Exploring Algorithm Aversion Through Construal Level Theory

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EXPLORING ALGORITHM AVERSION THROUGH CONSTRUAL LEVEL THEORY

Research in Progress

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Abstract

Despite algorithms’ ability to provide decision-makers with superior recommendations to their human counterparts, the reluctance to use algorithms – known as algorithm aversion – continues to emerge in research investigating algorithmic decision-making. This research in progress study investigates the role of construal levels and psychological distance in influencing the willingness to use algorithms in decision-making contexts. In examining algorithm aversion, we look to draw upon Construal Level Theory (CLT), a social psychology theory that describes how an individual’s psychological distance to a subject affects how they process information surrounding it. We will collect data through an online experiment that evaluates participant’s construal perceptions of ‘algorithmic versus human’ advisers in ‘visual versus verbal’ tasks before comparing their decisions to hire either a human or algorithmic agent. The study aims to expand upon the current understanding of IS research algorithms and clarify the causal factors that contribute to algorithm aversion.

Keywords: Algorithms, Algorithm Aversion, Construal Level Theory, Psychological Distance, Behaviour and Cognitive Processing, Quantitative Research

1 Introduction

Algorithms, which we broadly define as any evidence-based forecast formula or rule (Dietvorst et al. 2015), are essential information systems (IS), determining how programs read, collect, process, and analyse data in generating output for decision-making tasks. The increased sophistication of contemporary algorithms has led to advancements in artificial intelligence (AI) software, such as chatbots and digital assistants, which provide tailored information to users. Yet, empirical studies show that people avoid algorithmic advice, a phenomenon known as algorithm aversion, despite algorithms’ ability to outperform human equivalents in decision-making contexts (Dietvorst et al. 2015).

As technology continues to develop, several hypotheses on the future utilisation of algorithms have been put forward. For example, AI job replacement theory (Huang and Rust 2018) proposes that algorithmic alternatives will replace humans for tasks requiring analytical skills such as logical thinking or decision-making. An extensive body of research supports that even basic algorithms offer notable performance improvements compared to human equivalents (Dawes et al. 1989; Grove et al. 2000; Castello et al. 2019; Yeomans et al. 2019). Despite these benefits, research demonstrates a reluctance by users to select an algorithmic adviser over a human one. Studies in this area offer several explanations for why this may occur. However, there remains a lack of research that examines this phenomenon from a ‘construal’ perspective.

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Construal Level Theory (CLT) is a social psychology theory that describes how individuals' psychological distance to a subject affects how they process information surrounding it. CLT proposes that subjects who are psychologically distant from an individual will be thought of at higher-level mental construals, which are generally more abstract, whereas closer subjects are processed with lower-level mental construals, which are more concrete (Trope et al. 2007). Decision-making is an activity that is inherently tied to how individuals evaluate different alternatives and associated outcomes (Edwards 1954). Thus CLT, which examines how social factors affect information processing, may offer a valuable perspective to explain why individuals consistently avoid algorithmic advice sources.

This research supports the broader socio-technical phenomenon shaping the future of organisational structures in examining human behaviours (social) and algorithms and varied task types (technical). Many decisions in modern society, such as supply chain purchasing decisions, trading, medical data analysis, and different products' recommendation, require accurate forecasts. As a result, selecting forecasting or decision-making agents that do not provide the best outcome risks financial and reputational damage. The findings from this study aim to improve the understanding of why people avoid algorithmic advice and allow organisations to implement them effectively.

This study also seeks to clarify a potential contradiction inadvertently raised in the construal examination of algorithms by Kim and Duhachek (2020). Their study found that algorithms were considered low construal and were subsequently trusted more when the advice they offered was similarly low construal. Therefore, the relationship between construal level and psychological distance would suggest that algorithms and their advice would also be preferred when they were psychologically proximal (Trope et al. 2007). However, this idea is contrasted by Logg et al. (2019) who’s study demonstrated that farther social and hypothetical distances increased an individual’s willingness to use algorithmic advice, suggesting that algorithms are viewed as psychologically distal rather than proximal.

Building on existing research on the effect of construal incongruence on message effectiveness (Berson et al. 2015; Peng et al. 2020), we hypothesise that there may be a "perception paradox" between the perceived construal level and psychological distance of algorithms that hinders the adoption of algorithmic advice. Our study will test this theory by evaluating participants’ construal and psychological distance perceptions of algorithmic versus human advisers across visual and verbal tasks and require them to select which agent they would prefer for a matching hypothetical job scenario. The paper is structured as follows. First, we provide an overview of CLT and its relation to psychological distance and behaviour and cognitive processing. Next, we highlight algorithm aversion issues before discussing the effects of construal levels on algorithm aversion. We then present the research design, providing details of our intended study, including the data collection and analysis process. The paper concludes by discussing future work and potential implications.

2 Background

2.1 Construal Level Theory (CLT)

CLT builds upon Action-Identification Theory (Vallacher and Wegner 1987) and asserts that tasks and objects are represented at different mental construal levels corresponding to the relative distance to the subject. CLT suggests that construal levels increase with distance, such that targets further away are represented with higher construals while closer targets are represented with lower construals (Trope and Liberman 2010). High construals are abstract, decontextualised, and schematic. They typically denote broader subsets of the object while retaining the core aspects, as these attributes are more consistent and less likely to change with distance while disregarding or omitting peripheral details for the same reasons (Liberman and Trope 2008). For example, shifting the representation from a "cell phone" to a "communication device" would indicate a move to a higher construal level as it omits incidental information relating to size and only retains information relating to its core attributes (facilitating communication). Similarly, representing the activity "playing ball" as "exercising" omits the ball's peripheral details. In contrast, low construals are more concrete and include the additional rich details of the immediate situations. The details isolate the subject in the specific and denote a much smaller
category of subjects when compared to a high construal representation. In these examples, a shift in the opposite direction (i.e., representing a "communication device" as a "cell phone") would reflect a shift to a lower-level construal.

2.1.1 Psychological Distance

CLT posits that a subject's mental construal representation is tied to the distance between themselves and the object or task. These distances span across several dimensions and are collectively identified as a "psychological distance" as they represent the cognitive separation between oneself and others (Liberman and Trope 2008). Subsequent studies expanded the focus beyond temporal dimensions to include the physical distance between two points (Fujita et al. 2006), the likelihood of an event occurring (Wakslak et al. 2006) and the perceived degree of interpersonal similarity between two parties (Liviatan et al. 2008). These dimensions are termed spatial, hypothetical, and social distances, respectively.

The direct relationship between psychological distance and construal levels can be explained by the differences in information retention between near and far subjects. As an object becomes more distal, peripheral or incidental features of a target are more likely to change or become less certain compared to others (Trope and Liberman 2010). According to CLT, high construals are representative of the core attributes of the subject, which are more likely to remain constant as distance increases. Liberman and Trope (2008) use the following example related to communication to illustrate this relationship: "The higher-level goal to contact a friend is more stable over time than the more concrete goal to send her an email, because an Internet connection might be unavailable when one is actually trying to contact the friend". Thus, people may naturally be more inclined to use increasingly higher construals to represent distal objects to maintain accuracy in its representation while using lower construals to represent more proximal subjects to capture the additional available information.

2.1.2 Behaviour and Cognitive Processing

Both the construal level and psychological distance affect how individuals process and evaluate information by shifting the relative importance of the subject's attributes. These influences have broader implications for various human behaviours and tasks that require cognitive processing (Trope et al. 2007). To date, studies have explored how divergent construal levels lead to differences in an individual’s perceptions (see Trope et al. 2007). Construal levels are emblematic of the different cognitive representations that people form when considering an object or event. Thus, manipulating an individual's construal orientation (e.g., priming them to process information at higher or lower levels of construal) may impact how they perceive the same subject.

This is evident in an individual's ability to identify patterns in information, specifically recognising broader or narrower patterns when presented with stimuli containing both. Broadly speaking, people primed with higher construal levels are more likely to see the bigger picture (global patterns), i.e., the forest, whereas people primed with lower construals will more readily recognise the details (local patterns), i.e., the trees (Yan et al. 2016). These two processing approaches have been linked to cognitive mechanisms that consider the "how" and "why" of a task (Forster 2012) and suggest that when considering the reason or motivations behind an outcome (i.e., the "why"), individuals are orientated toward global processing and higher construals, whereas considering the steps or process required to reach an outcome (i.e., the “how”) results in local processing and lower construals.

Construal levels have also been linked to differences in visual versus verbal processing. Both images and words have construal associations that are intrinsically tied to their mode of representing meaning. Images are a fundamentally lower-level construal representation of an object or event as they bear physical similarities and represent an instantiation of the subject (Amit et al. 2009). As such, by their nature, images do not depict conceptual or superordinate subjects. Words, in contrast, do not bear any physical resemblance to the subject and instead represent a more abstract definition for the subject. The wider scope, generalisation and contextual nature of words result in representations of broader objects than images (Rim et al. 2015).
The effects of these differences in representation have been demonstrated in studies that manipulated information presentation through either visual or verbal formats (see Rim et al. 2015). In line with CLT, groups that were shown pictures, which evoked lower construals, used more categories on average than those that had the items represented with words. These findings are supported by additional studies that explore visual versus semantic processing (e.g., Wyer Jr et al. 2008; Yan et al. 2016). According to CLT, individuals also weigh information differently depending on the subject’s perceived construal level or psychological distance. These differences inevitably affect evaluation behaviour, as the criteria considered important or relevant to the decision shifts with their mental construal (Liberman et al. 2002). Studies have also linked the impact of construal levels on advice-taking behaviour. For instance, in examining the use of abstract language in conversation and interaction between advice-givers (advisers) and advice-seekers, researchers found that advisers that utilised higher construal and more abstract language were perceived as having greater levels of expertise and considered to be more focused, knowledgeable, and instilled greater confidence (see Reyt et al. 2016; Wiesenberg et al. 2017). These higher confidence levels correlated with greater adoption of the recommendations.

Although this current study primarily focuses on CLT as psychological mechanisms that drive the individual differences in the usage of algorithms, it is by no means an exclusive nor exhaustive list, and we acknowledge that other factors (e.g., perceived competence of the agent or credibility of statements, understandability, satisfaction of listening to an agent) may also play a decisive role.

2.2 Algorithm Aversion

Despite their superior accuracy and performance compared to humans, much empirical evidence has demonstrated a general resistance towards algorithms and algorithmic advice sources. Several studies have explored this phenomenon, termed “algorithm aversion” by Dietvorst et al. (2015), seeking to understand why. Dietvorst noted that a large proponent of algorithm aversion was rooted in a disproportionate intolerance for algorithmic error, resulting in a greater chance of abandoning an algorithmic adviser after seeing it perform (and subsequently err) compared to human advisers. Burton et al. (2020) identified that false perceptions of task-suitability as a contributing factor, as preconceived notions and biases of the tasks that algorithms are and are not suitable for can directly influence their willingness to utilise them. In their examination of algorithmic utilisation in objective versus subjective domains, Castelo et al. (2019) reaffirmed the idea that algorithms were viewed as more appropriate for objective tasks compared to subjective tasks. They also suggested that the lack of algorithmic trust in subjective domains may stem from a perception that algorithms are incapable of “human nature shared abilities” (such as intuition), which are affective or emotional (Haslam et al. 2008). Dietvorst and Bharti (2019) similarly demonstrated that this was partly due to the perceived lack of suitability to irreducibly uncertain domains. Efendić et al. (2020) further expanded on this in their study of response times' effect. Participants believed that forecasting and other complex tasks were easier for algorithms than for people and thus only correlated slower response times for algorithms with increased effort and not better outcomes.

Research in this area has also cited a lack of understanding of how algorithms function and make decisions to cause algorithm aversion. A common factor that drives resistance towards the adoption of self-driving cars arises from user’s uncertainty regarding how they process information, particularly when dealing with potential ethical dilemmas (Shariff et al. 2017). Yeomans et al. (2019) replicated these findings in a decision-making context through an empirical study comparing algorithmic and human recommendations' responses in both subjective and objective tasks. In addition to showing that people remained reluctant to use algorithms even when it would improve their performance, the results from their experiments indicated that people preferred to receive advice from a human adviser, even when the information was the same or the source was an algorithm. Analysis of follow-up questions with participants identified that this was because people believed recommendations to be more understandable when they came from a human. After all, they had a frame of reference with which they could rationalise the decision-making process. This observation is supported by a recent study conducted by Kim and Duhachek (2020), who noted that people were more likely to view algorithms as low
construal because of their perceived lack of autonomous goals and intentions. Consequently, participants directed their attention towards how the algorithms implemented their actions rather than why they did so. Furthermore, in line with CLT, participants were less receptive to algorithmic-advice messaging framed at high construal.

Thus, based on a review of the above literature, our study aims to answer the following research question: “Does task type influence the perceptions of construal level and psychological distance for algorithms, and does these influences impact the decision to utilise them?”

3 Hypothesis Development

The intersection of the above two areas of research, construal levels and algorithm aversion, offers an interesting opportunity to provide insight into algorithm aversion's contributing factors. Studies that examine CLT in decision-making contexts have demonstrated that congruence between the advice and its source influences the receptiveness towards information by reducing the cognitive processing required (Wakslak 2012). Subjects that shared synonymous traits result in a more aligned mental “fit”, making information easier to process and more receptive. Conversely, incongruent subjects were interpreted as more cognitively complex and face greater resistance towards their adoption.

Although Kim and Duhachek (2020) showed that algorithmic agents were perceived as low construal due to their perceived inability to learn and lack of superordinate goals (and were subsequently less utilised when paired with high construal advice), anecdotal evidence suggests algorithms may not be uniformly distant across all dimensions. From a social distance perspective, algorithms would generally be considered inherently different from people due to their lack of perceived interpersonal features and characteristics and are more likely to be considered socially distant when compared to other individuals, regardless of their characteristics. Similarly, from a spatial distance perspective, the lack of a physical presence and general awareness around the concepts of cloud computing would suggest that algorithms are also perceived as being physically distant. Therefore, although individuals perceive them as only being capable or effective in low construal activities, they may also simultaneously be viewed as psychologically distant, contradicting the traditional relationships predicted by construal level theory and forming a perception dissonance. Thus, we hypothesise that:

H1: Algorithms are perceived at lower construals levels than humans.

H2: A lower construal level results in AI being perceived at father psychological distances compared to humans.

We believe that this dissonance may contribute towards the dismissal of algorithmic advice by forming an incongruent conceptualisation of algorithms. In line with other incongruent subjects, this perception of algorithms and their advice would increase the associated cognitive complexity, reducing the individual's willingness to utilise them. Furthermore, even if aligning algorithmic advice messaging with lower construals is more effective (Kim and Duhachek 2020), the advice's effectiveness may still be mitigated by the dissonance between psychological distance and construal level evaluations of the algorithm. As this incongruence would only have an effect if both construal level and psychological distance are important, we instead turn our attention to psychological distance and hypothesise that:

H3: Relative psychological distances influence preferences between human and AI for undertaking tasks.

Furthermore, dismissal of algorithmic advice has also been demonstrated to stem from the perception of task suitability. From a CLT perspective, this is commonly manifested in visual versus verbal processing (Amit et al. 2009), which allows for clear and objective discernment between different task types, unlike subjective versus objective or difficult versus simple measures. Tasks that require verbal processing are associated with farther psychological distances, while visual tasks are associated with closer distances. Hence, based on our above hypotheses relating to AI psychological distances, we also conclude that:

H4: The task type (verbal versus visual) moderates the relationship between psychological distance and agent preference.
These hypotheses are summarised in Figure 1.

Figure 1. The research model depicting the hypothesised relationship between agent construal level, psychological distance and task suitability.

4 Research Design

Our research objective addresses this perception dissonance by investigating the role of CLT and psychological distance in the willingness to use algorithms in decision-making contexts by testing the above four hypotheses. In doing so, we aim to identify other potential causal factors that contribute to algorithm aversion and prevent their effective utilisation within organisations. This study will adopt a quantitative research methodology similar to other studies that have examined algorithm aversion. To clarify, research surrounding CLT has various methods of measuring construal levels and psychological distance, including behavioural identification forms (BIF), multiple forms of language analysis, Navon letter (NL) tasks, Gestalt Completion Tests, Kimchi-Palmer Tests, Likert scales, distance estimation tasks and Inclusion of Others in Self scale. Both measures are generally inferred based on the outcome of several tasks. We will collect data via an online experiment where participants evaluate both human and algorithmic agents across several dimensions and consider a hypothetical scenario. This approach will allow us to evaluate participants’ construal perceptions of algorithmic versus human advisers across different task types (visual versus verbal) and determine these treatments influence perceived psychological distance and the willingness to utilise algorithmic advice.

4.1 Participants and Sample Size

The study will be conducted using Amazon's Mechanical Turk (MTurk) platform, a crowdsourcing marketplace. Participants will be openly recruited through online advertisements for a Human Intelligence Task (HIT) on the MTurk platform. Based on previous experiments in algorithm aversion and construal level theory, this study will aim for a medium effect size of 0.5, with an alpha of 0.05 and a power of 0.9. To do so will require a sample size of 70 people per treatment. Given that these studies are being run on MTurk, this study's recruitment goal will be 160 participants, with 80 people per treatment to protect against duplicate responses. This sample size will be sufficient to meet the research aims and test our hypotheses as it does not intend to generalise to a broader population but instead gain an in-depth understanding of the topic.

4.2 Study Design

The study will be a 2 (agent: AI versus human) x 2 (task type: verbal versus visual) mixed design experiment, where the agent treatment is varied within-subject while the task type treatments will be varied between subjects. Participants will be assigned to either the visual or verbal task type conditions. The procedure for both conditions will involve identical variables, but the construal level measurement
tasks will be varied to match the task type. Participants will be required to complete a series of evaluation tasks for both an AI and a human agent, with the order randomised for between participants. All participants will first complete a construal level evaluation task. In the verbal treatment, participants will be asked to complete five Behavioural Identification (BIF) tasks on behalf of each agent. For example, they may be asked, "How would a person interpret the behaviour ‘making a list’?". They would then select from two possible options that represent a high construal ("Getting organised") or low construal ("Writing things down") evaluation of the agent. Participants will instead be asked to complete five Navon Letter (NL) tasks in the visual treatment. For example, they may be shown an image of the letter "L" made of smaller "i"s and be asked: "Which letter do you think a person is more likely to identify for the above image?". These questions are designed to evaluate whether participants perceived each agent as more likely to engage in higher or lower construal processing.

After completing the construal level tasks, participants will identify how far away they thought each agent was across the four dimensions of psychological distance on a Likert scale that ranges from 1 (close) to 5 (far). Once the construal level and psychological distance evaluation tasks for both agents have been completed, participants will then be introduced to a hypothetical scenario where they will be asked to decide between hiring either a human or AI for a job related to the task type in their treatment condition. In the visual treatment, they will be asked to imagine hiring for a marketing analyst role requiring the agent to "accurately and effectively identify items and key themes across a large volume of images per week". In the verbal treatment, they will be asked to imagine hiring for an administrative assistant role that required the agent to "accurately and effectively read through a large number of emails per week in order to organise them". Participant response will be recorded on a Likert scale ranging from 1 (definitely hire the person) to 7 (definitely hiring the AI). Finally, participants will be debriefed, thanked, and paid $0.85(USD) for their successful participation.

The main dependent variables from this study were the responses to construal level and psychological distance measures, which will directly test H1 and H2 and the participants hiring decision, which will test H3. A comparison of our between-subject treatments will allow us to test H4. The data will be analysed using standard statistical approaches for comparisons across treatments (e.g., ANOVA and regression analysis).

5 Future Work and Implications

A review of the existing academic literature reveals that there are still gaps in understanding how people evaluate algorithms from a construal perspective. Mental construal can influence an individual’s decision-making by changing how they perceive and represent different subjects (Liberman and Trope 1998). For example, advisers that communicate using higher construal messaging are viewed as more confident, resulting in higher utilisation of their recommendations (Kray 2000; Reyt et al. 2016). Therefore, an individual's utilisation of algorithmic advice would depend on their perception of the algorithm. Although previous research examining the perceived construal levels of algorithms (see Kim and Duhaheke 2020) has already been conducted, the findings are incongruous compared with other research studying CLT. In examining this incongruence from both an algorithm aversion and CLT perspective, this study aims to expand upon the existing understanding of algorithms and clarify the causal factors that contribute to the socio-technical phenomenon that is algorithm aversion.

The planned research methodology has several limitations. First, the intended sample population for our study would be drawn from Amazon’s MTurk platform, meaning that many of the respondents are likely to be from the U.S. Research on the differences in psychology across cultures has explored how Western, educated, industrialised, rich and democratic (WEIRD) societies, such as the U.S., are rather psychologically abnormal (Henrich et al. 2010). As such, studies that have primarily used a WEIRD sample population may produce results that are not widely generalisable to the greater global population. Second, this study does not consider actual algorithm performance. One of the foremost explanations for algorithm aversion is the intolerance of algorithmic error, which refers to the disproportionate aversive reaction towards inaccurate predictions made by AI when compared to a similar mistake made by a human (Dietvorst et al. 2015; Yin et al. 2019). This extreme intolerance is exhibited after seeing an
AI perform. As our experiment design has participants work with algorithms in a purely hypothetical context (i.e., they are not shown an example of the AI's performance), this may position them to assess algorithms against humans within a vacuum and under the assumption that they are equal in terms of performance. This would not necessarily reflect real-world circumstances, nor would it explain why this extreme intolerance for error exists. Future studies may address this gap by examining how seeing algorithms perform and subsequently err may change psychological distance perceptions of the AI and subsequent hiring decisions.

However, this study's significance lies in enabling the potential performance advantages that algorithmic agents offer over human decision-makers. As several studies on the topic have identified, algorithms offer markedly improved performance to human decision-making and forecasting in terms of accuracy and consistency. From a practical perspective, this study's potential findings may be used to inform the presentation and user experience of applications the utilised AI. Many decisions in modern society (e.g., supply chain purchasing decisions, the analysis of medical data or the recommendation of different products) require forecasts, predictions, and evaluations to be executed effectively and are often highly competitive. Given that they offer markedly improved performance over human decision-making and forecasting in terms of accuracy and consistency, algorithmic aversive behaviours are costly to both organisations and society.

Thus, methods of reducing adoption resistance are necessary to curb the disbenefits of algorithm aversion behaviours. Factors such as perceived size and height or the abstractness of the language used and the presence or absence of colour have been demonstrated to influence evaluations of construal level and psychological distance (Aggarwal & Zhao 2015; Van Kerckhove et al. 2014; Berson et al. 2015; Reyt et al. 2016; Lee et al. 2014). Understanding how algorithms are perceived from a CLT perspective may also enable the framing of tasks as being compatible with AI's construal level or psychological distance, which may increase the receptiveness towards algorithmic advice.

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