for the sake of simplicity. The positive and negative items were collapsed into two

[1] In addition, we used the Individualism and Collectivism scale (Triandis & Gelfland, 1998), which is not reported in this paper
[2] At the end of the experiments, all participants had to evaluate their knowledge about artificial intelligence and robots on a 1 "not at all" to 7 "I'm a professional" scale. Results showed that all participants were set in the lower quantile of the scale.

separate variables and showed overall good internal reliability across all entities (Divine entities: $\alpha_{positive}$[3] = .90; $\alpha_{disappointment}$ = .78; AIs: $\alpha_{positive}$ = .75; $\alpha_{disappointment}$ = .76; Robots: $\alpha_{positive}$ = .80; $\alpha_{disappointment}$ = .70; Humans: $\alpha_{positive}$ = .67; $\alpha_{disappointment}$ = .66, Animals: $\alpha_{positive}$ = .71; $\alpha_{disappointment}$ = .70).

2.1.3 Technology readiness. Participants also completed the Technology Readiness Index scale (Parasuraman, 2007; Parasuraman & Colby, 2015), which measured their propensity to embrace and use of technologies in general and cutting-edge technologies in particular. The measure consists of four subscales: optimism ("Technology gives people more control over their daily lives"), innovativeness ("You keep up with the latest technological developments in your areas of interest"), discomfort ("New technology makes it too easy for governments and companies to spy on people"), and insecurity ("You do not consider it safe giving out a credit card number over a computer"). Each item was scored on a Likert scale from 1 (strong disagreement) to 7 (strong agreement). All four subscales had an acceptable level of internal reliability ($\alpha_{optimism}$ = .82; $\alpha_{innovativeness}$ = .60; $\alpha_{discomfort}$ = .74; $\alpha_{insecurity}$ = .82).

2.1.4 Participants expertise. At the end of the experiments, all participants had to evaluate their knowledge about artificial intelligence and robots on a 1 "not at all" to 7 "I'm a professional" scale.

2.2 Results

2.2.1 Clustering. We first conducted a hierarchical agglomerative cluster analysis (Caliñski & Harabasz, 1974) using the Ward method to explore the associations between positive and negative attitudes toward divine entities, artificial intelligences, robots, humans, and animals (Davis, 2009). Hierarchical clustering is a bottom-up approach for grouping objects based on their similarity. Using this analysis, we created a dendogram: a multilevel hierarchy tree-based representation of objects where clusters at one level are joint together to form the cluster at the

[3] Cronbach's alpha or α is a statistic used in psychometrics to measure the reliability of questions asked during a test. A reliable α is superior to .70 (Brown, 2002; Cronbach, 1951).

next levels (see Figure 1). The dendrogram is a visual representation of the compound correlation data. The closer the concepts, the shorter the distance.

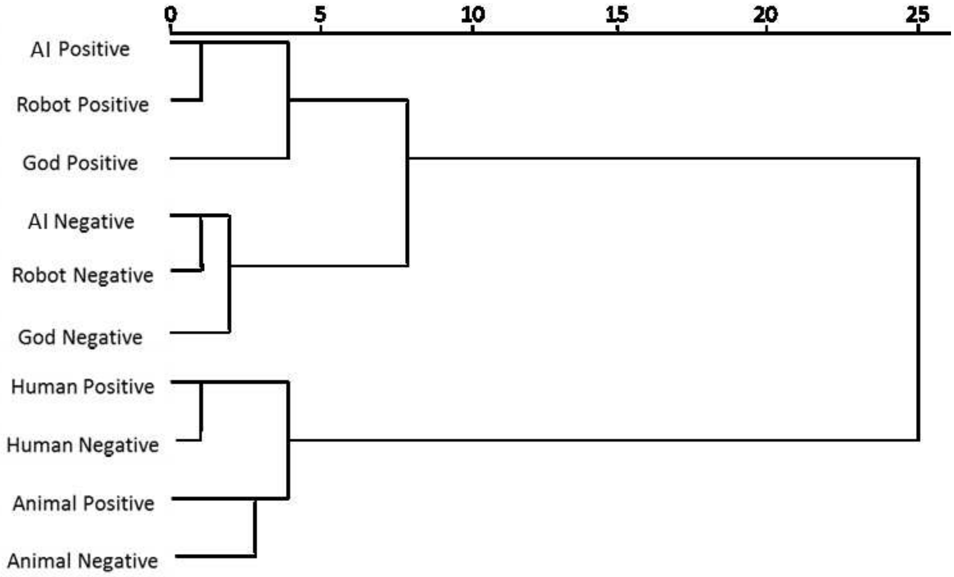

Fig. 1. Hierarchical clustering dendogram of positive and negative attitudes toward divine entities, artificial intelligences, robots, humans and animals. The height of each node is proportional to the level of dissimilarity between categories.

According to the combined rescaled distance cluster, we found that the AI and robots were considered as similar on both positive (B=.84, $t(75)$=13.94, p<.001, η^2_p=.73) and negative attitudes (B=.85, $t(75)$=12.36, p<.001, η^2_p=.68), creating a common cluster we call 'artificial entities'. This cluster was further close to the positive (B=.17, $t(75)$=2.38, p=.020, η^2_p=.07) and negative attitudes toward divine entities (B=.61, $t(75)$=7.32, p<.001, η^2_p=.43). Another cluster consisted of positive and negative attitudes toward humans ("human cluster", B=.28, $t(75)$=3.01, p=.004, η^2_p=.11), which was distinct from that of the artificial and divine entities (B=.01, $t(75)$=.09, p=.927, η^2_p<.01). Moreover, the human cluster was linked to the negative attitudes towards animals, creating a "*natural entities*" cluster (B=.312, $t(75)$=6.45, p<.001, η^2_p=0.36). Positive attitudes towards humans and animals were, however, not related (B=.103, $t(75)$=1.71, p=.091, η^2_p=0.04). This can be explained by the fact that the positive and negative attitudes towards animals were independent of each other, (B=-.017, $t(75)$=-.18, p=.858, η^2_p<0.01). In sum, this analysis demonstrates the overlap in representations of artificial entities and divine entities, with humans and animals represented dissimilarly from this cluster.

2.2.2 Technological readiness. We conducted a regression analysis including these four dimensions of technological readiness as predictors of positive and negative attitudes towards each entity.

2.2.2.1 Innovativeness*.* Interestingly, we found that disappointment/anger attitudes were predicted by the increased support for innovation of participants. Higher interest in technology was related to more negative attitudes towards AI (*B*=.52, *t*(75)=2.20, *p*=.031, η^2_p=.06), robots (*B*=.504, t(75)=2.28, *p*=.026, η^2_p=0.07), and divine entities alike (*B*=.59, *t*(75)=2.58, *p*=.012, η^2_p=.09). This result was also significant for the artificial entities cluster combining AI and robots (*B*=.513, t(75)=2.31, *p*=.024, η^2_p=0.07). We conducted a post-hoc analysis to investigate whether our participants were polarized in term of interest for technology. A one simple T-test comparing the average score of participants to the theoretical mean of the scale, showed that participants' score was significantly lower than the theoretical mean (t(75)=-4.69, p<.001, 95%CI [-.73, -.30]).

2.2.2.2 Optimism, Insecurity and Discomfort. These two subscales did not significantly predict positive or negative attitudes towards any entity (all p_s > .05).

2.2.2.3 Participants expertise. Results showed that all participants were set in the lower quintile of the scale. They were all laymen on this topic.

2.3 Discussion

Study 1 showed that the concepts of robots and AI were related to that of the divine entities in terms of the positive and negative traits people attribute to them. Moreover, this cluster seems to be independent of another cluster including *natural entities,* such as humans and animals. This result is in line with the trend to explicitly discriminate supernatural minds from human minds (Heiphetz, Lane, Waytz & Young, 2016). Thus, according to clustering, the representation of AI and robots, that is *artificial entities* and similar to *divine entities*, differs from the representation of *natural entities*. These results echo Durkheim's proposal with a natural and non-natural cluster, or a profane and sacred cluster respectively (Durkheim, 1912). However, the measure we utilised in the present study is quite specific in terms of the range of attitudes assessed and may not be sufficient evidence to demonstrate that the representations of artificial and divine entities are linked. The second study aims to answer this issue.

We also found a negative link between attitude toward innovation and attitudes toward *artificial* and *divine entities* cluster. While our participants seems lacked interested in technology, it seems that this factor may energize a modulation on *artificial* and *divine entities* perception. Indeed, Epley and colleagues (Epley et al., 2007) posit that the knowledge about non-human entities reduces the uncertainty about their true nature and thus, the attribution of unrelated characteristics (Eyssel & Kuchenbrandt, 2011) which suppose an accessibility to the “sacred” nature of artificial agents . Interestingly, in our results the more participants showed a high level of interest toward technology, the more he/she seemed believe in the negative power of AI and robots. This effect could be explain by the relative level of knowledge compare to a specific knowledge about these entities. Indeed, knowing a little can be worse than knowing nothing at all. On these topics, lay people reading non-scientific paper press or watching news could be misguided about the actual state of artificial agents’ performances. For instance, the cultural representation of “artificial intelligence” tend to be assimilated to “artificial cleverness” which is, in fine, overused. Thus, to know a little could be worst than knowing nothing at all because, in this context, the popularization on this topic is often too alarmist granting artificial agents with excessive skills and abilities, often under the prism of danger to humans. In 2016, Müller and Bostrom conducted a study about the potential future of AI with the opinion of experts (Müller & Bostrom, 2016). Their results showed a positive bias regarding the overall impact on humanity in experts’ opinions. Therefore, further research should investigate the distance modulation between- and within-clusters according to the level of knowledge and specific interest or expertise about artificial agents. We could assume than expert should be less willing to attribute high levels of powers to artificial agents because of their knowledge about their internal functioning granting them with a feeling of control (Haggard, 2017; Pacherie, 2015).

3. Study 2

Having established an association between mental representations of artificial entities and divine concepts, it is still not clear whether this link is superficial and dependable on the specific criteria that were set out (e.g., judging AI and robots on a specific scale) or whether it is grounded in a stable implicit cognitive association. If a semantic association between the two exists, it would demonstrate that artificial entities and divine entities rely on the same associations and semantic network, beyond an explicit simplistic overlap in their representations. In order to investigate whether there is an implicit cognitive overlap between divine and artificial entities, we designed a lexical decision task using divine and non-divine semantically related words in a masked prime paradigm. Masked prime paradigm allows activation of semantic categories by encouraging processing of the meaning of the word more deeply because of the degradation of the stimuli (Akhtar & Gasser, 2007; Madden, 1988). When a priming stimulus and a target word are semantically related, participants are faster in making a decision regarding the target word than when both stimuli are unrelated (Akhtar & Gasser, 2007; Balota, Yap, & Cortese, 2006; Bentin, McCarthy, & Wood, 1985; Collins & Loftus, 1975; Dehaene et al., 1998; Fazio, Jackson, Dunton, & Williams, 1995; Neely, 1977; Rugg, 1985).

Given the evidence regarding the relationship between artificial and divine entities in Study 1, we hypothesised that people would perform better in recognising words from the divine semantic category following the congruent activation of the divine and artificial entities categories. Lower response times would be expected when identifying divine-related words as real words compared to neutral words when participants are primed by the artificial entity and divine entity categories as a result of semantic congruence (see Cree, McRae, & McNorgan, 1999; Greenwald, McGhee, & Schwartz, 1998; Lucas, 2000; Thompson-Schill, Kurtz, & Gabrieli, 1998). This difference should not occur for the control primes involving natural entity and the neutral word categories.

3.2 Method

Participants were 27 women and 22 men (M_{age} = 23, SD = 10) from France who were right-handed and with normal or corrected vision. They participated voluntarily. In a lexical decision task, participants were asked to judge whether the target stimuli was a real word or not using 'Yes' or 'No' keys on the keyboard. All stimuli were presented in French using Arial font size 18. There were 12 words related to religious concepts (e.g., 'sanctuary') and 12 neutral words (e.g., 'silhouette'), which were chosen by the researchers. Specifically, religious and neutral words were chosen carefully to control for word frequency according to the number of occurrence in films subtitles (Brysbaert, Lange, & Van Wijnendaele, 2000), number of letters, and number of syllables (New, Pallier, Ferrand, & Matos, 2001). We also conducted a pretest with 20 participants to ensure the religious semantic activation of religious words[4]. Participants also saw 24 non-words (e.g., 'curtesins'). The non-words were created to also match the criteria above. One of the four primes was presented, including divine, artificial, and natural entities, as well as 'principal resume' as the control prime, before each target word. Thus, each participant responded to 192 experimental trials in total. Each prime was presented for each target word. The list of words presented and their characteristics are available via Open Science Framework: https://osf.io/uzpjn/

The experiment commenced, with a trial block consisting of two neutral words and two neutral non-words. Each trial followed the same procedure with a fixation cross displayed for 200 ms, followed by a mask composed of 20 "#" signs which was displayed for 500ms. At last, the prime was presented for 250 ms. The mask reappeared for 500 ms after which followed the target word, displayed for 3000 ms or until the response. A blank screen was displayed for 100 ms to end the trial (see Figure 2). The experiment was programmed using E-prime 2.

[4] In the pretest, participants had to rate whether words (neutral and religious) displayed in a random order were referring to the concept of religion on a scale going from 1 "not at all" to 7 "totally". Results showed a significant semantic association difference to religion difference between neutral and religious words ($F(1,19)=11679,25$, $p<.001$, $\eta^2_p=.99$).

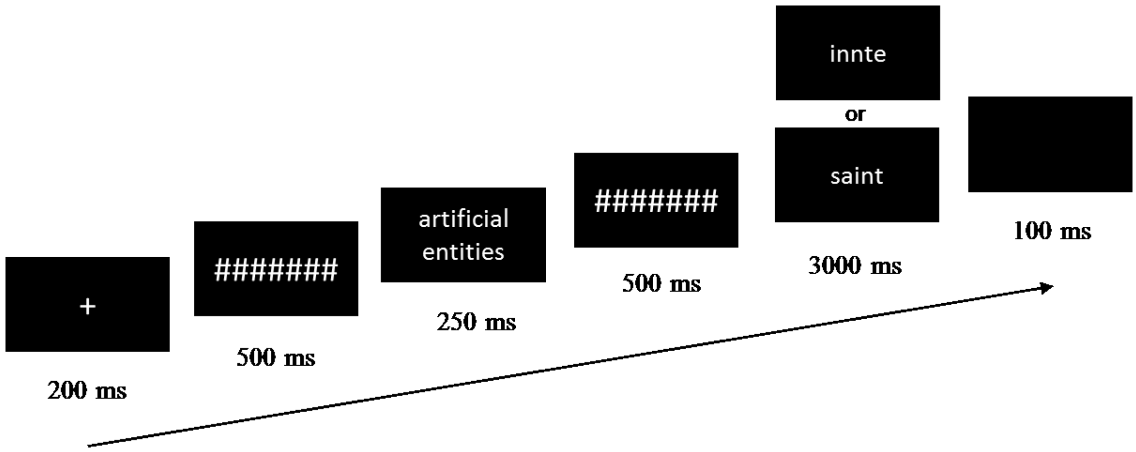

Fig.2. The running order of a trial.

3.3 Results

One participant was excluded from the analysis because of an error rate (i.e., the frequency of errors) superior to 30%. Errors occurred in 7.25% of the trials (633 trials out of 8736) and were analysed independently (all p_s >.05). Correct trials with a reaction time (RT) of over three standard deviations in any of the experimental conditions were considered outliers and were excluded from the main analyses (.09% of the trials).

Divine semantic bias. A 2 (Target Word: divine, neutral) x 4 (Prime: divine, artificial, natural, control) repeated measures ANOVA was conducted to investigate whether participants' RT to respond to the religious target word was significantly faster after divine and artificial primes compared to natural and control ones (Table 1 for descriptive statistics). There was a significant Target Word x Prime interaction on RT, $F(3, 46) = 5.12$, $p = .044$, $\eta^2_p = .16$. Preceded by divine entity prime, divine target words were identified as words faster than neutral words, $F(1, 48) = 9.32$, $p = .004$, $\eta^2_p = .19$. This pattern also occurred for artificial entity prime, $F(1, 48) = 11.36$, $p = .001$, $\eta^2_p = .19$, but not when the target divine and neutral words were preceded by the natural entity prime, $F(1, 48) = .57$, $p = .455$, $\eta^2_p = .01$, or the control prime, $F(1, 48) = .03$, $p = .872$, $\eta^2_p < .01$.

Table 1

Mean correct response times (in milliseconds) and standard errors (in parentheses) as a function of the Type of stimuli and the Prime type.

Primes	Targets	RT Mean	RT SE	RT differences between targets
Divine entities	neutral words	662	(20.8)	$p = .004$ $\eta^2 p = .16$
	divine words	603	(29.0)	
Artificial entities	neutral words	652	(19.4)	$p = .001$ $\eta^2 p = .19$
	divine words	593	(29.2)	
Natural entities	neutral words	653	(18.7)	$p = .455$ $\eta^2 p = .01$
	divine words	645	(20.0)	
Control	neutral words	662	(18.5)	$p = .872$ $\eta^2 p < .01$
	divine words	660	(20.0)	

We conducted a second repeated measure analysis on the RT differences between divine words and neutral words with a difference score computed from RT divine words minus RT neutral words (see Figure 3). Lower score indicated quicker identification of divine words following the prime. There were three planned contrasts corresponding to our hypotheses comparing 1) artificial and divine entity primes, 2) natural entity to control primes, and 3) artificial/divine entities primes average to natural entity/control primes average (see Figure 3 for distribution of scores). Results showed no significant differences in identifying neutral versus divine target words between Artificial entity and Divine entity prime conditions ($t(48) = .01$, $p=.995$, $\eta^2_p < .01$; Contrast 1) as well as between Natural entity and Control prime conditions ($t(48) = -.36$, $p=.718$, $\eta^2_p < .01$; Contrast 2). However, we found that participants identified divine target words significantly faster than the neutral target words following the combined average of artificial and divine entity primes compared to the combined average of natural entity and control condition primes ($t(48) = -2.96$, $p=.005$, $\eta^2_p = .04$), lending support for our hypothesis that divine and artificial entities are semantically related.

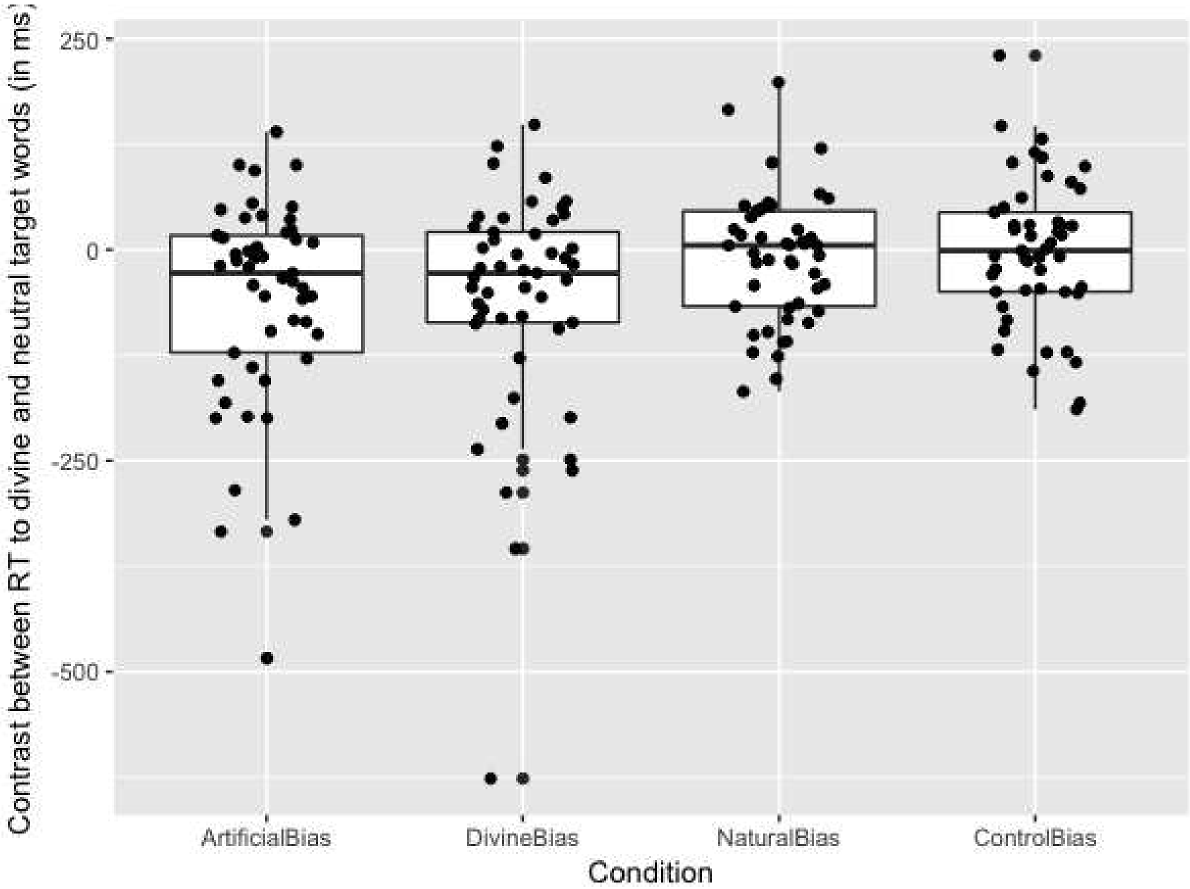

Fig. 3. Distribution of differences in RTs between divine and neutral target words according to the four prime categories. A lower score indicates quicker identification of divine target word in comparison to the neutral word. *Note:* The box represents the lower and upper quartile and the horizontal line denotes median.

3.4 Discussion

The second study aimed to investigate whether the similar representation of artificial entities (i.e., AI, robots) and divine entities (i.e., gods) was based on a semantic association between the two categories. Results showed that both artificial and divine entities are indeed related to the semantic divine category, while this was not the case for natural entities (i.e., humans, animals). Our results demonstrate a semantic proximity between artificial and divine entities. This supports the idea that abstract nature of these artificial entities encourages individuals to refer to conceptual constructs of other abstract entities, such as divine entities, as an inference to create a representation of AI and robots. This conceptual “borrowing” could be promoted by the similar presentation of fear and allure for AI and robots in pop-culture.

4. General discussion

Across two studies, we have demonstrated that there are significant overlaps in people’s representations of artificial entities, such as robots and AI, and those of divine entities. Study 1 showed that people hold similar attitudes to robots and AI. These attitudes were considerably similar to those held towards divine entities such as Gods, but there were no similarities with humans or animals. Study 2 further demonstrated that this explicit link is also present at a more implicit level. We showed that semantic activation of categories relating to divinity as well as artificial entities increased recognition of semantic related divine words compare to neutral words, highlighting that these categories are semantically related. Our studies provide new evidence that people perceive artificial entities in ways to how they reason about divine entities, as both of these entities are semantically related. According to both study 1 and study 2 results, artificial entities are not defined as new form of divine entities but rather as sharing a common semantic representation with divine entities. As proposed by Durkheim the distinction between the sacred and the profane is often independent of the idea of divine entities (Durkheim, 1912). As with the concept of “God”, the concepts of robots and AI could have been introduced into the category of sacred concepts as. This approach is interesting regarding the social nature of the representation of the sacred. What is defined as “sacred” arise from collective state, shared emotions, feelings or interests and, contrary to the profane, do not arise from sensorimotor experience. Actually, robots and AI are uncommon for most people. As we said their representation arise from a shared culture rather than own experience which echoes the view of the sacred as an intrinsic social concept.

By investigating representations of AI and robots in people’s minds, our research contributes to the growing literature on human-robot interactions and especially the perception of artificial agents (Ray, Mondada, & Siegwart, 2008). It is advancing knowledge on the type of impressions that an average individual can create about artificial entities, which have a growing influence in our societies. Our studies support the notion that, being a relatively new addition to everyday life, people use the impressions of other entities when they make sense of these new artificial entities. This is in line with the theoretical frameworks arguing that humans are natural meaning makers (Janoff-Bulan, 2010), seeking to avoid uncertainty (Rosen & Donley, 2006).

Given the complexity of the artificial entities technological capacities topic, science-fiction productions could be a tool to slowly introduce the representation and structuring of such concepts. When building a representation of a non-human entity, we make use of all the information that we possess to build a more complete, coherent, and stable representation - especially when we manipulate abstract concepts, such as divine entities or AI. This perception of power above human power seems shared with artificial entities as agents with unknown limits, especially when we talk about the all-knowing AI. Interestingly, in study 1 we found a relationship between the tendency to be a technology pioneer and a negative attitude toward AI and robots but not divine entities. This result could mean that people who are more interested in technology could also be more inclined to imagine the potential threatening effects of AI and robots. The effect would probably occur only until a certain level of knowledge about these technologies is reached. In other words, looking at artificial intelligence without fully understanding it would be more anxiety-provoking than not being interested in it. This hypothesis supports the idea that the definition of AI and robots concepts is mainly driven, for laymen, by the society itself that imposes its fears because of the disruptive nature of these technologies. Since the potentialities and the understanding of these potentialities seem out of reach or understanding, a tension is created in the face of fear of loss of control granting AA with excessive power.

Another possibility comes from the “like me” hypothesis (Costa, Abal, López-López, & Muinelo-Romay, 2014). According to this view, psychology is constructed on the apprehension that others are similar to the self. Interpersonal relations rely on the basic perception: “Here is something like me…” With regards to human development, it is a prime tool for categorization. This process is involved in our learning process - especially through imitation - to distinguish between targets as potential models and to understand their underlying intentions (Meltzoff, 2007). Based on this proposal, we could hypothesize that the explicit (i.e., cluster distance) and implicit (i.e., semantic distance) conceptual overlap between artificial and divine entities would not be a specific link between them but a “not like me” (i.e., not human) classification. Regarding the first study, participants could have taken the evaluation of humans as the central point and created a cluster according to the proximity between this central point and other entities (i.e., divine entities, artificial entities, robots, and animals). The result would have been the perception of artificial and divine entities as more distant because they were not “natural” (according to the Study 1 dendogram, animals remained closer to humans than any other entities). In sum, the process could involve two parameters. First, every entity considered as not “like me” and reaching a certain conceptual distance threshold with the observer could be judge as similar to other entities sharing the same state. Second, the attribution of fear and allure characteristics would not be a specific divine perception but an expectation of positive and negative outcomes of the presence of these entities when lacking in information about such agents. Further research will be needed to investigate this proposition.

There are important implications for this research. Our results argue that Artificial Agents should be considered as a social and sociological phenomenon (Woolgar, 1985). Several issues emerge regarding the resilient adaptability of social systems in this technological change. These AA will probably contribute to major transformations when it comes to the ways we live, think and communicate. Thus, question such as “what exactly is AI as a social phenomenon?” will have to be answered (Mlynář, Alavi, Verma, & Cantoni, 2018). Furthermore, technological entities such as robots and AI are irreversibly continuing to develop and it is in the common best interest that their functions and aims remain aligned with those of humans. If artificial entities are perceived as similar to gods in terms of their potential power, this can manifest itself in two different ways according to previous research: as punitive or as benevolent (Johnson, Li, Cohen, & Okun, 2013). There is a danger that if artificial entities are perceived as punitive, this can be a source of threat to people and even encourage non-moral behaviours towards robots and AI. Thus, it is in the manufacturers’ best interest to push for producing technology that is benevolent and non-threatening. At the same time, policy makers need to debate the legal status of technological entities as their advancement continues (Spatola & Urbanska, 2018).

The mechanisms and explanations behind the semantic connection between artificial and divine entities still need to be addressed. In line with previous research (Epley et al., 2007; Waytz, Cacioppo, et al., 2010), we could assume that the development of knowledge about these artificial agents could reduce this divine perspective of AI and robots. Indeed, it would not be necessary to rely on other representation while we possess already stable and reliable representation. Thus, accessibility of agent representations should influence the type of attributions made and the tendency to perceive them as more or less powerful or as entities with a will (Medin & Atran, 2004). As a consequence, for experts, the overlap between divine and artificial entities should not occur.

Second, cultural understanding of religion could highly influence the perception of AI and robots especially regarding the positive or negative attitude that may arise from human-robot interactions (Bartneck et al., 2007). For example, religious culture might have had an influence on the development of robot culture in countries like Japan (MacDorman, Vasudevan, & Ho, 2009; T. Nomura, Kanda, Suzuki, & Kato, 2005; Robertson, 2007). While Western culture has been influenced more by Christian teachings in which there is no specific spiritual consideration of objects, the same does not hold true for other countries where Buddhist and Confucian teachings are traditionally dominant. In these belief systems, spirits may live in objects, and thus, divine figures can be more easily associated with embodied structures or technological entities in general. Interestingly, while Western cultures do not have this representation of divine structures in objects, we nonetheless found a semantic overlap between the two structures in our two experiments with Western participants. Thus, we could hypothesise that, intrinsically, artificial intelligences and robots are not considered simple objects, even for Christianity-influenced cultures. In addition, we could assume that the divine overlap for AI and robots should be strengthened in Japanese culture because of the initial tendency to see objects as potential spirit vessels. It would be interesting to investigate these differences across cultures considering that while robots may be present worldwide, their consideration may deeply change from one culture to another. As a consequence, acceptance of them may also vary across cultures.

There were several limitations to our research. Firstly, the scale measuring attitudes towards entities was designed to measure attitudes towards gods specifically, and thus the range of attitudes that we measured were limited. It is possible that more links between robots, AI and other entities exist, but that these were not detected by our current measure. Therefore, we cannot rule out that artificial entities may be explicitly represented similarly in other ways. Secondly, while demonstrating the overlap between artificial and divine entities and hypothesising that these could be due to ambiguous feelings of both a positive and possibly threatening nature, we did not explicitly test whether these mechanisms could be account for in the present research. Thirdly, our sample was principally female and several studies demonstrated a gender effect on attitudes toward robots (Echterhoff, Bohner, & Siebler, 2006; Eyssel, Kuchenbrandt, Hegel, & De Ruiter, 2012; Tatsuya Nomura, Kanda, & Suzuki, 2006). For instance, individuals experienced more psychological closeness to a same-sex robot than toward a robot of the opposite sex and most people report a preference for human avatars that matched their gender (Nowak & Rauh, 2005). This gender effect could affect the representation of AA and thus the semantic network associated. Thus, it could be interesting to control this factor in a subsequent study investigating the implicit representation of AA. Finally, our samples included mainly young people who would have more exposure to technology. This would mean that their representations of artificial entities could well differ to those of other generations who are not as familiar with technologies. Using samples that are more representative would be informative in delineating whether the representations of divine and artificial entities overlap universally. However, according to Epley and colleagues, higher exposure to technology should result in higher knowledge about this technology and thus less belief in AA superpower (Epley et al., 2007). Therefore we can formulate two hypotheses: either the relation between the level of knowledge about AA and attitudes follow a Log-Normal distribution or a Benktander type II distribution. Further research including people presenting all the spectrum of knowledge should have to emphasize this issue.

Conclusion

Regardless of whether anthropomorphism or deism is the underlying attribution process, the way we accept and act with AI and robots will depend greatly on the representations we develop.

It is interesting to see that in our ever faster developing technological society, these representations can be guided by information from fiction and positive or negative expectations, even if AI and robots become more and more present in our everyday life. This supports the idea of working to support the pedagogy of this AI and robots revolution in order to ensure a more positive adaptation between human and artificial entities.

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