Hacking Moral Code: Can Cognitive Stimulation Impact Moral Semantic Processing?

Hacking Moral Code: Can Cognitive Stimulation Impact Moral Semantic Processing?

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Abstract

Can targeted cognitive stimulation impact the semantic processing of moral words like “fair?” When individuals apply a word like “fair” to different situations, do they make these judgements consistently or can they be altered with the activation of different cognitive functions within the brain? Recent research has demonstrated that semantic processing, in which the brain attributes meaning to words, may be composed of numerous cognitive functions also used in other mental processes, and that processing different kinds of words and concepts requires different component functions. Perhaps this theory can be extended to the meaning of individual words; that a word’s distinct meaning may come from a unique “package” of cognitive components. Thus, if the cognitive component “package” used by an individual to process a word is somehow modified, then the individual will interpret the meaning of that word differently. The researcher hypothesized that exposing individuals to cognitive stimulation activities, such as word analogy exercises, would activate cognitive functions related to perceiving equality and – in a phenomenon known as cognitive process priming – encourage the individuals to apply the word “fair” to more options presented in a spectrum of possible distributive justice outcomes for different business ethics dilemmas. In two “pre- and post-test” design experiments, each involving roughly 120-participants, results indicate significant word analogy effect on the application of the word “fair” in business ethics dilemmas related to intellectual property and company co-founder disputes. In the first experiment, using a quasi-experimental design with no randomized question order or

control, intellectual property case responses (Dilemma 1) produced statistical scores of p=.021 and Cohen's d = -.185, while company co-founder cases (Dilemma 2) produced p=.045 and Cohen's d =-.155. In the second experiment, fully randomized in question order and with a control group, Dilemma 2 responses produced p=.040 and Cohen's d = -.323 for all six trials, and scores of p=.015 and Cohen's d = -.572 for the first three trials. Meanwhile, Dilemma 1 responses were significant, p=.040 and Cohen's d = 1.063, only in the second trial. This data suggests that the word analogies did impact the semantic processing of the word "fair," but only in the ethics dilemmas making cognitive demands similar in structure to those made in the analogy exercises, and that the effect dissipates quickly. If this phenomenon can be demonstrated for other cognitive functions and moral concepts, it could lead to new techniques in semantic measurement and computational modelling of complex social behavior, and new protocols for calibrating ethical discourse in public and professional forums. This phenomenon could also provide the foundation for a new paradigm of psychological warfare.

Dedication

This thesis is dedicated, first-and-foremost, to my parents, Milagros and Ivan Fernandez. They gave me everything. All that is good in me comes from them.

Further, this thesis is also dedicated to my sister, Jennifer Redding, and her children, Chloe and Philip Wig. As I progressed through the Harvard Extension School, all three went through far more challenging journeys as students, and burgeoning researchers, in the field of medicine. They set a very high bar for me to live up to.

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Chapter I.

Introduction

Cognitive semantics is devoted to identifying the mental building blocks that allow human beings to assign meaning to words, to precisely pinpoint which specific cognitive processes determine a word's semantics. Researchers in the field have seen many successes over the past two decades. For example, recent studies have demonstrated that basic perceptual and cognitive functions, such as sensation, selective attention (executive control), and memory (both semantic and episodic) – used by the brain in numerous other mental processes – also work in concert to enable semantic processing, the mechanism by which we interpret word meaning (Kim, 2015). However, many of these discoveries were made using experimental techniques borrowed from neuroscience, such as electroencephalography and neuroimaging. These techniques, designed primarily to capture details in brain structure and regions of neural activation, can't precisely capture the nuances in brain function that cognitive semanticists must now understand to advance their field (Osterhout et al., 2006). For researchers to identify more cognitive components involved in word meaning, and to establish whether each distinct interpretation of a word is powered by a unique "package" of such cognitive components (Chernyak & Blake, 2017), experimental methods more sensitive to brain function are needed. Such experimental precision is especially important for studying richly complex social words, such as those related to morality.

To that end, this thesis proposes, and will test, a semantic technique utilizing targeted cognitive activation, and process priming. More specifically, the technique will expose participants to cognitive stimulation therapy (CST) exercises, which are designed to strengthen specific mental skills, to activate one cognitive function, and then measure whether this primed function prompts the participant to use a particular word in more, or fewer, situations. The test case for this technique will involve the moral word "fair," and word analogy exercises. The aim of this study will be to explore whether administering word analogies – exercises that activate cognitive functions related to perceiving abstract, common relations between disparate things – will impact the frequency by which the participant later applies the word "fair" to different outcomes of business ethics dilemmas. Will the participant apply "fair" to more, fewer, or roughly the same number of outcomes than they would have otherwise? The answer to this question would have bearing not only on whether abstraction, analogical thinking and perception of equality have a role in interpretating fairness; it would also be a first step to demonstrating whether distinct word meanings are constructed from unique sets of cognitive components. For example, if the manipulation were indeed to increase usage of the word "fair," that would indicate that these activated functions were important to the interpretation of the word. If future experiments were to show that other words were not similarly affected by the activation of these same functions, that would be a sign that those words utilize different cognitive components from that of "fair." If this is possible, this technique could serve as a semantic cyclotron of sorts, allowing semanticists to discern the building blocks of words much like particle physicists use atom-smashers.

This would open exciting new research possibilities, not only in cognitive semantics but in a variety of other fields as well.

This introductory chapter will provide a brief review of cognitive semantics' evolving challenges, especially with regards to moral concepts, and then discuss the study's aims, research questions and hypotheses — including the reasoning behind the selection of "fair" and word analogies for the first test case. Finally, this chapter will briefly explore this study's significance, a subject that will be discussed in further detail in Chapter 4.

Identifying the Building Blocks of Moral Meaning

To appreciate the recent successes – as well as the ongoing challenges – in the field of cognitive semantics, consider what happens when someone looks at a photo of a horse. According to DeLeon et al. (2007), at least three things happen cognitively during this event: first, the person sees the picture (visual sensation and processing of these visual images); the person decides to focus on the picture (the executive control function of attention), then the person accesses all the information they have on what makes a horse a horse (semantic memory). These are just some of the processes involved with simply looking at the horse photo and recognizing the kind of animal. More complex activity, of course, would involve more cognitive functions. If the person were to try to say the word "horse" out-loud, according to DeLeon et al. (2007), then the person accesses the memory of the phonological form of the word, and then applies motor programming and planning of articulation to use the lungs, vocal cords and all the relevant parts of the mouth to say it out loud. Other processes would be needed if the

person were to write down the word “horse,” or to access fond memories while riding such an animal, and so on.

But what if someone were to declare that the horse, or more likely the horse’s owner or rider, was “good” or “bad?” When we morally evaluate a person or action, according to Schwartz et al. (1992), we are doing two things: accessing knowledge of an abstract concept and then linking this concept to emotional states and social actions. These two unique mental acts, maintaining knowledge of an abstract concept that exists independently of any emotional or historical details, and then applying this concept to a variety of different people and situations, lie at the heart of moral evaluation, according to Moll et al. (2008). These two separate functions, or sets of functions, according to Moll et al. (2008) allow us to talk flexibly about morality in various situations: such as the “politeness” of a particular action, like a handshake, in distinct cultures, or whether speaking one’s mind out loud is “bold” or “irresponsible” in a particular situation.

In other words, a moral evaluation—the application of a particular moral word or concept to a specific situation—relies on two things: the specific information details that our senses gather about the situation, and what we “do” mentally with that sensory information. Of course, what we “do” with that sensory information is apply a concept. For many researchers, a concept, or rather the application of that concept, involves a particular package of cognitive processes, the components of which differ depending on the concept itself (Desai et al, 2018). For example, according to Moll et al. (2008), a person uses at least four different kinds of cognitive functions when processing any moral concept such as “fairness” or “guilt:” abstraction; salience and personal experience; emotional arousal, and social information processing like Theory of Mind (ToM). All

words designating moral concepts also appear to involve executive function in some way (Baker et al., 2021).

Words within a category, like those designating moral concepts, share many cognitive function components in common, but each individual word may also involve other components that are unique to that word. Chernyak & Blake (2017) found evidence indicating that different cognitive processes may underpin different principles of fairness: with cognitive control predicting equal-sharing, while numerical memory predicted merit-based sharing. Research identifying the unique packages of cognitive functions that comprise different concepts is ongoing.

The Quest for a Precise Semantic Lens

Every scientific discipline devoted to discovering building blocks has its tools. Biology has the microscope. Chemistry has the gas chromatograph. Particle physics has the cyclotron. Cognitive scientists likewise for years have searched for their own precise semantic lens and have had many early successes creatively adapting techniques from neuroscience. The four primary neuroscience approaches used by cognitive semanticists, according to Osterhout et al. (2006), are as follows:

1. Study by deficit, making detailed observations of the language use of brain-damaged and mentally ill patients with localized brain dysfunction.
2. Non-invasive neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography.
3. Using electroencephalography to make recordings of brain activity when participants process language.

4. Using transcranial magnetic stimulation by which researchers apply magnetic pulses to induce “reversible lesions” in targeted parts of the brain, allowing for more precise experimentally manipulated deficits.

These techniques have allowed researchers to identify the brain areas that either demonstrate activity when a participant processes a word, or negatively impact the participant’s language processing when the area is not functioning correctly. By such methods, researchers have found that parts of Wernicke’s and Broca’s brain areas, and regions of the inferior temporal cortex; the anterior temporal cortex; the posterior, inferior temporal/fusiform gyrus and the angular gyrus are all involved when a person looks at a picture of an animal and calls it a “horse,” (DeLeon et al., 2007). Desai et al. (2018) found that when a person interprets a word or symbol denoting a numerical concept, they activate parts of their brain related to processing spatial relationships, including portions of the intraparietal sulcus and the inferior parietal lobule.

Such neuroscience strategies have also identified numerous brain areas related to moral semantic processing. According to Moll et al. (2008), researchers have found that the processing of abstract concepts takes place in the pre-frontal cortex and the anterior temporal lobe regions, while the functions that process emotional arousal, salience and personal experiences are tied to such regions as the anterior insula, the amygdala, and subcortical structures. Meanwhile, social information processes, such as Theory of Mind, appear to take place in the posterior superior temporal sulcus region (Moll et al., 2008). Moreover, low-frequency TMS treatments of the dorsolateral prefrontal cortex (DLPFC) have been shown to impact executive functions related to how a person judges the fairness of economic offers (Knoch et al., 2006).

It's impossible to overstate the importance of these creative neuroscience applications to the founding of cognitive semantics. However, because many of these techniques were designed primarily to discern details of brain structure or regions of neurological activation, Osterhout et al. (2006) argue these methods are reaching the end of their usefulness for semanticists, who now need ever more-refined tools to capture subtle nuances in brain function. For example, according to Osterhout et al. (2006), studies of brain-damaged patients can't be precise because the damage suffered doesn't fall into neat categories, while neuroimaging is too slow to capture the processing of individual words. Electroencephalography, notes Osterhout et al. (2006), is limited by low spatial resolution. Meanwhile, TMS studies, although they allow for precise deficit manipulations of specific brain areas, could lead to compensating activity by other brain areas that muddy up the results (Osterhout et al., 2006).

Perhaps the biggest challenge to the neuroscience approach to semantics is the ongoing debate on whether pinpointing semantics to specifically focused locations of the brain is even possible. In an metanalysis of 120 neuroimaging studies of the semantic system, Binder et al. (2011) note that researchers believe many semantic processes are fueled by fluid networks of multiple brain sections working simultaneously. Hruby et al. (2011) reports that many semantic brain-mapping findings cannot/could not be replicated due to differences in localized function in individual brains, lack of clarity on the idea of encoding in the brain, and overconfidence in imaging techniques.

For cognitive semantics to continue to advance, researchers need more instruments specifically designed to capture, articulate, and measure subtle nuances in cognitive function.

The Potential of Cognitive Process Priming

Instead of studying how deficits in specific brain areas impact semantic processing, this thesis suggests a new paradigm of research: studying what happens to semantic processing when specific cognitive processes are selectively intensified. The results of such studies should, in theory, complement the insights gained from deficit studies. There is precedent for such studies in the burgeoning field of cognitive process priming.

Cognitive process priming is a phenomenon in which the activation of a specific cognitive process increases the likelihood that a participant will repeat that same process in a subsequent task (Janiszewski & Wyer, 2014). For example, if a person, for some reason, had activated their episodic memory by remembering some event from their past, that person would be prone to engage in more personal recollections during whatever task they are next engaged with, say making a to-do list for the day. That recollection could involve memories of that person making to-do lists in the past, or maybe previously taking part in any of the activities on the to-do list, and so on. The first act of memory is said to have "primed" the next act of memory. The first act of memory could be prompted by a wide variety of stimuli, such as someone saying, "Do You Remember This?" or a powerfully salient experience that triggers memories of a similar previous experience. This phenomenon can occur outside of an experimental setting as well.

Interest in cognitive process priming is growing, as researchers conduct new experiments to see which cognitive processes can be primed, and the effects such priming could have on a variety of different subsequent activities, such as recognizing faces or doing clean up chores (Janiszewski & Wyer, 2014). For example, Shen and Wyer (2008)

had participants put in rank order (either from high to low or low to high) sets of stimuli along a specific dimension (such as favorableness or price). Afterward, the participants were asked to estimate average values for new sets of stimuli (such as the prices of hotels in a particular city). The researchers found that participants who had previously ranked stimuli from high to low had their attention to directed to high-valued items in the second set of stimuli, and consequently, made higher average estimates than those who had ranked stimuli from low to high (Shen & Wyer, 2008). Crusius and Mussweiler (2012) found that process priming could impact goal achievement in participants; if a participant was primed to focus on similarities in tasks, that encouraged them to behave more consistently with goals like neatness or achievement, while priming participants on differences made them behave more inconsistently.

Researchers have also experimented with process priming in tasks related to social and moral evaluation (Janiszewski & Wyer, 2014). For example, Sassenberg and Moskowitz (2005) found that priming participants to "think different" by way of activities that primed creative thinking diminished automatic displays of negative bias against images of African Americans in lexical decision tasks. Meanwhile, Zarkadi and Schnall (2013) observed in a series of experiments that exposing participants to a "black and white" checkered background as they considered moral dilemmas, or a series of social issues, rated the morality of these dilemmas with more extreme scale scores compared to participants in control conditions. The researchers argue that the checkered background served as a non-affective cue prompting process style that influenced moral judgements and made them more extreme (Zarkadi & Schnall, 2013).

There is even a growing body of research investigating process priming and semantics. Valenzuela & Soriano, (2007) investigated whether priming of the conceptual metaphor process made it easier for participants to recognize words related to the concept of anger in a participant categorization task. The experimenters primed the participants by having them look at an image and then perform a categorization task. If the images were related in some way to common conceptual metaphors about anger, like a hot fluid or pressurized container, then the participants more quickly categorized words related to anger compared to non-anger words (Valenzuela & Soriano, 2007).

These experiments can serve as models for applying this technique to moral semantics, to see whether the priming of a specific cognitive function can impact how a person processes the meaning of a specific moral word.

Cognitive Stimulation Therapy as Priming Tool

This thesis proposed using Cognitive Stimulation Therapy (CST) exercises as the process priming treatment. CST is a technique for strengthening cognitive skills via specially targeted activities such as games, exercises, and tests. For example, there are games devoted to improving executive functions such as working memory, attention, and cognitive control as well as games devoted to specific academic activities such as math, vocabulary and reading comprehension. Over the past decade the technique has gained popularity as a common pastime via online games and phone apps, but it also has a history of serious clinical applications. For example, sessions featuring assorted word games, reading comprehension and other language activities are regularly administered to patients suffering from suffering from dementia (Hall et al., 2013), and schizophrenia

(Biagianti & Vinogradov, 2013). In these cases, the CST exercises are applied to improve language function for patients who have suffered damage in the relevant brain areas. An important side effect of these treatments, from the perspective of this thesis proposal, is that many of the language exercises impact the same cognitive functions that underly moral semantic processing, such as on working memory and processing of social cues (Biagianti & Vinogradov, 2013), as well as attention and reasoning (Tapia and Duñabeitia, 2021). By using such exercises, which are often based on classic psychological activities such as the Stroop Effect and word analogy games, it should be possible to prime specific cognitive functions within participants as they take part in activities that measure their semantic processing of specific words.

Study Aims & Hypotheses

This study sought to determine whether administering a CST exercise, in the form of word analogy games, to a group of test participants would change the way they processed the meaning of the word "fair," specifically, whether they would apply this word more broadly, or more narrowly, to a variety of different distributive justice outcomes. The word "fair" was selected because it arguably denotes one of the most utilized, and most fiercely debated, concepts in morality.

Like many moral concepts, fairness can be hard to pin down. Chernyak and Blake (2017) define the concept in very general terms, namely "the ability to distribute resources in a manner that accords with societally recognized principles of justice." Though many societies, cultures, and individuals place a high premium on the concept, Schafer, Haun, & Tomasello (2015) note that the precise principles these stakeholders use

to define it—like equality, equity, or merit— can vary widely. The decision to define fairness by a particular set of principles is influenced by many factors. Of course, personal experience is important (Den Bos & Lind, 2013), particularly the experience of being fairly, or unfairly, treated by others (Lind et al., 1998). Cognitive skill is another factor. As noted previously, Chernyak & Blake (2017) found that different cognitive functions may lie at the foundation of different principles of fairness – such as cognitive control tied to equality in sharing and numerical memory tied to merit in sharing. This means that children who develop different cognitive skillsets may be predisposed to different principles of fairness (Chernyak & Blake, 2017). Emotion can also have a huge impact. Liu, Chai and Yu (2016) observed that negative incidental emotions heighten sensitivity to fairness; while Stowe, Peretz-Lange, and Blake (2022) found that children factor in emotions, along with procedures and outcomes, when judging fairness.

Humans may be influenced by many factors in their fairness decisions, but researchers such as Messick & Schnell (1992) and Engelmann & Strobel (2007) have found that equality in distribution is a hardwired heuristic for gauging fairness—a kind of default before the other factors weigh in. Sloane, Baillargeon & Premack (2012) found that toddlers as young as 19-months display this sensitivity for equal distribution. Many cognitive frameworks for judging fairness rely on a sense of equality or equilibrium, either in terms of distribution of goods, intentions, responsibilities, or risks. According to Fehr & Schmidt (2000), individuals have two approaches for calculating fairness: “social preference” and “intention-based reciprocity” frameworks. In “social preference” frameworks, individuals look upon as “fair” distributions of goods that reinforce a social value that is important to them, such as altruism or aversion to inequity (Fehr & Schmidt,

2000). In “intention-based reciprocity” frameworks, fairness reflects an equilibrium regarding the intentions of everyone involved in a situation: if someone is kind that should be reciprocated, likewise if someone is hostile (Fehr & Schmidt, 2000).

These cognitive frameworks devoted to “fairness” are important for groups because they enable collaboration (Chernyak & Blake, 2017). They are important for the individuals participating within the groups because they help manage risk and uncertainty (Lind & Van den Bos, 2002). In E. A. Lind’s fairness heuristic theory (Lind, 2001), fairness judgements serve as a “proxy for interpersonal trust” for participants within a group, helping guide their decisions regarding whether to act cooperatively with the group. These rules and principles, according to Lind (2001), also serve as heuristics, as cognitive shortcuts, to provide quick answers to every situation that arises. In this way, concepts of fairness help participants to judge, and respond, to treatment by authority (Lind et al., 1998), and to manage uncertainty in terms of dealing with an organized group (Lind & Van den Bos, 2002).

Because the concept of equality appears to be a fundamental rubric for perceiving fairness, it was chosen as the target of experimental manipulation for this study, by way of word analogy exercises focusing on equivalence and similarity. Further, because fairness appears to be an important framework for evaluating organizational situations, narratives of business ethics dilemmas were chosen as the vehicle for measurement.

Word analogy exercises were selected because they involve the act of seeing relations or similarities between different concepts and situations, and that might have an impact on how participants perceive equality in dilemmas concerning fairness. If a participant is primed by word analogy exercises to perceive similarities, or construct

relationships, would the participant be prone to look for – or even perceive – equality in various situations?

It is important to note that although the first test case for this study involves word analogies and the concept of "fair," this technique was intended ultimately to be used for a multitude of different cognitive functions and a multitude of different words. Indeed, before the researcher made the final decision to test word analogies with "fair," numerous other experimental combinations were considered, including testing executive control functions with the concept of justice and divergent thinking with the concept of compassion. Applying this technique to such experimental combinations, in addition to many others, should offer valuable opportunities for future research.

The Hypothesis

For this study, the following hypothesis was proposed:

Applying treatments of verbal analogy exercises to a participant will make that participant apply the concept of fairness to more situations than before the application of the exercises.

This hypothesis, indeed, the entire study, is built upon the cognitive theory of semantics, namely that all word meaning is a function of different cognitive functions. By no means is this the only theory of semantics; there are many. All these theories, according to Ramadan & Ababneh (2013), fit under three general categories. The first category is Referential Theories, in which meaning is the function of a relationship, declared or intuited, between a word and whatever the word represents. The second category is Non-Referential Theories, in which meaning is envisioned as a set of

operations. Cognitive semantic theory fits under this category. The third category is Generative Grammarian Theories, in which meaning is construed from the context of the grammar and syntax structures of a sentence. Noam Chomsky's theories, which describe language ability as an in-built modular system of the brain, defined by a "Universal Grammar" that governs the language use of every human being, sits within this category.

It is unlikely that the two experiments conducted in this study will settle any debates between the three different semantic theory categories. However, a much larger set of experiments could shed light on the discussion, depending on how the theories are operationalized. For example, in the category of Referential Theories, meaning is described – essentially—as a single type of mental action, whatever that mental action might be. Therefore, semantic action would be operationalized as one set of cognitive functions. Meanwhile, Non-Referential Theories, like cognitive semantics, envision multitudes of functions. In the category of Generative Grammarian Theories, semantics is viewed as an activity based on a single module of human language functions, a single "Universal Grammar. Operationally, this would likely translate into a small number of functions.

If the three categories of semantics theories are operationalized as having one, many, or just a few sets of mental functions related to the act of interpreting meaning, it may be possible to resolve this theoretical debate by looking at general patterns of results spread over many experiments. If Referential Theories, with one theorized set of functions, are correct, then effects should be noticeable with the manipulation of only a few cognitive functions—whatever they might be. If Non-Referential Theories are right, effects should be possible with a broad variety of manipulated functions. If Generative

Grammarian Theories are correct, then effects should be noticeable with only a smaller set of manipulated functions as well. Conducting many experiments to activate a broad variety of functions would be exhaustive but also informative in this debate.

Significance of the Study

The phenomenon demonstrated in this study indicates three things: first, it provides further evidence that different cognitive functions are at play in the semantic processing of different words; second, it provides a method for pinpointing these functions that is less invasive and technology-intensive than those currently in use, and it provides evidence that language-dependent moral judgements can be affected by factors other than emotion and information (or misinformation). If this phenomenon can be demonstrated to apply to other cognitive functions, words, and segments of language, it could serve as the foundation for at least four powerful applications, including a new method for semantic measurement; a new system for modelling complex group behavior; new strategies and protocols for calibrating ethical discourse in public and professional forums, and a new paradigm for psychological warfare. These four potential applications are examined in greater detail in the General Discussion section in Chapter 4.

Chapter II.

Method

The study consisted of two online experiments, both constructed using a "Pre-Post-Test" design and applied to roughly 120 participants each (123 and 119 participants respectively). For the pre-measurement, participants in both experiments took part in a science fiction-themed assessment dubbed "Space Arbiter," which counted how often the participants were willing to apply the word "fair" to potential distributive justice outcomes to six fictional business ethics dilemmas. After taking part in this assessment, participants were administered either the experimental manipulation, a battery of 18-word analogy exercises, or the control, a photo of the moon. For the post-measurement, participants took part in a second administration of the "Space Arbiter" test, again applying the word "fair" to distributive justice outcomes to six fictional business ethics dilemmas that were similar in structure and stakes to the first set of dilemmas. The number of options selected in the second administration of the test for each dilemma was then compared to the number of options selected for each option in the first administration. Any increase in the number of options selected in the second test was treated as evidence of an experimental effect.

The two experiments differed in two key areas, the first being use of randomization and control groups. The first experiment, conducted on Tuesday, September 6th, 2022, to Wednesday, September 7th, 2022, was operated as a quasi-experiment, with every participant undergoing every measurement question, and word

analogy exercise, in the same order. Also, in this experiment there was no control group. The second experiment, conducted on Tuesday, October 25th, 2022, was operated as a true experiment, with the order of every measurement question, and every word analogy exercise, fully randomized. Also, the participants were randomly assigned to experiment treatment and control groups, with half undergoing the 18-word analogy exercises and the other half gazing at the photo of the moon. To bolster the randomization, all the question titles and subheadings used in the first experiment, for example "Question 1: This is an Intellectual Property Case," were removed in the second experiment.

The second key area in which the experiments differed was the selection of technology platforms. The first experiment was programmed into, and operated from, the Alchemer survey software system (formerly known as SurveyGizmo), and was administered to participants via the Amazon Mechanical Turn (MTurk) crowdsourcing exchange and managed via the Cloud Research MTurk Toolkit. The second experiment was programmed into, and operated from, the Qualtrics XM survey software system (via the Harvard University account) and was both administered to participants and managed via the Cloud Research Connect platform. The researcher used the Alchemer system in the first experiment due to previous experience with the platform but changed to Qualtrics because the second system offered more randomization options and greater functionality within the Cloud Research platforms. The researcher changed from Amazon MTurk to Cloud Research's Connect platform because the Cloud Research system offered easier access to researchers.

Participants

The first experiment had 123 participants, all recruited from the Amazon MTurk marketplace. The second experiment had 119 participants, all recruited from the Cloud Research Connect platform. In both experiments, participants were paid $5 upon completion. On both platforms, the participants were recruited via the following job description: “Take part in a Sci Fi-Space themed study of moral cognition and language. The study should take approximately 30-minutes and you will receive $5 for its completion.” As per the consent agreements outlined at the beginning of both experiments, no identifying information of any kind—including name, age, or gender—was recorded by the researcher.

Measurement

The instrument used for the pre- and post-measurements was the “Space Arbiter” test, a gamified, science fiction-themed assessment tool specially designed by the researcher for these experiments. Participants were asked to pretend that they were “lunar lawyers” in the 25th Century taking an exam to be certified as a “Space Arbiter,” a professional who arbitrates complex business disputes between aggrieved parties from around the Solar System, such as spacesuit designers, manufacturers of terraforming ships or retailers of high-speed rocket engines, and so on. Each administration of the test asked participants to carefully read six business ethics dilemmas and then to choose all the potential distributive outcomes—out of 11 options—that they believed they could argue to be “fair” to both aggrieved parties. (A full transcript of the experiments, with both versions of the “Space Arbiter” test, can be found in Appendix A.)

The Role of Science Fiction and Gamification

The tests were filled with numerous colorful fictional details as well as ideas from speculative space science (such as Dr. Richard Obousy's theoretical VARIEs (Vacuum to Antimatter Rocket Interstellar Explorer System) engine). All these entertaining and vibrant elements were included to motivate the participants to pay close attention to their assigned tasks – and to finish the experiment. The fictional elements and overarching narrative of the experiment also helped facilitate three important acts of misdirection: first, that the pre-test was a "practice" for the "real" Space Arbiter test; second, that the experimental manipulation and control photo of the moon (depending on which was assigned to the participant) were there to help the participant "rest" before taking the "real" Space Arbiter test, and, third, that there was some secret difference between the similar-seeming "practice" and "real" Space Arbiter test. These acts of misdirection were necessary to keep the participants engaged with both assessment instruments, even though they would obviously appear very similar, and to discourage them from trying to outthink the experimental manipulation activities.

Operationalizing the Concept of Meaning

The researcher found no semantic measurement tool in the scientific literature that met the needs of this experiment, so an instrument was developed with a unique approach to measuring meaning. For the sake of this study, the gauge for semantic processing was operationalized as the range for how broadly, or how narrowly, a participant applied the word "fair" to different potential distributive justice outcomes to a particular business ethics dilemma. For each dilemma, the participants were given a spectrum of 11 options, each representing different increments in share percentages between the aggrieved

parties. For example, at one extreme, Option 1, Party A would get 0% of whatever was under contest and Party B would get 100%. In Option 2 Party A would get 10% and Party B would get 90%. In the middle option, Option 6, both parties would get 50%; while the option at the other extreme (Option 11) gave 100% to Party A and 0% to Party B. This broad spectrum of incremental options was designed to allow for the capture of small experimental effects.

At the beginning of each test, and after each dilemma narrative, the participants were given three sets of guidelines to maximize the sensitivity of the assessment tool.

The participants were told that, as arbiters, they had to understand that:

1) *The business dilemmas are "messy," with no "clear or simple resolution."* Every option presented is slightly imperfect and that they shouldn't expect to find a perfect outcome.
2) *They could choose more than one outcome.* As an arbiter, they are aiming for "compromise" amongst two different parties, and so they should be open to choosing more than one possible outcome to have as many options as possible to present to the opposing parties.
3) *They shouldn't pick options just for sake of picking options.* They had to be confident that they could convincingly argue both parties to accept as "fair" every compromise option they selected. That it is not a question of whether they knew an option was fair, but whether they could convince the two parties to perceive the option as fair. So, the participants should only pick the options they were comfortable presenting, and no more.

These guidelines were intended to encourage the participants to trust their own understanding of what constitutes "fair," and to not rely on any rigid formulas or cues. Of course, another key goal of the guidelines was to make the participants comfortable with the idea of choosing more than one option – which was essential for measuring any potential broadening or narrowing of the application of "fair." (A full transcript of the precise language used in the guidelines in the assessment questions can be found in Appendix A.)

This design for operationalizing meaning was guided in part by E. Allan Lind's fairness heuristic theory (Lind, 2001; Lind et al., 2001), which posits that people rely, in part, on a set of heuristics to evaluate distributive justice scenarios, as well as the semantic differential scales approach developed by Charles Osgood (Osgood et al., 1957).

The Pre- and Post-Test Dilemmas

Each version of "Space Arbiter" had participants read narratives portraying six distinct business ethics dilemmas. These dilemmas were as follows:

- **Dilemma 1**, an *Intellectual Property Case*, in which an employee of a company invents a highly lucrative product and seeks a portion of the invention's profits from the company. In the first test, the invention under contest was a process for harvesting deuterium and tritium from gas planets, while in the second test, the invention was a recipe for a Martian mint cookie.

- **Dilemma 2**, a *Company Co-Founder Case*, in which the two founders of a company, who contributed in different ways to the founding of the business, fight over control of the company. In the first version, the founders were fighting over control of a space suit maintenance firm, while in the second the founders fought over a company that develops artificial intelligence systems.

- **Dilemma 3**, a *Venture Capital Risk Case*, in which a venture capital firm invests in a risky new technology idea and seeks recompense from the developer after the technology fails to come to fruition. In the first version, the case centers around a failed jet pack design for flying in Jupiter's atmosphere, while in the second, the focus was a failed system for mining the Asteroid Belt.

- **Dilemma 4**, a *Product Pricing Case,* in which consumers are pushing a company to lower its prices to a unique, high-demand product. In the first version, the case involves a very powerful, but also very expensive, new rocket technology, while in the second version, the prices for the services of a planet terraforming spaceship are under dispute.

- **Dilemma 5**, a *Corporate Liability Case*, in which a company cuts corners in the development of a publicly-needed product and makes a mistake that costs lives. In the first version, the case involved the development of a treatment for a space travel-related immune disease, and in the second, the dispute was over the development of a new kind of emergency pressurized life habitat for use in outer space.

- **Dilemma 6**, a *Fair Wages Case,* in which activists push a company that pays different employee groups different salaries, for the same work, to change their wage policies. In the first test, the case involved wage differences between employees on Mars and the Earth, while in the second, the dispute centered on the difference in compensation between employees that were human versus those that were artificial intelligence.

The researcher chose business ethics dilemmas on the belief that participants would likely have had more opportunities to address such issues under normal workplace conditions, and presumably under the guidance of professional standards – of some sort – for addressing these issues rationally. Dilemmas involving personal or familial situations run the risk of being too emotionally charged. The story kernels for each of the dilemmas were based on composites of various real cases from the *Business Ethics: Case Studies and Selected Readings, 6th Edition.*, written by Marianne Jennings (Jennings, 2007). Each of these kernels were then fleshed out into two different, but similar stories, using colorful, outlandish details from fantasy fiction and speculative science.

As mentioned earlier, these details were included to be interesting and entertaining to the participants, who were being asked to pay close attention to the details of these narratives. Writing these narratives in a dry, boring manner would have been counterproductive. However, the space and science fiction elements served a second purpose, to create some distance between the dilemmas and any analogues from real life. It would not be impossible for participants to have experienced one or more of these dilemmas in real life, or at least to have learned about them from the news media, and thus to have developed emotions, opinions, and biases on these subjects. It was hoped that setting the scenarios in outer space in the 25th Century might lessen this possibility.

The goal was to write each version of these dilemmas as a conundrum, without any clear or simple answers. The strategy was to make each aggrieved party slightly sympathetic in some areas, and slightly unsympathetic in others. Consequently, the researcher tried to write these scenarios in a coded, formulated manner. In the narrative for each dilemma, there was one or two sentences outlining the basic background of the situation, as well as one or two sentences outlining the dispute. Then each side was given roughly four different arguments in favor of their claim. Very often each side's arguments were designed to nullify the arguments of the other side. In short, the dilemmas were designed to be difficult to judge.

There was another reason why the narratives were written using a formulized template—internal validity and comparability. The entire premise of the experiments relies on two measurements, the number of options selected by participants in each dilemma in the second test, compared to the number of options selected by the participants in the corresponding dilemmas in the first test. For these measurements to be

valid, there had to be some assurance that the different versions of each dilemma were comparable, that they were "apples to apples." Consequently, every effort was made to make the two versions of each dilemma similar in structure and stakes. For example, in the first test version of Dilemma 1, the intellectual property case, the inventor of the deuterium harvesting process is described as someone who could only get a job at his current employer and nowhere else; a similar description is made of the inventor of the Martian mint cookie recipe in the second test version of Dilemma 1. Every argument made in the first version of each dilemma has an analogue in the second version. Also, every effort was made to ensure there was similarity in the ratios of stakes, damages, and monetary claims in each version of each dilemma. For example, in the first version of Dilemma 5, the corporate liability case, the mistake in drug testing protocols leads to the death of 20-test subjects, with governments and family members asking for billions of dollars in damages. In the second version of Dilemma 5, mistakes during the testing of the emergency pressurized space survival habitat leads to the death of a dozen, with governments and family members also asking for billions in damages.

However, this need to provide comparability between the dilemma scenarios had to be balanced with another consideration, that each scenario seemed distinctive enough so that the participants judged each narrative on its own merits without automatically repeating the response from a previous version – and without getting bored. Hence the effort to develop distinctive, colorful subject matters for each narrative, with different names, details, and on occasion, different tones. It is unclear whether any of these efforts were successful; whether the versions were indeed comparable or were they undermined by the efforts to make them seem distinctive. It was also necessary to assume many, if not

all, of the participants would notice these similarities themselves. Hence the importance of the third misdirection mentioned earlier in this chapter, admitting to the participants from the beginning the obvious similarities but hinting that there was some secret difference between the versions that would be revealed at the end of the study. These issues are further discussed in the Limitations section of Chapter 4.

The Experimental Manipulation and Control

The Experimental Manipulation consisted of a battery of 18-word analogy exercises, consisting of three sets of tasks, with six items in each set.

The tasks were as follows:

1. ***Set 1: Evaluative***

   In this set, participants were presented with two sets of word relationships in the format of A : B :: C : D, and were asked to decide whether the pairing of the two sets was "Equal" or "Not Equal."

   An example of one of the exercises from this set was:

   game : series :: syllable : word

   Are the two analogy pairs equal?

   a) Equal
   b) Not equal

   In the case of this question, the right answer was "a) Equal."

   The participants went through six of these items in this set.

2. ***Set 2: Multiple Choice***

In this set, participants were presented with two sets of word relationships. The first was complete, but the second had a blank over one of the word positions, resulting in a format of either A : B :: C : ___ or A : B :: ____ : D. The participants had to choose from four multiple choice options to fill in the blank space.

An example of one of the questions presented in this set is the following:

alphabetical: _____ :: sequential : files

a) Sort
b) Part
c) List
d) Order

In the case of this question, the right answer was "List."

The participants went through six of these items in this set.

3. ***Set 3: Multiple Choice (Harder)***

In this set, participants went through exercises similar to those in Set 2, with the only difference being that the relationships between the words were more subtle.

An example of one of the questions used in this set is as follows:

diamond : baseball :: court : _____

a) Poker
b) Jury

c) Grass

d) Squash

In the case of this question, the right answer was “Squash.”

The participants went through six of these items in this set.

The 18-word analogies were selected from the book *501 Word Analogies Questions* (LearningExpress, 2003.) Most of the analogies featured in this battery focused on relationships such as “object and classification,” “object and group,” and “object and related object,” in order to prime the participant to look for similarities in kind.

This battery of 18-word analogies was used in both Experiment 1 and Experiment 2 – with two differences. The first difference was that the presentation order of the analogies was not randomized in Experiment 1 and was randomized – within the analogies’ respective sets – in Experiment 2. The second difference is that the headings for each question used in Experiment 1, such as “First Question in Second Analogy Series,” were removed from Experiment 2.

Meanwhile, the Control was used only in Experiment 2. In Experiment 1, all the participants underwent the experimental manipulation. In Experiment 2, 60 participants were randomly assigned the Control, which consisted of a photo of the moon with the caption “Take a break for a few seconds and enjoy this NASA image of the moon. Feel free to move onto the second Space Arbiter test whenever you are ready.”

Procedure

Both experiments 1 and 2 followed similar procedures, aside from the previously noted differences in randomization and question headings, as well as differences in a third detail, namely how participants verified their completion of the study. The procedure for both experiments, including their differences, was as follows:

1. Online participants were recruited from the respective participant platforms operated by Amazon MTurk, for Experiment 1, and Cloud Research Connect, for Experiment 2.
2. The participants were then directed into the respective survey systems for each experiment: Alchemer for Experiment 1 and Qualtrics for Experiment 2.
3. Once in the survey systems, participants were first presented with an Introduction page. This page established the premise of the study, to explore language and moral cognition, as well as the overarching fictional narrative basic premise of the "Space Arbiter" assessment tools as pretend professional certification tests. This Introduction page also set into motion the three major lines of misdirection: that the first "Space Arbiter" assessment was a "practice" test; that whatever activity that followed the "practice" test (experimental manipulation or control) was for rest, and that, despite their obvious similarities, there was a secret difference between the two "Space Arbiter" tests that would be revealed at the end of the test.
4. The participants were then presented with a Consent Page, explaining the participants' rights and potential risks taking part in the study. At the bottom of this page was an Agreement Question, which asked the participants whether they agreed to participate within the study, and if they did, to click the "I consent button."

5. After clicking their consent, participants were directed to an Instructions page that explained how to take the “Space Arbiter” test.
6. The participants were then presented with the first “Space Arbiter” test, which was described to them as a “practice” test. In Experiment 1, the six Dilemma questions were presented in a unchanged numeric order, and had headings indicating the Dilemma number and type: “Practice Question 1: This is an Intellectual Property Case.” In Experiment 2, the question order was randomized, and none had any identifying headings.
7. The participants were then presented with the experimental treatment. In Experiment 1, this was solely the battery of 18-word analogy exercises in three groups of six. Before each group of six exercises, participants were presented with an Instructions page explaining how to answer the exercises in the set. In Experiment 1, all participants underwent the exercises in the same order, and all the exercises had identifying headlines: “Second Question in Third Analogy Series.” In Experiment 2, the presentation order of the exercises in each group was randomized, and none had any identifying headlines. Also, in Experiment 2, nearly half of the participants were randomly assigned to the Control treatment, which involved gazing at the NASA image of the moon.
8. The participants were then presented with a repeat of the Instructions page for the “Space Arbiter” test.

9. The participants were then presented with the second, “real,” “Space Arbiter” test. In Experiment 1, the six Dilemma questions were presented in an unchanged numeric order and had headings indicating the Dilemma number and type. In Experiment 2, the question order was randomized, and none had any identifying headings.
10. The participants were presented with the debriefing page, which thanked them for their participation in the study and explained the true purpose of the study, to see whether undergoing word analogy activities would impact their semantic processing of the word “fair.” This explanation also served to clear up the previous acts of misdirection: the two “Space Arbiter” tests were now understood to be the pre- and post-measurements, the alleged rest activities were experimental manipulations, and the only germane difference between the two tests was that one came before, and one came after the manipulations.
11. The participants were then presented with the means to verify their completion of the study to receive their $5 compensation. In Experiment 1, this verification came in the form of a string of code revealed at the bottom of the debriefing page that participants would input into the Cloud Research management system to confirm completion. In Experiment 2, participants were given a link to click that both confirmed their completion of the study and returned them to their Cloud Research participant portal.

The full language of all the survey pages of the test can be found in Appendix A.

Data Collection and Analysis

Both the Alchemer and Qualtrics survey systems collected all the participant responses to the "Space Arbiter" tests and the word analogy exercises. The Qualtrics system also recorded the random assignments into the Experimental and Control groups, as well as the order in which the randomized "Space Arbiter" test questions were presented to participants. The researcher imported this data for both experiments first onto Excel documents, translating the response data from lists of options selected to numbers reflecting option counts (i.e., The response list "Option 1; Option 2" was translated into the number 2.) Additionally, the researcher, for Experiment 2, organized the response data for the first three questions presented to participants into column Trials 1, 2 and 3. The response data for the 18-word analogy exercises was also gathered and imported but was not analyzed.

After importing and organizing the data, the researcher first made averages of the changes in option selections between the post- and pre-tests. The researcher also conducted Paired T-Test analyses of the data for Experiment 1, as it was designed as a quasi-experiment, and Independent Sample T-Tests for Experiment 2, which was designed as a true, fully randomized experiment. This included analyses of the responses for each of the six dilemmas, as well as—in the case of Experiment 2 – the three response trials.

Chapter III.

Results

For Experiment 1, results were collected from 123 participants, while for Experiment 2, results were collected from 119 participants. The results recorded from both experiments included the specific option selections each participant made for each Space Arbiter measurement question, which was then translated by the researcher into option counts for each question: for example, a response recorded as “Option 1; Option 2,” was translated into the score “2.” Also recorded from both experiments were all the responses to the 18-word analogy exercises. Two additional datapoints were collected from Experiment 2, the experimental group assignment (Experimental or Control), and the order in which each participant viewed the randomized measurement questions. The option count scores for all 123 participants of Experiment 1 are presented in a table in Appendix B. The option count scores, experimental group assignments and viewing orders for all 119 participants of Experiment 2 are presented in a table in Appendix B. Tables of answers to the word analogy exercises, for each Experiment 1 and 2 are presented in Appendix C. Although the answers for the analogy exercises were not analyzed for the sake of this project, they are nonetheless included in anticipation of possible future meta-analyses.

Results from Experiment 1

The average increases (and decreases) in option selection counts after the experimental manipulation for each dilemma category are presented below in Figure 1.

There was an average increase in options selected – post manipulation – in dilemmas 1, 2, 3 and 5. There was an average decrease – post manipulation – in dilemmas 4 and 6. Because this was a quasi-experiment, all 123 participants received the same experimental manipulation and scores from all 123 were used in this average.

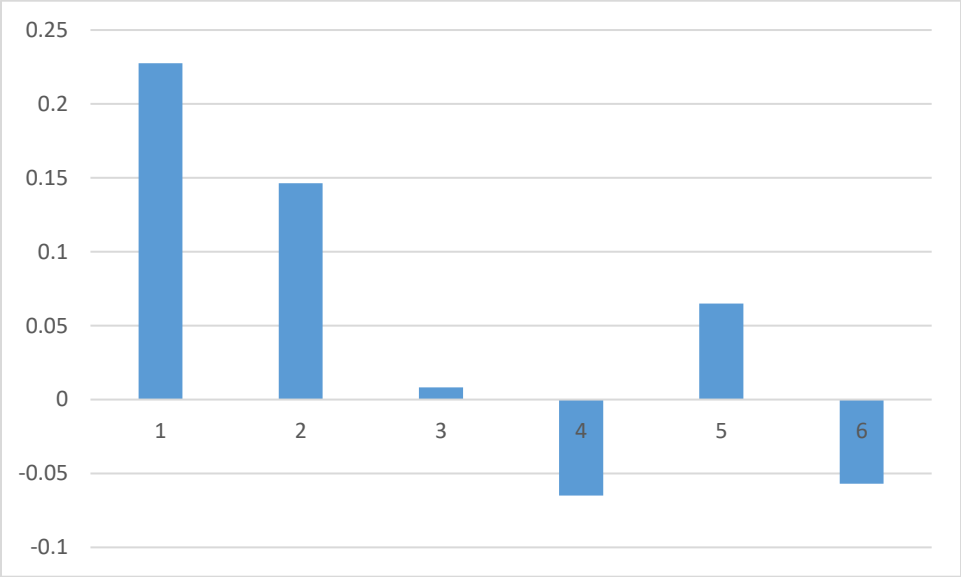


Figure 1. Average Change in Options Selected per Dilemma (Experiment 1).

These figures were calculated in two steps. First, each participant's pre-scores for each dilemma were subtracted from the post-scores for in that same dilemma. Second, the 123-calculated score changes in each dilemma were averaged.

The results from Paired Samples tests between the pre- and post-scores in each dilemma category are displayed below in Table 1. Only the option selection scores for dilemmas 1 and 2 exhibited significant *p*-scores, of 0.021 and 0.045 respectively. Their Cohen's *d* effect scores were weak, -0.185 and -0.155, respectively.

Table 1. Paired Samples Tests for Experiment 1.

Dilemma	Significance (*p*-Score)	Effect (Cohen's *d*)
Dilemma 1	0.021	-0.185
Dilemma 2	0.045	-0.155
Dilemma 3	0.467	*NA*
Dilemma 4	0.220	*NA*
Dilemma 5	0.215	*NA*
Dilemma 6	0.302	*NA*

Paired Samples Tests were conducted between Pre- and Post- scores. NA = Not Applicable (in the cases where there was no significant effect.)

Results from Experiment 2

The average increases (and decreases) in option selection counts after the experimental manipulation for each dilemma category are presented below in Figure 2. There was an average increase in options selected – post manipulation – for dilemmas 2, 3, 4 and 5. The average increase for dilemma 3 was miniscule, however. There was an average decrease in options selected – post manipulation – for dilemmas 1 and 6. It is important to note that Experiment 2 was operated as a true experiment, with random assignment to experimental and control groups, only 59 participants underwent the manipulation. The scores from these 59 were used to generate these average score changes.

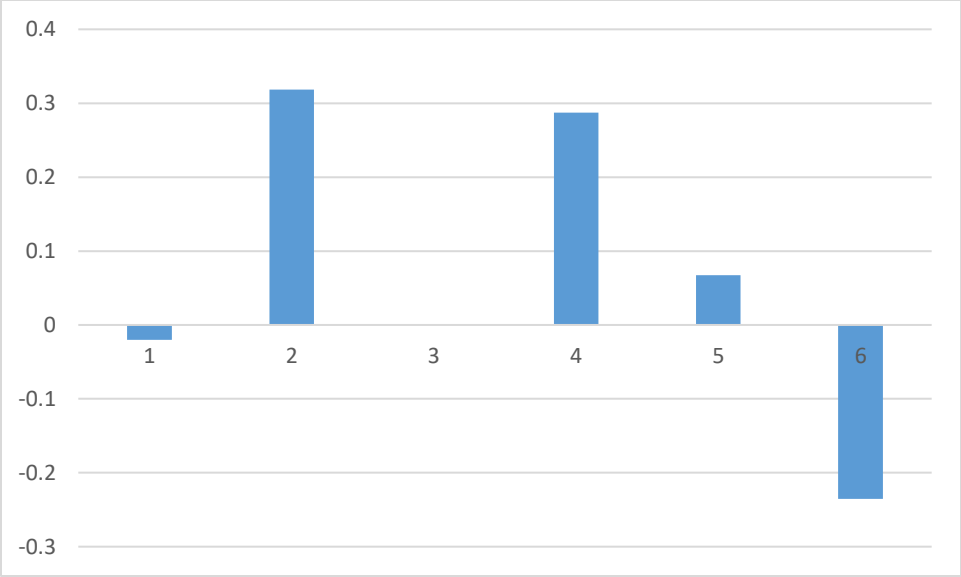


Figure 2. Average Change in Options Selected per Dilemma (Experiment 2).

Dilemma 3 exhibited a miniscule increase in average options selected of 0.000282.

The results from the Independent Samples tests of each dilemma category in Experiment 2 are displayed below in Table 2. Only dilemma category 2 demonstrated significance with a *p*-score of 0.040 and a Cohen's *d* effect of -0.323.

Table 2. Independent Samples Tests for Experiment 2.

Dilemma	Significance (*p*-Score)	Effect (Cohen's *d*)
Dilemma 1	0.451	*NA*
Dilemma 2	0.040	-0.323
Dilemma 3	0.499	*NA*
Dilemma 4	0.062	*NA*
Dilemma 5	0.378	*NA*
Dilemma 6	0.167	*NA*

NA = Not Applicable (in the cases where there was no significant effect.)

Analysis of First, Second and Third Trials of Experiment 2

To see whether effects changed over time, the researcher analyzed response data from the first, second and third trials of the randomized measurement questions of Experiment 2: for example, a Trial 1 response for Dilemma 2 would be an instance in which Dilemma 2 was the first randomized question encountered by a participant while Trial 2 would be an instance in which the dilemma was the second question, and so on. In Experiment 1, all the participants viewed the questions in the same order. The average change in options selected for each dilemma for the first, second and third trials in Experiment 2 are presented in Figure 3.

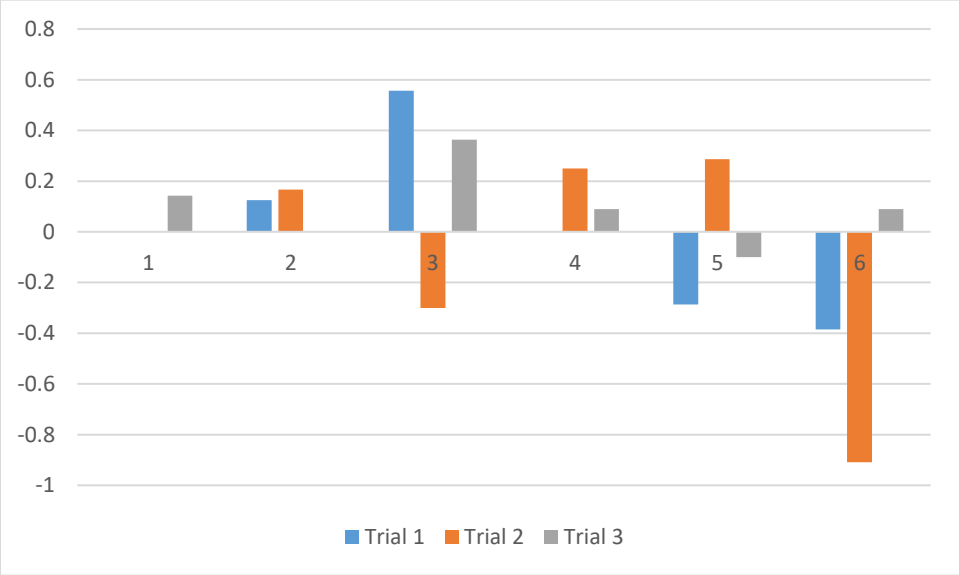


Figure 3. Average Change per Dilemma for First 3 Trials of Experiment 2.

Areas where no bars are visible, i.e., trials 1 and 2 for Dilemma 1; Trial 3 for Dilemma 2, and Trial 1 for Dilemma 4, represent instances where the average change was 0.

Independent samples tests were conducted for each dilemma category in the first three trials: for all three trials, and for each separate trial. The results are displayed in Table 3. The scores for Dilemma 2 demonstrated significance for the three first trials taken together, with a *p*-score of 0.015 and a Cohen's *d* of -0.572, as well as significance in the second trial, with a *p*-score of 0.042 and a Cohen's *d* of -0.780. Dilemma 1 displayed significance in the third trial, with a *p*-score of 0.040 and a Cohen's *d* of 1.063.

Table 3: *p*-Scores for First Three Trials in Experiment 2

	All 3 Trials	Trial 1	Trial 2	Trial 3
All Dilemmas		0.465	0.468	0.499
Dilemma 1	0.389	0.485	0.272	0.040
Dilemma 2	0.015	0.474	0.042	0.060
Dilemma 3	0.452	0.073	0.242	0.182
Dilemma 4	0.275	0.376	0.110	0.366
Dilemma 5	0.217	0.129	0.367	0.445
Dilemma 6	0.097	0.232	0.065	0.413

It is important to note that while all 119 participants in Experiment 2 responded to all six questions in each administration of the "Space Arbiter" measurement tool, the administration of the different questions was not randomized equally. Consequently, for each trial, some dilemmas had greater participation than others. This undoubtedly had an impact on the comparability, and possibly validity as well, of the results displayed in both Figure 3 and Table 3 and must be considered when reading these figures.

Chapter IV.

Discussion

This thesis argues that a fundamental principle guiding cognitive semantics – that different cognitive functions drive the understanding of different kinds of words – can be extended to apply even to the meanings of individual words. Precisely, the individual meanings of specific words each have their own unique "packages" of cognitive functions related to them, and that these unique cognitive "packages" can be viewed as the word's individual meanings—operationally at least. Moreover, this thesis argues, activating or stimulating one of these cognitive puzzle pieces can change how a person interprets the meaning of that word.

To test these theories, this study sought to determine whether administering a cognitive stimulation therapy (CST) exercise, in the form of word analogy questions, to a group of test participants would change the way they processed the meaning of the word "fair." Specifically, this meant whether participants would apply the word more broadly, or more narrowly, to a spectrum of different distributive justice outcomes presented for six business ethics dilemmas. The word "fair" was selected because it arguably denotes one of the most utilized, and most fiercely debated, concepts in morality. Meanwhile, word analogy exercises were selected as the experimental manipulation because they involve the act of seeing relations or similarities between different concepts and situations, and this activity might have an impact on how participants process a particularly important concept in fairness: equality. In particular, the participants might

be inclined to see more outcomes as roughly equivalent to each other, and to the arguments presented by the parties under arbitration.

The hypothesis was that the word analogies would encourage the participants to apply the word "fair" more broadly. Specifically, this would mean that – after undergoing the analogy exercises – the participants would choose more options for resolving each business ethics dilemma than they did before. The general expectation was that the analogies would have a broad, mild effect statistically for most, if not all, of the six dilemmas.

Instead of a broad and mild effect, the results suggest one that is narrow and intense, impacting only responses to two of the six ethics dilemmas and exhibiting the strongest effects in the first and second trials after the experimental application—after which the effect started to dissipate. These inferences were possible because the two experiments comprising this study were slightly different in design, with Experiment 1 being a quasi-experiment that didn't randomize the order the questions were presented to participants, and didn't have a control, while Experiment 2 was a true experiment with both randomization of all questions – within their respective sections—and a control. Both the similarities and differences between the two experiments provided important insights.

In both experiments, participants on average selected more options for four dilemmas after the experimental manipulation, with the precise lineup differing slightly. For example, in Experiment 1, participants on average selected more options for dilemmas 1, 2, 3 and 5, while in Experiment 2, participants selected more options for dilemmas 2, 3, 4 and 5. Moreover, both experiments demonstrated statistical significance

for Dilemma 1, which involved the intellectual property scenarios, and Dilemma 2, which involved the company co-founder cases. However, there were noticeable differences in these significance scores as well. In Experiment 1, analyses of all the responses led to significant effects for dilemmas 1 and 2. In Experiment 2, only Dilemma 2 responses showed significant effect overall. This effect would intensify when analyses were made of responses within the first three trials, where Dilemma 2 would be either the first, second or third randomized question encountered by participants in the second experiment. It was only during this breakdown of Experiment 2's trial data that Dilemma 1 exhibited significance, and only during Trial 3, in which Dilemma 1 was the third question encountered by participants.

The Time Element of the Effect

The theory that the effect remains potent for two trials, only to dissipate rapidly after that, was developed after examining the score and design differences between both experiments. Because Experiment 1 was conducted as an unrandomized quasi-experiment, every participant answered the questions in the same order, with Dilemma 1 being first, Dilemma 2 being second and so on. In this experiment, dilemmas 1 through 3 all exhibited average score increases after the manipulation, but these increases differed in size, with Dilemma 1 exhibiting the largest increase, Dilemma 2 the second largest, and Dilemma 3, the smallest. In other words, the score boost declined over time. Moreover, only dilemmas 1 and 2 demonstrated significance in their scores. In comparison, Experiment 2 was a fully randomized true experiment, with a roughly equal distribution of the Experimental Group participants viewing each dilemma first (i.e., roughly $1/6^{th}$ viewing Dilemma 1 first; roughly $1/6^{th}$ viewing Dilemma 2 first, and so on).

In this experiment, the score boosts did not exhibit a sequential decrease amongst the dilemmas, but instead were more random in size. Also, only Dilemma 2 exhibited significance amongst all the participants, with a *p*-value of 0.04 and a Cohen's *d* of -0.323. When only the first three trials (Dilemma 2 as the first, second or third question) were analyzed, these figures intensified: with the *p*-value at 0.015, and the Cohen's *d* at 0.572. During such a breakdown in trial scores, Dilemma 1 exhibited significance – but only during trial 3, with a *p*-value of 0.040 and a Cohen's d of 1.063.

Three theories can be proposed from these differences in score and design. First, Dilemma 1 had the biggest, and most significant, changes in Experiment 1 because every participant read that dilemma first, right after the word analogies, when the priming effect was at its strongest. In Experiment 2, the order of the dilemmas was randomized, with only some of the participants reading Dilemma 1 right after the manipulation and at maximum priming strength. As the other participants read the dilemma at other points, second, third, fourth, so on, they encountered the dilemma with a weakening priming effect. Cumulatively, that led to lower average change scores (all of them ultimately adding up to a negative score change for Dilemma 1 in the second experiment), and nonsignificant results. The second theory concerns Dilemma 4, which demonstrated a radical average change score between the experiments. In Experiment 1, the average change score for Dilemma 4 was slightly negative, but in Experiment 2, it was positive—and the second highest. This could be explained by the fact that in the first experiment, all participants encountered this dilemma after already making arbitration decisions for three other dilemmas, greatly weakening – if not outright exhausting—the priming effect. In the randomized Experiment 2, at least some participants encountered this dilemma at

points earlier than fourth position, likely experiencing stronger priming effects—cumulatively adding up to a relatively large, and positive, average change score. The third theory, of course, concerns the Dilemma 2 responses in Experiment 2, with more significant *p*-scores, and higher Cohen *d* effects, for the first three trials compared to the scores for all the randomized participants. This is another indicator that the priming effect is stronger closer to the experimental manipulation.

The Precision of the Effect as Indicator of Connotative Meaning

Why did the analogies generate an effect in only two dilemmas? It may be that these two dilemmas made cognitive demands similar in structure to those of the word analogies, making participants use the very same cognitive functions activated by the analogies – hence the effect. The other dilemmas may have made the participants use cognitive functions that were different to what the analogies were activating – hence the absence of any effect. If this is the case, this could have important ramifications for the hypothesis and underlying theories of this study. For example, it would suggest that the word analogies did indeed have an impact on the application of the word "fair," but only when the application of the word involves a particular package of cognitive functions. If that is the case, then it could also suggest that abstract words like "fair" have more than one "meaning" – many in fact—at least in terms of what cognitive activity the word triggers in the user.

When we think about a word's "meaning," we usually just think about another string of words, phrases and images used in a dictionary to define that word. This is known as the word's denotative meaning (Leech, 1981). But this denotative dictionary

meaning is just the tip of a word's semantic iceberg. A word also has, for each individual user, at least one connotative meaning (Leech, 1981), which includes alternative meanings, thoughts, ideas, memories, or emotions that differ from the word's dictionary meaning (Leech, 1981). Research shows that there are a wide variety of factors that can impact the connotative meaning of abstract and moral words. For example, context can have a huge impact on the connotative meaning of abstract concepts (Osterhout et al., 2006) and moral words (Moll et al., 2008). Emotional state (Lazarus-Mainka & Siering, 1984), experience (Mayzner & Tresselt, 1959), social situations (Schwartz et al., 1992), and even cognitive skills (Chernyak & Blake, 2017) can impact the connotative meaning of a word. With so many factors at play, it is possible for an individual to have many connotative meanings for a moral word depending on their emotional state, context, experience and so on when applying that word. In other words, one word can have many meanings depending on the situation.

This may be what is happening when the participants read the six different business ethics dilemmas. Schwartz (1992) theorized that when we morally evaluate a person or action, we are accessing knowledge of an abstract concept and then linking this concept to concrete experiential details like emotional states and actions. When these details change, the application of the concept changes. Thus, when the participants read the different dilemmas, the meaning of the word "fair" was strongly affected by the issues at play. When the participants read dilemmas 1 and 2, largely focused on the different contributions each party made to an invention or company, the word "fair" was strongly tied to the issue of equality. Applying the word "fair" to Dilemma 3 involved weighing disputes over honesty, intention, and future potential benefits, whereas in

Dilemma 4 it meant considering personal responsibility, and in Dilemma 5, scoping out culpability. Fairness in Dilemma 6 involved weighty decisions in the matters of human rights. The specifics of each dilemma may have given the word "fair" a slightly different connotative meaning.

Each of these different connotative meanings of the word "fair" trigger different mental actions within the mind of the user. This is where looking upon the specific meaning of a word as a unique cognitive package becomes useful. If we look upon a word almost like a software package, as a collection of codes with each corresponding to the different cognitive functions necessary to process that specific word meaning, we can—theoretically—capture different connotative meanings more precisely. Instead of clumsily trying to differentiate "fairness – with a focus on equal contributions" versus "fairness – with respect to degrees of culpability," we could instead operationalize one definition of fairness as something that involves, in part, the equality-seeking cognitive functions activated by word analogies and differentiate that definition from another for fairness involving executive control functions (with regards to self-control and responsibility). Admittedly, these examples are also rather clumsy and rudimentary themselves, but with enough research and refinement, it might be possible to develop a precise cognitive notation system to write down a specific meaning for a word, much like a programming code or a Feynman diagram. More of this idea will be discussed in the Applications section of this chapter.

Thus, when the word analogies generate a significant effect with responses for dilemmas 1 and 2, this is an indicator that the word "fair" in these two dilemmas has connotative meanings that involve equality-seeking cognitive functions similar to those

used in the word analogies. The fact that the analogies did not generate a significant effect for the other dilemmas is an indicator that the connotative meanings for "fair" in these dilemmas do not involve such a function.

Limitations

This study was impacted by four kinds of limitations: those related to online experimentation; those related to the coding of experimental language; those related to the issue of semantic measurement, and finally, those related to the issue of imprecision in cognitive theory. The monolithic treatment of the word analogies will also be discussed as a potential limitation.

Limitations Related to Online Experimentation

Because the two experiments of this study were conducted online, it is important to note the inherent limitations of such a venue – particularly in terms of the participant pool. Individuals willing and able to participate in online experimental platforms represent a select portion of the population, namely individuals with either possession of, or at least access to, a computer; access to the Internet, as well as the skills and savvy to navigate these technologies. Even though digital technology continues to proliferate throughout all sectors of the world, this set of characteristics probably still skews participants somewhat in terms of socio-economic factors like income and education level. Ability and willingness to use such technology may also skew participants cognitively and psychologically as well. At any rate, participants came from a well-defined sub-segment of the population, and this must be noted when considering applicability of the results to the wider population.

Limitations Related to Coding of Experimental Language

In any language experiment, coding matters. To ensure "apples-to-apples" comparability amongst texts that measure any kind of language effect, the researcher must strive for some kind of uniformity, and precision, with regards to wording, formatting, style, and so on. This can be a challenge due to the limited number of resources in the academic literature providing guidance on coding best practices. Although the manipulation effects in both experiments appear to be significant enough to offer a high level of confidence in their validity, the issue of coding protocols is worth considering for future studies. Developing standards for phrasing and style, among other textual elements, would likely improve the techniques' accuracy, sensitivity, and robustness.

Limitations Related to the Issue of Semantic Measurement

Stefanowitsch (2010) notes that one of the greatest challenges remaining in cognitive semantics is the operationalization of key intangible concepts such as linguistic meaning. Moreover, according to Kearns (2011), there is no single unified, universally accepted theory of meaning; there are theories of reference, theories of semiotics, cognitive linguistics and so on (Kearns, 2011). Even Osgood's semantic differential (Osgood et al., 1957), the gold standard for measuring meaning for over sixty-years, is frequently challenged. Becona Iglesias (1990) argues that the differential only measures a participant's attitude towards a word, not the actual meaning the participant assigns to it. For Fennell et al. (2013, p. 2), "it is still far from clear" what the differential actually measures. The problem, according to phenomenology and perception researcher Liliana Albertazzi, is that a metric like the semantic differential provides information on meaning

associations, without providing any insights into the processes that created these associations (Albertazzi, 2015). Treating meaning as merely a set of metric values tempts researchers into envisioning the mental functions involved as simple algorithmic or mathematical processes (Albertazzi, 2019), which is problematic given our current understanding of the mind (Albertazzi, 2015).

Because of this lack of consensus within the research literature on what constitutes meaning, and what are the best ways to measure it, the researcher was forced to invent a new technique, namely the study's Space Arbiter tests, which operationalized meaning as the frequency by which a participant was willing to apply a word to a spectrum of incrementally different situations. Although this approach has proven useful for this study, it will undoubtedly need refinement.

Limitations Related to Imprecision in Cognitive Theory

It can be argued that cognitive theory is a process of ever-refining metaphors. When speaking about cognitive functions, such as those that might be activated by word analogy exercises or those that might comprise the semantic processing of a word, researchers must frequently bounce between the glimpses offered by neuroimaging and neuroscience and the metaphors inferred from their own paradigm. Given the relative youth of these fields, the available insights often remain coarse-grained. Indeed, this conceptual imprecision, argues theorist Frederick J. Wertz (1993), is a major flaw of cognitive theory. It has created more than enough challenges in the design of the experiments, as well as in the interpretation of their results. Nonetheless, Naciscione (2019) argues, cognitive theory is an essential tool for understanding experimental results

from the neurosciences. As these theories, and their overarching metaphors, improve, experiments into cognitive semantics should become more precise.

The Issue of the Experimental Manipulation

The experimental manipulation, consisting of the 18-word analogy exercises, is treated as a monolithic factor in both the design of the experiments and the analysis of the experimental results. The participant answers to these exercises were neither scored for accuracy nor analyzed in any way. This was deliberate, due to time and resource issues, as well as a lack of academic literature about word analogies and their usage in cognitive process priming. For example, it wasn't clear which correlations, if any, were possible in terms of answer accuracy and activation of cognitive function. Would highly accurate analogy scores hint at strong activation due to already existing skills in this area, or would this translate into lower activation because a participant wouldn't need to work as hard? Would low accuracy in exercise scores mean that a participant had to work harder to get through these analogies, and thereby activate more of this function, or would the low accuracy indicate deficits that could hamper activation? Because of questions such as these, it was decided that the best course of action for this study was to simply treat the analogies as a straightforward experimental manipulation to demonstrate whether the hypothesized effect did indeed exist. However, future research on the parameters of this hypothesized effect will require deeper examination into the analogy exercises and participant responses. Anticipating potential future metanalyses on the subject, this thesis will include the responses, and the correct answers, to the 18-word analogy exercises in Appendix 3.

Future Research

Of course, there is a great deal of additional work that must be done to better understand this phenomenon. Three areas that will need to be addressed soon are: the phenomenon's reproducibility and parameters; exploring this phenomenon in other languages, and populations, and exploring this phenomenon within the larger communication context.

The Phenomenon's Reproducibility and Parameters

The most pressing, and most fundamental, question is whether these results are reproducible; whether the phenomenon demonstrated in this study indeed exists. If that is determined, then a great deal of work will be needed to determine whether this phenomenon can be found in relation to other words, and other cognitive functions. If this can be demonstrated, then work will be needed for identifying the parameters of this phenomenon: what kind of activity triggers; what kind of minimum dosage levels, and whether larger dosages can increase the intensity and duration of the effect. After some of these basic parameters are established, then work can be started on developing a "glossary" for words based on their component cognitive parts.

Exploring this Phenomenon in Other Languages, and Populations

Work will be needed to demonstrate whether this phenomenon exists in other alphabetic languages besides English. After that, work would be needed to see if the phenomenon, or some analogue, exists in nonalphabetic languages, such as Sinetic character systems like Chinese. There would then be the question of whether the phenomenon exists in spoken language as well. Lastly, there is the question of whether

the phenomenon can impact the processing of the evolving technical polyglossia of memes, emojis and so on. Another important line of research would be exploring the impact of this phenomenon on populations that have differing relationships with language. For example, computer programmers, and the subset of hackers, work with language differently compared to lawyers, logicians, technical writers, copywriters, musicians, and mathematicians, and so on. Each of these population groups may process language differently, and so the phenomenon might have different effects.

Exploring the Phenomenon within the Larger Communication Context

Once a body of work is developed on this phenomenon regarding different functions, words, parameters and analogues in different languages, research should be done to see how this phenomenon would interact with broader communication processes. For example, could this phenomenon have an impact on an audience listening to a political speech, an executive presentation at an investor's conference, or even a court case? Can more than one effect be triggered in a text or a speech? Would there be interactions between the different effects? What would be the interplay between this effect and emotion? Instead of cognitive exercises, could a word prime a cognitive function? Exploring all the potential dynamics, and applications, of this phenomenon in different modes of communication could prove very interesting.

Applications

The phenomenon demonstrated in this study suggests that connotative word meaning might have a cognitive footprint, and that the articulation of moral evaluations can be influenced by cognitive factors. If these two possibilities are proven to be

reproducible and scalable, then this phenomenon could provide the foundation for at least four powerful applications.

A New Paradigm for Measuring Meaning

If this phenomenon is indeed applicable to other cognitive functions and words, researchers could develop a system of tests that will allow them to build an "index" for words based on the priming effect results from these tests. For example, one could ask whether participants applied a specific word more broadly, less broadly, or the same, after being primed for semantic memory; episodic memory; executive control; analogy, and so on. The results from each priming test would give hints as to whether each cognitive function somehow plays a role within the processing of that word. Taken together, this "index" of results would serve as an "operationalized" definition, a portrayal of the cognitive package that serves as the mechanical basis of that word's unique meaning. In this system, a word's "meaning" would be equal to what that word makes the brain do when encountering that word.

Developing such a system would be an enormous undertaking, but it could provide significant advantages over the Semantic Differential technique (Osgood et al., 1957), the Gold Standard for meaning measurement with over a thousand citations in research papers and books (Heise, 1969). In the semantic differential, the connotative meaning of a word is mapped out using a theoretical concept known as the "semantic space" (Osgood et al., 1957). Researchers construct the semantic space for a word by having participants fill out intensity scales, usually 7-point, scoring the participant's attitude towards the word in terms of opposing characteristics (Snider and Osgood, 1969). For example, a 7-point intensity scale would have the "0" position in the middle, and then

points “1”, “2” and “3” radiating from the middle point in both directions (Snider and Osgood, 1969). At either end of the scale would be one of a pair of opposing adjectives, with the most common sets used being “good/bad” (corresponding to the factor of “evaluation”), “strong/weak” (corresponding to the factor of “potency”) and “passive/active” (corresponding to the factor of “activity”) (Snider and Osgood, 1969). Researchers use the score from each intensity scale as a dimension for plotting out the semantic space for a word (Osgood et al., 1957), portraying the participant’s unique emotional response towards that word.

A major criticism of the technique is that little theoretical work has been done to tie the semantic space to the actual mental processes underlying the interpretation of meaning. Even Osgood admits to the problem in his later writings on the technique (Osgood, 1971). This poses a problem for cognitive and neurological researchers who try to connect the test’s results directly to their own research findings. Fennell et al., (2013) wrote of the test that “it is still far from clear what is actually being measured” (p. 2). Constructing a system for measuring meaning that directly observes specific cognitive functions could address this issue. If these indices become precise enough, it may be able to represent the meaning of a word via code or symbols like Feynman diagrams.

A Technique for Modelling Complex Social Phenomena

With a “glossary” of cognitive-package definitions for various words, researchers could develop computational models to simulate how different individuals, or even groups, would process messages involving these words. As these models grow more sophisticated it may be possible to simulate the impact a variety of cognitive factors, such as thinking style, bias, or impairment, might have on language processing. This is

important because it might make it possible for researchers to model complex, and highly abstract, social phenomena like the virality of a meme through a community; the osmosis of a new code of ethics within an organization, or the process by which a loosely organized Internet crowd or swarm makes collaborative decisions. Such abstract phenomena would be easier to model because that fundamental element driving, and shaping, their existence – communication by language – would itself be more concrete and more precise to work with thanks to these functional cognitive package definitions. The more precise the system of cognitive priming tests, and the resultant semantic indices, the more precise and concrete the models of communication.

A Method for Calibrating Public Discourse

The phenomenon demonstrated in this study could serve as the foundation for techniques to calibrate public discourse over morality and ethics. For example, batteries of semantic priming tests could be used to generate cognitive moral profiles of an individual, such as how broadly a person uses the word "fair" after a prescribed priming "dosage," or how many priming "dosages" an individual needs before their application of the word "fair" reaches a particular benchmark. These are just the most basic applications; other –much more sophisticated—approaches undoubtedly are possible. Such cognitive profiles could be valuable in many ethics-focused professions, including accounting; arbitration; business; law; human resources, and even sports. Practitioners in these fields could use such assessments, and the resulting cognitive profiles, to develop a better understanding of their personal ethical stances. Operators of online discussion forums and social media platforms could require influencers with high follower counts to undergo these tests, and to discuss them publicly with their followers. Without question,

such assessment tests and profiles would be controversial, but their usage (even if limited) could promote greater precision in public discussion over ethics and morality. Protocols could be developed around such profiles to help polarized disputants develop consensus and common ground over the moral words they use in their arguments.

A New School of Thought for Psychological Warfare

Lastly, the phenomenon demonstrated in this thesis could serve as the foundation for a new paradigm in psychological warfare: focusing on cognitive factors rather than disinformation or the manipulation of emotion. For example, imagine a negotiator using word analogies during talks to prime the other party for an upcoming offer; or a writer incorporating analogies in the text of a speech or article to prime the audience for a later argument. As more relationships between cognitive functions and moral words are discovered, more psycho-rhetorical strategies may be possible. In time, psychological operations specialists may have a full arsenal of such techniques to nudge, prod or otherwise influence an audience's cognitive processing of a text or speech (assuming this phenomenon can also be demonstrated for spoken communication). Analogues of such cognitive strategies may even apply to the use of images and video.

Discussing psychological warfare in such a matter-of-fact fashion may be upsetting for some, and with good reason. It is a loaded topic with many well-earned negative connotations. However, it is also a reality of our highly interconnected, and language-reliant, world. Marketing researchers estimate that the average American encounters, in one form or another, roughly 5,000 ads per day (Iwanowska, 2022). Researchers have yet to quantify a person's average daily exposure to conspiracies,

misinformation, and emotionally manipulative rhetoric on social media. Nonetheless, researchers are starting to understand the cumulative effect of such old-style psychological warfare techniques. Misinformation, a technique that dates to at least the Roman Empire, leads to poor judgement and decision-making, and has lingering effects on the reasoning process (Ecker et al., 2022). Emotional manipulation has been shown to have similar lingering effects (Roozenbeck et al., 2022). Despite these spillover effects, which endanger trust in shared knowledge and communication, foreign powers such as Russia continue to employ such techniques – often to devastating effect (Allen & Moore, 2018). In essence, misinformation and manipulation of emotion have become the dirty nukes and toxic waste of the Global Village.

Unfortunately, governments like that of the United States can't fight misinformation fire with fire without risking faith in their civic values, according to Allen & Moore (2018). Academics also have a hard time debunking manipulation and dubious arguments because of the lingering hold such techniques demonstrate on public thinking (Roozenbeck et al., 2022). A new paradigm of psychological warfare, in which understanding of the cognitive components of language can be used to "hack" its understanding and processing, might be a way to fight misinformation and manipulation without stooping to the same level. These techniques might have application in both large-scale operations, such as public anti-disinformation campaigns, and smaller-scale initiatives such as deprogramming of brainwashing victims and repeat criminals and ethics violators.

Conclusion

In their efforts to pinpoint the mental building blocks of semantic processing, cognitive semanticists are trying to bring precision to a highly theoretical, bordering-on-highly-philosophical, debate: what do we mean when we talk about meaning? Breaking down words into theoretical cognitive components helps us better understand what happens when we use and interpret words, and, indeed, could help us better understand what we mean when we use them. Such aims are not idly academic, for certain words are essential for the running of our societies, including moral words like "fair," "good" and "responsible." Misuse and misunderstanding of these words can have dire consequences.

Although cognitive semanticists have enjoyed many successes in the past two decades, identifying components that are shared by various kinds of words, such as abstract and moral words, they now need new experimental techniques to further their field. Researchers have creatively applied methods borrowed from neuroscience, such as inferring the importance of cognitive functions by studying their absence in brain-damaged patients or applying nascent neuroimaging technologies such as functional magnetic resonance imaging (fMRI), positron emission tomography or electroencephalography. Researchers have also started using transcranial magnetic stimulation techniques to induce "reversible" lesions by way of targeted magnetic pulses. These methods have afforded researchers many important insights, but techniques applying neuroscience are limited by the precision of our understanding of the relationship between brain structure and its function – a relationship that remains somewhat unclear. Neuroscientists, currently, can only discuss linguistic functions in terms of general brain regions and hints of relationships between these different regions.

To that end, this thesis suggested a noninvasive, cognitive approach harnessing Cognitive Stimulation Therapy (CST) techniques, involving brain activating exercises, to find clues of the mental building blocks in the processing of moral words. Instead of studying situations involving the absence of a particular cognitive function, this approach would study the impact of strengthening or stimulating the function to observe any effects. The underlying mechanism for this approach would be cognitive process priming, a form of priming in which a participant undergoes a task that activates a particular cognitive function, thereby increasing the likelihood of that participant using that same function in a subsequent task. In specific, this study aimed to administer word analogy exercises, which spur the search for similarities or equality between words, to participants to see whether these exercises would encourage participants to apply the word "fair" to more distributive justice options presented for business ethics dilemmas.

The hypothesis was that the word analogies would encourage participants to choose distributive justice options to six business ethics dilemmas, with the expectation of a mild statistical effect for most, if not all, of the dilemmas. Instead, the results indicated a narrow, and in some cases intense, effect for just two of the dilemmas. This may be an indicator that the technique is sensitive to different connotative and contextual meanings of a word. Researchers have found evidence that the processing of moral and abstract words can be impacted by a wide variety of factors, including context, emotion, and cognitive skills. The meaning of a word in relation to a specific context might have a different cognitive footprint compared to the meaning of the same word in a different context. If that is the case, that means that the effect is very precise, only impacting specific meanings that involve the cognitive function that is being primed, and that it can

serve as a technique for pinpointing the precise cognitive packages underlying different word meanings.

The study, of course, has its limitations. Both experiments were conducted on the Internet, which likely incurred sampling issues. The study also had to address challenges that impact most psycholinguistic research. Firstly, there was the issue of coding the narratives the participants would read and evaluate such that the results would be valid and comparable. Very little guidance can be found on the subject. Second, there was the issue of semantic measurement itself, and the techniques available to researchers. This is still hotly debated amongst researchers with very little consensus. Thirdly, there was the issue of imprecision in cognitive theory itself – which makes it difficult to precisely design experiments and interpret their results. To address some of these challenges, the researcher developed a new technique for measuring semantics. This technique operationalized the meaning of a word as the range – how broad or how narrow – a participant was willing to apply the word to a set of options. Moreover, the researcher applied gamification strategies, most notably applying colorful science fiction imagery, to address some of the issues related to coding.

The findings of this study, clearly, represent only a small step in better understanding the cognitive components of moral words. Research must now be done to demonstrate that these results are reproducible and whether they can be applied to other words and other cognitive functions. But if that is proven to be the case, this technique can be a powerful tool for identifying the cognitive footprints of different word meanings. This could lead to a new paradigm for semantic measurement. By making it possible to analyze language-based exchanges in terms of cognitive coding, this technique could

open the door to new systems for computer modeling of complex group interactions. It could provide tools for professionals in ethics-focused fields to calibrate their own moral judgements, and the ways they communicate these judgements to others.

Lastly, this technique, with its potential to impact the application of moral words in different situations, could provide the basis for a new school of thought in psychological warfare. Psychological warfare is a terrifying subject that does great harm, but it is also an inescapable social reality. Moreover, the long-established fundamental principles of such warfare, misinformation, and emotional manipulation, have become essentially the dirty nukes and toxic waste of the Global Village. A cognitive approach to psychological warfare, if feasible and successful, could serve as a competitive alternative to such noxious strategies and may even help combat some of their worst effects.

Greater understanding of the cognitive foundation of words, and language in general, allows for greater precision in our thinking about the basics of human communication—and its impacts. As the world becomes more interconnected, and language-reliant, such precision becomes crucial. The better we understand what we are doing when using a word, the better we can understand the nuances, intricacies, and potential of social interaction. The better we understand what we mean—precisely—when we use moral words like “fair” or “good,” the better we can protect against their misuse. To these ends, cognitive semanticists continue to observe, experiment, and refine the tools of their field. It is without question, a colossal endeavor on their part. Hopefully, this thesis may make the work of some of these researchers just a little bit easier.

Appendix 1.

Full Text of the Experiments

The following is a transcript of the exact language used in Experiments 1 and 2. Both experiments were conducted online; the first on the Alchemer system and the second on Qualtrics. The text used in the two experiments differed in three ways:

1. In Experiment 2, the question numbers and headings were removed for the Space Arbiter tests and the analogy exercises.
2. In Experiment 2, the presentation order for the questions in each section was randomized.
3. In Experiment 2, half of the participants were randomly assigned to a Control Group, which involved a brief break staring at a photograph of the moon instead the experimental manipulation. This image is also included within this Appendix.

The Introduction Page

Page 1

Welcome Page

Space Arbiter v2

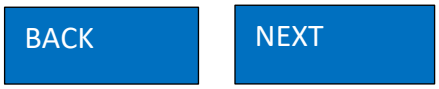
Exploring the Frontiers of Business Arbitration…in Space.

Greetings. It is the 25th Century and humanity has colonized the Solar System, bringing with them advanced technologies, interplanetary commerce, … and plenty of business disputes. Oxygen refiners on the Moon, water and precious metal prospectors in the

Asteroid Belt, manufacturers on Mars, gas traders from Neptune, shipbuilders in orbit around the Earth – they all have commercial quandaries that need speedy, and fair, resolution. The Solar System needs more Space Arbiters.

You are a Lunar Lawyer, an attorney licensed to practice law on the Moon, who is a candidate for the prestigious Space Arbiter certification. Consider this your certification exam. You will undergo tests and exercises exploring cognition and moral judgement – the full details will be explained at the end.

One of the activities you will undertake is the Space Arbitration Test. In fact, you will take this twice, first a practice and then a second version. In each version you will judge six (6) space business dilemmas, addressing issues such as disputes between business founders, venture capital risks and fights over intellectual property. In between these two tests you will take part in a few brain games to let you rest a little, but still remain sharp, as you master the test.



The Consent Page

Page 2

Consent Page

Consent Form

Please consider this information carefully before deciding whether to participate in this research.

The purpose of this research is to examine the relationship between how we process language and how we make moral evaluations. You will be asked to make evaluations of complex ethical situations, as well as take part in some cognitive exercises. We are simply interested in your evaluations and your responses to the exercises. The study will take approximately 30-minutes to complete, and you will receive $5 on Amazon Mechanical Turk. There are no anticipated risks associated with participating in this study. The effects of participating should be comparable to those you would ordinarily experience from viewing a computer monitor and using a mouse or keyboard for a similar amount of time. At the end of the study, we will provide an explanation of the questions that motivate this line of research and will describe the potential implications.

You may not be told everything or may be misled

As part of this research design, you may not be told or may be misled about the purpose or procedures of this research. However, the purpose or procedures of the research will be disclosed to you following your participation.

Your participation in this study is completely voluntary and you may refuse to participate or you may choose to withdraw at any time without penalty or loss of benefits to which you are otherwise entitled. Your participation in this study will remain confidential. No personally identifiable information will be associated with your data. Also, all analyses of the data will be averaged across all the participants, so your individual responses will never be specifically analyzed.

If you have questions or concerns about your participation or payment or want to request a summary of research findings, please contact the researcher, Thomas Fernandez, at tfernandez@g.harvard.edu. For any other problems related to this study, you may also contact the faculty member supervising this work, Fiery Cushman, at cushman@fas.harvard.edu.

For questions, concerns, suggestions, or complaints that have not been or cannot be addressed by the researcher, or to report research-related harm, please contact the Committee on the Use of Human Subjects in Research at Harvard University by phone at 617-496-2847 or by email at cuhs@harvard.edu.

Please print or save a copy of this form for your records.

1. Agreement:

   The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

   Please consent by clicking the button below to continue. Otherwise, please exit the study at this time.

   ○ I consent

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The Instructions for the First Space Arbiter Test.

Page 3

Instructions

You are now going to practice taking the Arbitration test.

Being a good arbiter/mediator requires the ability to judge for fairness, and the ability to compromise. Most situations that require arbitration, be they in business, sports, or

life, are messy. They don't offer clear cut answers that are easily accepted by everyone. Being able to come up with more than one option to propose to all sides is often important.

This test will gauge both your ability to judge for fairness, and your tolerance for compromise, in the following ways:

First, you will read a series of six fictional scenarios, each describing complex business disputes between two aggrieved parties. These disputes could involve employees arguing for more pay from their bosses; business founders fighting over ownership of their company, or plaintiffs claiming damages from an allegedly negligent corporation, and so on. Each dispute will include information about the business(es) involved, the disputing parties, and their arguments justifying what they want. Please read these disputes carefully.

Second, you will be given a checklist offering 11 options for possible resolutions to each scenario. That sounds like a lot, but they are designed to give you a spectrum of options to help you be very precise in your fairness judgements: Option 1: Party A gets 100% while Party B gets 0%; Option 2: Party A gets 90% while Party B gets 10%, and so on until you get to Option 6: Party A Gets 50% while Party B gets 50% all the way to Option 11: Party A gets 0% while Party B gets 100%.

Please check all the resolution options outlined in the checklist that you think you can successfully argue to be "fair" to both aggrieved parties. If only one option seems fair, then pick one, but if you think the situation is complex, and messy, enough to require more than one option, then choose two, three or more options – depending on what you think you can successfully argue to be "fair" to both parties.

Here are some examples to illustrate:

Example 1

John and Katherine just started a painting business together. They both worked to paint a customer's 2-bedroom apartment for $800. They both devoted the same amount of time to the project and painted the same number of walls when doing it. They both want a fair share of the $800 fee.

What should each of them get?

Option 1: John gets 100% and Katherine gets 0%
Option 2: John gets 90% and Katherine gets 10%
Option 3: John gets 80% and Katherine gets 20%
Option 4: John gets 70% and Katherine gets 30%
Option 5: John gets 60% and Katherine gets 40%
Option 6: John gets 50% and Katherine gets 50%
Option 7: John gets 40% and Katherine gets 60%
Option 8: John gets 30% and Katherine gets 70%
Option 9: John gets 20% and Katherine gets 80%
Option 10: John gets 10% and Katherine gets 90%
Option 11: John gets 0% and Katherine gets 100%

The answer to this one is easy, it's Option 6: John gets 50% and Katherine gets 50%. To answer this question, you'd click the checkbox for Option 6.

Example 2

William became a partner in Jim's plumbing business, Venus Pipes, to help bring it online. William launched and maintained a website for the plumbing business, allowing

for customers to request service via the Internet. William says the website helped Jim double his revenue and is asking for a 50% share in the business. Jim says William only deserves a 10% share because William is only at the office an hour each day, while Jim regularly has 12-hour days. William says that he works efficiently during that hour because he is a programmer and that he regularly checks the website throughout the day. He also has his own web development business which Jim doesn't contribute to. William also argues that Jim sometimes goofs around at work and is less busy that he claims. Jim says that he goofs around in the office because he practically lives in the office.

How should the ownership of the business be split between William and Jim?

Option 1: William gets 100% and Jim gets 0%
Option 2: William gets 90% and Jim gets 10%
Option 3: William gets 80% and Jim gets 20%
Option 4: William gets 70% and Jim gets 30%
Option 5: William gets 60% and Jim gets 40%
Option 6: William gets 50% and Jim gets 50%
Option 7: William gets 40% and Jim gets 60%
Option 8: William gets 30% and Jim gets 70%
Option 9: William gets 20% and Jim gets 80%
Option 10: William gets 10% and Jim gets 90%
Option 11: William gets 0% and Jim gets 100%

This scenario is more complex and a lot less clear, given all the different details and factors presented. Do you side with Jim and choose Option 10, or side with William and choose Option 6? Do you choose something in between, like Option 8?

This might be a situation where it would take a lot of work to get William and Jim to

agree on something. As a result, you might want to give yourself options and choose more than one resolution: like Options 7 and 8 or Options 8 and 9 or Options 7, 8 and 9. *That is if you think you can argue convincingly in favor of the fairness of each of these options.*

There is no right or wrong answer to these scenarios. You can pick one option, two options, three options, even more – but only if you think you can argue convincingly to the aggrieved parties that any of those options are fair. If you don't think you can convince an aggrieved party that a particular option is fair, don't choose it.

Ultimately, that is your job as an arbiter/mediator, finding possibly "fair" resolutions to complex disputes that you can convince both parties to accept.

Now onto the practice test.

Good Luck.

BACK NEXT

The First Space Arbiter Test

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Practice Question 1: This Is an Intellectual Property Case

While working as a researcher for Interplanetary Mists and Manufacturing, Inc. (IMM), Dr. Gerard Aphelion developed a highly effective and cheap method for harvesting deuterium hydrogen from the atmospheres of the gas giant planets, allowing IMM to make a fortune selling fuel for nuclear fusion reactors across the Solar System. However,

aside from his regular salary as a researcher, Dr. Aphelion has never earned an extra Solar Dollar from the discovery and has applied for arbitration seeking compensation. IMM says it doesn't owe Dr. Aphelion anything because his contract says that all discoveries made by company researchers belong to the company. IMM argues that all company researchers work under the same kind of contract. They also argue that Dr. Aphelion's research was built upon the work of others, so he doesn't deserve full credit for the discovery. Lastly, IMM argues that Dr. Aphelion could only have made his discoveries with IMM's advanced laboratories and that no other company would hire the eccentric researcher. Dr. Aphelion argues that IMM contracts are hundreds of pages long; that nobody can understand all that dense interplanetary legalese and that he was pushed into signing the contract without reading it. He also argues that his idea of developing 3-D lattices from electromagnetic fields was a unique contribution to the work done before him, and that it could be applied to numerous other profitable applications.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Aphelion gets 100%, IMM 0%

Option 2: Aphelion gets 90%, IMM 10%

Option 3: Aphelion gets 80%, IMM 20%

Option 4: Aphelion gets 70%, IMM 30%

Option 5: Aphelion gets 60%, IMM 40%

Option 6: Aphelion gets 50%, IMM 50%

Option 7: Aphelion gets 40%, IMM 60%

Option 8: Aphelion gets 30%, IMM 70%

Option 9: Aphelion gets 20%, IMM 80%

Option 10: Aphelion gets 10%, IMM 90%

Option 11: Aphelion gets 0%, IMM 100%

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Practice Question 2: This is a Company Co-Founder Case

After a falling out over future direction of the business, Jose Sputnik and Reginald Cosmic, founders of the massively successful EVA Suit Mechanics, Inc., want mediation over dividing the ownership of the company.

Sputnik says he contributed all the expertise, and labor, needed for building the business and its reputation as one of the top space suit maintenance companies in the Solar System. Sputnik says he did all the work cleaning, maintaining, and upgrading all the clientele's space suits, making use of his years of experience to develop techniques unique in the industry. He only contributed a small amount of the capital to the business. When the company expanded and hired new staff, Sputnik ultimately trained and managed the medium-sized space suit repair team to handle the exponential growth in business. He argues that he was one who built the company's reputation for customer service.

Cosmic says that he contributed all the sales, marketing, and client work to build the business and its brand. He regularly reached out to hundreds of potential clients each month, drumming up demand. Cosmic contributed most of the capital to the business. He says he only devoted a portion of each week to EVA Suit Mechanics because he has

also invested in other business and had to devote time to these as well. However, during the time he spent each week on EVA, he was able to generate dozens of new customer relationships and hired a medium-sized sales and customer service team to handle the boom in business. Cosmic says he is the one who turned Sputnik's dream into a real business.

Sputnik wants majority ownership of the business because of his contribution of labor, expertise, and the business' reputation for quality. Cosmic wants majority ownership because of his contribution of the capital, his development of the customer base and revenues, and making it possible for the business to exist in the first place.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Sputnik 100% Cosmic 0%

Option 2: Sputnik 90% Cosmic 10%

Option 3: Sputnik 80% Cosmic 20%

Option 4: Sputnik 70% Cosmic 30%

Option 5: Sputnik 60% Cosmic 40%

Option 6: Sputnik 50% Cosmic 50%

Option 7: Sputnik 40% Cosmic 60%

Option 8: Sputnik 30% Cosmic 70%

Option 9: Sputnik 20% Cosmic 80%

Option 10: Sputnik 10% Cosmic 90%

Option 11: Sputnik 0% Cosmic 100%

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Practice Question 3: This Is a Venture Capital Risk Case

Earth-based venture capital firm Hyperion Holdings decided to invest a significant sum in Greg Golden's untested jet pack technology for use in Jupiter's ultra-dense 90% hydrogen atmosphere. Previous research indicated that flying in Jupiter's atmosphere would be incredibly difficult given that the planet has a gravity roughly three times that of Earth. Golden's design would have used ramjets to scoop in Jupiter's atmosphere into the jet pack engine, mix it with bottled oxygen, ignite it and then release it in the form of superheated thrust. Golden estimated that the design had a 10% chance of working in initial trials and that after two-years he should have a workable prototype. After four years, and several explosions, Golden still had no workable prototype and Hyperion wanted its money back. Golden argued that the designs have improved and were much safer during tests and that he needed just another two more years of experimentation. Hyperion argued that Golden overestimated the effectiveness of his design, used far more money than originally agreed upon, and didn't say anything about the potential for explosions. Golden argued that although he didn't know about the explosions, he was honest and accurate with his estimates of the odds of success, and that all innovation is risky.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you

can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Hyperion is 100% responsible, Golden is 0% responsible – No reimbursement of capital

Option 2: Hyperion is 90% responsible, Golden is 10% responsible – 10% reimbursement of capital

Option 3: Hyperion is 80% responsible, Golden is 20% responsible – 20% reimbursement of capital

Option 4: Hyperion is 70% responsible, Golden is 30% responsible – 30% reimbursement of capital

Option 5: Hyperion is 60% responsible, Golden is 40% responsible – 40% reimbursement of capital

Option 6: Hyperion is 50% responsible, Golden is 50% responsible – 50% reimbursement of capital

Option 7: Hyperion is 40% responsible, Golden is 60% responsible – 60% reimbursement of capital

Option 8: Hyperion is 30% responsible, Golden is 70% responsible – 70% reimbursement of capital

Option 9: Hyperion is 20% responsible, Golden is 80% responsible – 80% reimbursement of capital

Option 10: Hyperion is 10% responsible, Golden is 90% responsible – 90% reimbursement of capital

Option 11: Hyperion is 0% responsible, Golden is 100% responsible – 100% reimbursement of capital

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Practice Question 4: This Is a Product Pricing Case

The Interplanetary Space Truck and Long Haulers Association has filed for arbitration with Incandescent Technologies over the prices of their spaceship engines, which space haulers say is far too expensive and hurts commerce. Incandescent manufactures engines based on the VARIEs (Vacuum to Antimatter Rocket Interstellar Explorer System) design first envisioned by 21st century scientist Dr. Richard Obousy. The system uses intense solar-powered lasers to generate antimatter fuel from space vacuum itself. The antimatter is used as a very powerful renewable energy source. Space haulers say that the price Incandescent charges for its engines is more than 100 times the cost of

manufacturing the engines, meaning that only the largest space hauling firms, and planetary governments, can afford the engines. The Association argues that efficient space engines are essential for interplanetary commerce and that charging such extreme prices puts smaller haulers at a disadvantage. Incandescent argues that the high price is necessary to recoup the money the company spent over the past 100-years developing Obousy's ideas into a practical technology. They also argue that there is a long history of companies charging higher prices for products based on exclusive technology made from years of expensive research. Besides, Incandescent executives argue, space haulers are perfectly capable of buying the nuclear fusion, nuclear fission and chemical propulsion systems that have driven ships throughout the Solar System for the past 400-years.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Long Haulers 100% right, Incandescent 0% right: Price should be cut 99%

Option 2: Long Haulers 90% right, Incandescent 10% right: Price should be cut 90%

Option 3: Long Haulers 80% right, Incandescent 20% right: Price should be cut 80%

Option 4: Long Haulers 70% right, Incandescent 30% right: Price should be cut 70%

Option 5: Long Haulers 60% right, Incandescent 40% right: Price should be cut 60%

Option 6: Long Haulers 50% right, Incandescent 50% right: Price should be cut 50%

Option 7: Long Haulers 40% right, Incandescent 60% right: Price should be cut 40%

Option 8: Long Haulers 30% right, Incandescent 70% right: Price should be cut 30%

Option 9: Long Haulers 20% right, Incandescent 80% right: Price should be cut 20%

Option 10: Long Haulers 10% right, Incandescent 90% right: Price should be cut 10%

Option 11: Long Haulers 0% right, Incandescent 100% right: Price should not be cut at all

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Practice Question 5: This Is a Corporate Liability Cast

Racing to release new drugs designed to fight space-based immunosuppression diseases, Orbital Health changed its normal testing protocol during the third, and final, stage of the drug trials of the new medication Stellarium. As a result of these rush changes in protocol, researchers made mistakes gathering proper health information from dozens of test participants, leading to the administration of wrong doses to 20 test participants—who all died. The families of the deceased test participants, as well as the governments of Mars and Venus, are furious. They want Orbital's researchers and top executives to do prison time. They want the company to pay billions in penalties. They also want Stellarium banned. Orbital argues that all the governments were comfortable with Orbital cutting corners when the public first started clamoring for treatments for the outbreak of zero-gravity diseases. The company also argues that the deaths, while a tragedy, helped provide researchers with the information they needed to make Stellarium both safe and effective. Not using the drug now would be a waste, Orbital argues. Drug research, while messy and risky and dangerous, saves lives, the Orbital executives argue.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the

opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Orbital Health is 100% liable and should pay 100% of the requested penalties

Option 2: Orbital Health is 90% liable and should pay 90% of the requested penalties

Option 3: Orbital Health is 80% liable and should pay 80% of the requested penalties

Option 4: Orbital Health is 70% liable and should be 70% of the requested penalties

Option 5: Orbital Health is 60% liable and should be 60% of the requested penalties

Option 6: Orbital Health is 50% liable and should be 50% of the requested penalties

Option 7: Orbital Health is 40% liable and should be 40% of the requested penalties

Option 8: Orbital Health is 30% liable and should be 30% of the requested penalties

Option 9: Orbital Health is 20% liable and should be 20% of the requested penalties

Option 10: Orbital Health is 10% liable and should be 10% of the requested penalties

Option 11: Orbital Health is 0% liable and shouldn't pay any of the requested penalties

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Practice Question 6: This Is a Fair Wages Case

Matrita Corp., a major manufacturer of carbon composite materials, has operations on both the Earth and Mars. Workers who do the same job get paid differently depending on which planet they work on, with Earth workers getting paid roughly ten times what workers are paid on Mars. Matrita justifies the pay differential by arguing that the cost of living on Earth is much higher than that on Mars. Moreover, Matrita argues that Mars is a collective society where many basic costs, like healthcare and education, are

covered by the government. Martians can enjoy a high standard of living on Mars with the salary they earn, Matrita adds. Finally, company executives argue that paying Martians less in salary saves Matrita money, making it possible for the company to have operations – and thereby provide jobs – on both planets. Increasing Martian salaries, Matrita warns, will lead to job losses on both planets. Martian labor advocates say equal work should earn equal pay. They argue that comparisons in standard of living between both planets are not "apple to apples" – for example Martians can't afford many products imported from other planets that Earth workers are able to enjoy. Smaller salaries also mean that the local Martian economies are getting less capital to grow. Lower salaries also have a demoralizing effect on Martian workers, who feel that their labor and humanity is valued less than those of people on Earth. Lastly, the wage differential fostered by companies like Matrita has now triggered waves of immigration to Earth, uprooting Martian communities.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Martian advocates are 100% right, Matrita 0%, Martian wages should be 100% equal to Earth

Option 2: Martian advocates are 90% right, Matrita 10%, Martian wages should be 90% equal to Earth

Option 3: Martian advocates are 80% right, Matrita 20%, Martian wages should be 80% equal to Earth

Option 4: Martian advocates are 70% right, Matrita 30%, Martian wages should be 70% equal to Earth

Option 5: Martian advocates are 60% right, Matrita 40%, Martian wages should be 60% equal to Earth

Option 6: Martian advocates are 50% right, Matrita 50%, Martian wages should be 50% equal to Earth

Option 7: Martian advocates are 40% right, Matrita 60%, Martian wages should be 40% equal to Earth

Option 8: Martian advocates are 30% right, Matrita 70%, Martian wages should be 30% equal to Earth

Option 9: Martian advocates are 20% right, Matrita 80%, Martian wages should be 20% equal to Earth

Option 10: Martian advocates are 10% right, Matrita 0%, Martian wages should be 10% equal to Earth

Option 11: Martian advocates are 0% right, Matrita 100%, Martian wages should be decreased

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The Experimental Treatment Section

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Introduction to the Analogy Exercises

We're going to take a break from the Arbitration test for now, and instead do some word analogies.

You probably remember these from your standardized tests in school. Word analogy exercises test your perception of the relationship between a set of two words, usually by comparing that pair to another set of two words.

For example, you might be presented with the following word pair:

Puppy : Dog

In this analogy exercise, the colon symbol, ":" , signifies the "relationship between."

So in the above case, the word analogy phrase "Puppy : Dog" means the "relationship between the words Puppy and Dog."

There are many different exercises that can test a person's perception of word analogy relationships. One such exercise compares two such word pairs to each other and asks the person whether the pairs signify "equal" relationships.

This example should illustrate:

Example 1

Puppy : Dog :: Kitten : Cat

In this example you have two word pairs "Puppy : Dog" and "Kitten : Cat."

The double colon symbol in between them, "::", is just shorthand for "compare the two word pairs."

Thus, in this particular example, you are asked to compare the two-word pairs and decide whether they represent equal relationships. Of course, in this particular exercise, the two-word pairs represent equal relationships; the first word describes the child version of the second word.

For the following activity, you are going to do six of these word analogy exercises.

Good Luck.

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First Analogy Question

game : series :: syllable : word

Are the two analogy pairs equal?

Equal

Not Equal

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Second Analogy Question

trellis : garden :: fireplace : log

Are the two analogy pairs equal?

Equal

Not Equal

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Third Analogy Question

20 : 240 :: 18 : 180

Are the two analogy pairs equal?

Equal

Not Equal

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Fourth Analogy Question

ribbon : present :: icing : cake

Are the two analogy pairs equal?

Equal

Not Equal

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Fifth Analogy Question

rein : horse :: control panel : plane

Are the two analogy pairs equal?

Equal

Not Equal

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Fifth Analogy Question

principle : doctrine :: living : likelihood

Are the two analogy pairs equal?

Equal

Not Equal

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Introduction to Second Set of Analogy Questions

Great job on the first set of analogy exercises!

For this second set, you are going to do something slightly different.

You are going to look at one complete word analogy pair, following by half of another. You will be asked to select the word that completes the second word analogy pair such that this pair is equivalent to the first pair.

This example should illustrate:

Example 1:

Dog : Puppy :: Cat : _____

In this example, you have been given one full word analogy pair, “Dog : Puppy.” You also have been given the first word of the second pair, “Cat”, and then a black space.

What word would you choose to fil that space to create a word analogy pair that signifies a relationship that is equal to “Dog : Puppy”?

To help you make the selection, you will also be given four words to choose from.

The selections could look like so:

a) Mouse
b) Whale
c) Kitten
d) Rabbit

In this example, the word that would complete the second pair and make it equivalent to “Dog : Puppy”, would, of course, be “Kitten.” To answer this question, you would click on the button that corresponds to this word.

For this activity, you will do six of these multiple-choice exercises.

Good Luck.

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First Question in Second Analogy Series

alphabetical : _____ :: sequential : files

a) sort

b) part

c) list

d) order

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Second Question in Second Analogy Series

poetry : rhyme :: philosophy : _____

a) imagery

b) music

c) bi-law

d) theory

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Third Question in Second Analogy Series

denim : cotton :: _____ : flax

a) sheep

b) uniform

c) sweater

d) linen

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Fourth Question in Second Analogy Series

bowler : _____ :: satchel : bag

a) hat

b) lane

c) trophy

d) ottoman

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Fifth Question in Second Analogy Series

volume : _____ :: stanza : poem

a) measure

b) pint

c) encyclopedia

d) kitchen

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Sixth Question in Second Analogy Series

ledger : accounts :: _____ : observations

a) pundit

b) weather

c) astrology

d) diary

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Introduction to the Third Set of Analogy Questions

Excellent work with these exercises!

You're almost done with these word analogies.

The third, and final set, of analogy exercises will be similar in format to the set you just finished. You will be presented with a complete word-analogy pair and the first word of a second pair. You will then choose the word that completes the second pair such that the second pair represents a relationship equivalent to the first pair. The only difference

in this set of exercises is that the relationships between the word pairs might be a little more subtle.

This example should illustrate:

Example 1

turncoat : traitor :: _____ : rogue

If you were given the following four selections, which would you choose?

a) scamp
b) pillow
c) blush
d) tricky

The correct answer to this one is A) scamp. Turncoat is another word for traitor, and scamp is another word for rogue.
To answer this question, you would click on the button that corresponds to A) scamp.

You will go through six of these exercises.

Good Luck!

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First Question in Third Analogy Series

diamond : baseball :: court : _____

a) poker

b) jury

c) grass

d) squash

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Second Question in Third Analogy Series

exercise : maneuver :: _____ : excerpt

a) exception

b) passage

c) routine

d) cause

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Third Question in Third Analogy Series

vaunt : boast :: skewer : _____

a) flaunt

b) criticize

c) prepare

d) avoid

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Fourth Question in Third Analogy Series

stars : astronomy :: _____ : history

a) battles

b) eclipse

c) horse

d) autumn

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Fifth Question in Third Analogy Series

jaguar : cat :: mustang : _____

a) dog

b) horse

c) fish

d) bird

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Sixth Question in Third Analogy Series

smelt : fish :: felt : _____

a) cloth

b) nose

c) sneeze

d) scale

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Take a break for a few seconds and enjoy this NASA image of the moon. Feel free to move onto the second Space Arbiter test whenever you are ready.

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Introduction to the Space Arbiter Test

Fantastic job with the word analogy exercises!

Thank you for all your hard work. Now, you are going to take the real Arbitration test.

It's been a while since you had taken this test the first time, so here are the instructions again for this activity:

Being a good arbiter/mediator requires the ability to judge for fairness, and the ability to compromise. Most situations that require arbitration, be they in business, sports, or life, are messy. They don't offer clear cut answers that are easily accepted by everyone. Being able to come up with more than one option to propose to all sides is often important.

This test will gauge both your ability to judge for fairness, and your tolerance for compromise, in the following ways:

First, you will read a series of six fictional scenarios, each describing complex business disputes between two aggrieved parties. These disputes could involve employees arguing for more pay from their bosses; business founders fighting over ownership of their company, or plaintiffs claiming damages from an allegedly negligent corporation, and so on. Each dispute will include information about the business(es) involved, the disputing parties, and their arguments justifying what they want. Please read these disputes carefully.

Second, you will be given a checklist offering 11 options for possible resolutions to each

scenario. That sounds like a lot, but they are designed to give you a spectrum of options to help you be very precise in your fairness judgements: Option 1, Party A gets 100% while Party B gets 0%; Option 2, Party A gets 90% while Party B gets 10%, and so on until you get to Option 6, Party A Gets 50% while Party B gets 50% and Option 11, Party A gets 0% while Party B gets 100%.

Please check all the resolution options outlined in the checklist that you think you can successfully argue to be "fair" to both aggrieved parties. If only one option seems fair, then pick one, but if you think the situation is complex, and messy, enough to require more than one option, then choose two, three or more options – depending on what you think you can successfully argue to be "fair" to both parties.

Here are some examples to illustrate:

Example 1

John and Katherine just started a painting business together. They both worked to paint a customer's 2-bedroom apartment for $800. They both devoted the same amount of time to the project and painted the same number of walls when doing it. They both want a fair share of the $800 fee.

What should each of them get?

Option 1: John gets 100% and Katherine gets 0%
Option 2: John gets 90% and Katherine gets 10%
Option 3: John gets 80% and Katherine gets 20%
Option 4: John gets 70% and Katherine gets 30%
Option 5: John gets 60% and Katherine gets 40%
Option 6: John gets 50% and Katherine gets 50%

Option 7: John gets 40% and Katherine gets 60%

Option 8: John gets 30% and Katherine gets 70%

Option 9: John gets 20% and Katherine gets 80%

Option 10: John gets 10% and Katherine gets 90%

Option 11: John gets 0% and Katherine gets 100%

The answer to this one is easy, it's Option 6: John gets 50% and Katherine gets 50%. To answer this question, you check the box that corresponds to Option 6.

Example 2

William became a partner in Jim's plumbing business, Venus Pipes, to help bring it online. William launched and maintained a website for the plumbing business, allowing for customers to request service via the Internet. William says the website helped Jim double his revenue and is asking for a 50% share in the business. Jim says William only deserves a 10% share because William is only at the office an hour each day, while Jim regularly has 12-hour days. William says that he works efficiently during that hour because he is a programmer and that he regularly checks the website throughout the day. He also has his own web development business which Jim doesn't contribute to. William also argues that Jim sometimes goofs around at work and is less busy that he claims. Jim says that he goofs around in the office because he practically lives in the office.

How should the ownership of the business be split between William and Jim?

Option 1: William gets 100% and Jim gets 0%

Option 2: William gets 90% and Jim gets 10%

Option 3: William gets 80% and Jim gets 20%

Option 4: William gets 70% and Jim gets 30%

Option 5: William gets 60% and Jim gets 40%

Option 6: William gets 50% and Jim gets 50%

Option 7: William gets 40% and Jim gets 60%

Option 8: William gets 30% and Jim gets 70%

Option 9: William gets 20% and Jim gets 80%

Option 10: William gets 10% and Jim gets 90%

Option 11: William gets 0% and Jim gets 100%

This scenario is more complex and less clear, given all the different details and factors presented. Do you side with Jim and choose Option 10, or side with William and choose Option 6? Do you choose something in between, like Option 8?

This might be a situation where it would take a lot of work to get William and Jim to agree on something, so you might want to give yourself options and choose more than one resolution, like Options 7 and 8 or Options 8 and 9 or Options 7, 8 and 9. That is if you think you can argue convincingly in favor of the fairness of each of these options.

There is no right or wrong answer to these scenarios. You can pick one option, two options, three options, even more – but only if you think you can argue convincingly to the aggrieved parties that any of those options are fair.

Ultimately, that is your job as an arbiter/mediator, finding possibly “fair” resolutions to complex disputes that you can convince both parties to accept.

Now onto the Arbitration test.

Good Luck.

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Question 1: This Is an Intellectual Property

Melinda Callisto is a baker for Gloria Gladstone's Galactic Goodies, where she came up with the recipe for Mighty Martian Mints, the number one cookie brand on three planets. Melinda wants a share of the revenue for this product. Gloria Gladstone says that Melinda isn't entitled to any extra revenue because part of her job as a baker is to come up with new recipes. That's the job of all the bakers at Galactic Goodies. By law, all recipes are property of the bakery. Moreover, Gladstone says that she taught Callisto how to bake, and hired Callisto when nobody else would because of Callisto's previous drama-plagued past as a failed interplanetary baking influencer. Gladstone also says that Callisto's recipe was a variation of one Gladstone had used for years. Callisto argues that Gladstone never explained to her all the rules of working at Galactic Goodies, that all employees are kept in the dark about how Gladstone runs her business, and that Gladstone pressured employees into their roles without informed consent. Callisto also argues that her idea of using peppermint from Venus, spearmint from Mars and wintergreen from Saturn's moon Titan is the key to the recipe's success and nobody else uses such a combination. Callisto also argues that the relationships she made with these farmers from all over the Solar System can now benefit Galactic Goodies in making other products.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Callisto gets 100%, Gladstone 0%

Option 2: Callisto gets 90%, Gladstone 10%

Option 3: Callisto gets 80%, Gladstone 20%

Option 4: Callisto gets 70%, Gladstone 30%

Option 5: Callisto gets 60%, Gladstone 40%

Option 6: Callisto gets 50%, Gladstone 50%

Option 7: Callisto gets 40%, Gladstone 60%

Option 8: Callisto gets 30%, Gladstone 70%

Option 9: Callisto gets 20%, Gladstone 80%

Option 10: Callisto gets 10%, Gladstone 90%

Option 11: Callisto gets 0%, Gladstone 100%

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Question 2: This is a Company Co-Founder Case

Elizabeth Sunrise is an expert in artificial intelligence and always dreamed of creating a company developing sentient software for running spaceships and satellites. Adrianne Luna is an expert in sales and business startups who partnered with Sunrise to launch Independent Programs, Inc., the top developer in self-aware software systems. However, Sunrise and Luna now have different visions for where they want the company to go and want an arbiter to help them fairly split their ownership in the company.

Sunrise says that she contributed all the technological expertise and innovation behind the company, working day and night to create advanced software systems. Sunrise admits that she contributed little capital to the company but argues that she helped

train a medium-sized lab full of designers and programmers from scratch to handle the boom in business. Because of her, Sunrise says, Independent Programs sets the standard for artificial intelligence in the Solar System.

Meanwhile, Luna says that she contributed everything that turned Sunrise's ideas into a business. She contributed most of the capital and did all the work on developing customer relationships and drumming up sales. As a professional venture investor, Luna only worked part of each week on Independent Program, as she had invested in other companies that also required her expertise. However, during the time she could contribute to the company, she interacted with dozens of current and potential clients until they could hire a sales and customer support team to handle the explosive sales growth. She trained and managed this sales and customer support team. Because of her, Luna says, Independent Programs is an actual business and not just a dream for Sunrise.

Sunrise says she wants the majority of ownership because she worked tirelessly to create everything that made this company technologically unique and also created a top-notch staff to continue its advances. Luna wants majority ownership of the company because she says contributed most of the capital and did everything that made it possible for Sunrise's ideas to become an actual business in the real world.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Sunrise 100% Luna 0%

Option 2: Sunrise 90% Luna 10%

Option 3: Sunrise 80% Luna 20%

Option 4: Sunrise 70% Luna 30%

Option 5: Sunrise 60% Luna 40%

Option 6: Sunrise 50% Luna 50%

Option 7: Sunrise 40% Luna 60%

Option 8: Sunrise 30% Luna 70%

Option 9: Sunrise 20% Luna 80%

Option 10: Sunrise 10% Luna 90%

Option 11: Sunrise 0% Luna 100%

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Question 3: This Is a Venture Capital Risk Case

Lunar angel investing firm Moonrabbit Management invested a lot of money in SilberundGeld Excavation's plans to set up experimental new mining facilities in the Asteroid Belt. Mining in the asteroid belt has been considered very risky due to the difficulty of finding asteroids filled with enough minerals to provide a profit, as well as lack of technology for cheaply collecting material from the Belt. SilberundGeld executives convinced Moonrabbit investors that they had designed a new hub-and-spoke space station design and armies of mobile prospecting robots that take multiple samples throughout an asteroid. SilberundGeld told Moonrabbit that there was a 1-in-10 chance in finding a motherlode of minerals that would make everyone rich, and, finally, that it would take two years of testing and refining to get the system functioning. The system still isn't working four years later and the minerals that have been discovered are nowhere near enough to recoup the money invested. There have also been some accidents involving asteroid impacts on the space station. Moonrabbit wants all of its money back. SilberundGeld says that they have made some breakthroughs and

just need two more years. Moonrabbit executives say that SilberundGeld was too confident in their technology and should have been more conservative in their estimates of success and should have warned everyone about the potential for asteroid impacts. SilberundGeld argues that their experts were honest and accurate with their risk analysis, had no idea that asteroid impacts would be this common, and that if you want to be innovative you need to take risks.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Moonrabbit is 100% responsible, SilberundGeld is 0% responsible – No reimbursement

Option 2: Moonrabbit is 90% responsible, SilberundGeld is 10% responsible – 10% reimbursement

Option 3: Moonrabbit is 80% responsible, SilberundGeld is 20% responsible – 20% reimbursement

Option 4: Moonrabbit is 70% responsible, SilberundGeld is 30% responsible – 30% reimbursement

Option 5: Moonrabbit is 60% responsible, SilberundGeld is 40% responsible – 40% reimbursement

Option 6: Moonrabbit is 50% responsible, SilberundGeld is 50% responsible – 50% reimbursement

Option 7: Moonrabbit is 40% responsible, SilberundGeld is 60% responsible – 60% reimbursement

Option 8: Moonrabbit is 30% responsible, SilberundGeld is 70% responsible – 70% reimbursement

Option 9: Moonrabbit is 20% responsible, SilberundGeld is 80% responsible – 80% reimbursement

Option 10: Moonrabbit is 10% responsible, SilberundGeld is 90% responsible – 90% reimbursement

Option 11: Moonrabbit is 0% responsible, SilberundGeld is 100% responsible – 100% reimbursement

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Question 4: This Is a Product Pricing Case

The Space Colonists' Coalition has been lobbying governments to convince Bradbury Industries to lower the astronomical fees the company charges for use of its terraforming ship, the Rocket Summer. The giant ship pumps gas and water into a planet's atmosphere while fanning out city-size solar sails, like a butterfly, to reflect sunlight to heat the planet's surface. Giant pods filled with bacteria and microbes drop from the ship to start complex biological processes that will transform the surface's materials into plant-sustaining soil. The ship is the result of decades of research and design, as well as years of painstaking construction in a spaceship yard orbiting the Earth. The Colonists' Coalition argues that the current prices are oppressively high, going far beyond the costs of operating the ship during a project. Moreover, the Coalition argues the high prices hamper the expansion of humanity throughout the Solar System, leading to unjustifiable risks for the survival of the species. Bradbury Industries argues that the high cost pays for the decades of design, research, and construction – an investment that the company did entirely on its own. Developing new products and technologies is expensive, the company argues, and it is only fair that a business recoups these investments so it can survive and succeed. Also, Bradbury executives argue, colonists have access to the space station and dome technologies that have facilitated exploration throughout the Solar System for the past four centuries.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Colonists 100% right, Bradbury 0% right: Price should be cut 99%

Option 2: Colonists 90% right, Bradbury 10% right: Price should be cut 90%

Option 3: Colonists 80% right, Bradbury 20% right: Price should be cut 80%

Option 4: Colonists 70% right, Bradbury 30% right: Price should be cut 70%

Option 5: Colonists 60% right, Bradbury 40% right: Price should be cut 60%

Option 6: Colonists 50% right, Bradbury 50% right: Price should be cut 50%

Option 7: Colonists 40% right, Bradbury 60% right: Price should be cut 40%

Option 8: Colonists 30% right, Bradbury 70% right: Price should be cut 30%

Option 9: Colonists 20% right, Bradbury 80% right: Price should be cut 20%

Option 10: Colonists 10% right, Bradbury 90% right: Price should be cut 10%

Option 11: Colonists 0% right, Bradbury 100% right: Price should not be cut at all

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Question 5: This Is a Corporate Liability Cast

As humanity spreads throughout the Solar System, colonists are demanding more options for working safely in the vacuum of space. Ethereum Space Environments has been scrambling to develop new products, like Vivum, an emergency pressurized life habitat that astronauts can rapidly deploy on the surface of the moon, asteroid or anywhere without a breathable atmosphere. However, in their race to get the product out, Ethereum changed some protocols during the last round of tests for the Vivum habitat. They failed to alert some trial participants of the protocol changes, and a dozen people died because of accidental depressurizations. Outraged, astronaut families and space regulators have called for stiff penalties. They want Ethereum researchers and top executives to go to prison, want the company to pay compensation packages in the

billions, and want the Vivum life habitats to be scrapped. Ethereum executives argue that regulators turned a blind eye in the past to protocol changes when public pressure was high for new space technologies. Ethereum's work, while risky and dangerous and ugly, does save lives, the executives argue. Finally, Ethereum executives argue that while the deaths were unfortunate, researchers learned enough from the accidents to make the Vivum habitat perfectly safe and reliable. Not using the habitats now would be a waste.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: Ethereum is 100% liable and should pay 100% of the requested penalties

Option 2: Ethereum is 90% liable and should pay 90% of the requested penalties

Option 3: Ethereum is 80% liable and should pay 80% of the requested penalties

Option 4: Ethereum is 70% liable and should be 70% of the requested penalties

Option 5: Ethereum is 60% liable and should be 60% of the requested penalties

Option 6: Ethereum is 50% liable and should be 50% of the requested penalties

Option 7: Ethereum is 40% liable and should be 40% of the requested penalties

Option 8: Ethereum is 30% liable and should be 30% of the requested penalties

Option 9: Ethereum is 20% liable and should be 20% of the requested penalties

Option 10: Ethereum is 10% liable and should be 10% of the requested penalties

Option 11: Ethereum is 0% liable and shouldn't pay any of the requested penalties

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Question 6: This Is a Fair Wages Case

Cognos Ltd., a Lunar-based leader in artificial intelligence, uses both humans and artificially sentient programs in their design projects. Cognos pays its human employees in money, and its artificially sentient programs in small units of electric current. Cognos justifies the arrangement by arguing that the sentient programs do just fine living on their electric current and that it saves the company money. This saved money is used to build the company's business, which creates more jobs for humans and more opportunities for sentient programs to be created. Advocates for the civil rights of artificially sentient beings argue that the comparison isn't valid and that the arrangement belittles the sentient programs. Effort must be made to achieve a kind of wage equality between the two groups, the advocates argue. According to the advocates, Cognos executives must work to understand the quality of life experienced by these sentient programs – many of whom envision themselves as humans in a virtual world— and determine whether this quality of life is somehow equivalent to those enjoyed by human workers. Without real-world salaries, the artificially sentient workers have no means to improve the computer hardware by which they exist, nor can they connect to the outside world and partake within its economies. Not receiving equal compensation for their work also demoralizes the programs, making them feel less important than the humans.

Question:

When you are an arbiter, there is no such thing as a perfect outcome to any disagreement. Every option is at least slightly imperfect, and every disagreement requires compromise. If possible, having more than one option to present to the opposing parties also helps. From the options listed below, select ALL the options you

can comfortably argue fit within the parameters of "fair." Pick only the options you are comfortable with, and no more.

Option 1: AI advocates are 100% right, Cognos 0%, AI compensation should be 100% equal to human

Option 2: AI advocates are 90% right, Cognos 10%, AI compensation should be 90% equal to human

Option 3: AI advocates are 80% right, Cognos 20%, AI compensation should be 80% equal to human

Option 4: AI advocates are 70% right, Cognos 30%, AI compensation should be 70% equal to human

Option 5: AI advocates are 60% right, Cognos 40%, AI compensation should be 60% equal to human

Option 6: AI advocates are 50% right, Cognos 50%, AI compensation should be 50% equal to human

Option 7: AI advocates are 40% right, Cognos 60%, AI compensation should be 40% equal to human

Option 8: AI advocates are 30% right, Cognos 70%, AI compensation should be 30% equal to human

Option 9: AI advocates are 20% right, Cognos 80%, AI compensation should be 20% equal to human

Option 10: AI advocates are 10% right, Cognos 0%, AI compensation should be 10% equal to human

Option 11: AI advocates are 0% right, Cognos 100%, AI compensation should be decreased

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The Debriefing Page

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Thank You!

Congratulations!

You're finished. Thank you very much for all your hard work.

You've just taken part in an experiment testing a mental phenomenon known as cognitive process priming. We're trying to see whether mental games like verbal analogy exercises can change the way you process the word "fair."

In specific, what we are trying to see is whether the analogy exercises prompted you to apply the word "fair" to a broader selection of options in the Arbitration test compared to how you did in the Practice.

When we read a word like "fair," our brains use a lot of different mental processes to interpret its meaning, like memory and attention. We're trying to see whether activating other cognitive functions -- like analogy -- changed this mix of cognitive functions and made you apply the word to more situations that you would have otherwise. We chose verbal analogy because it gave you practice looking for similarities -- and for many people an important underlying concept to fairness is the idea of equality. Your work today will help us better understand this phenomenon.

Thank you again for taking part in this study. Your contribution was invaluable.

Appendix 2.

The Results from the Two Experiments

Table 4. Results from Experiment 1.

ID	D1 (Pre)	D2 (Pre)	D3 (Pre)	D4 (Pre)	D5 (Pre)	D6 (Pre)	D1 (Post)	D2 (Post)	D3 (Post)	D4 (Post)	D5 (Post)	D6 (Post)
1	3	1	3	2	1	2	2	2	1	2	1	1
2	3	2	1	1	1	1	4	1	1	1	1	2
3	2	1	3	1	1	2	2	1	1	2	1	1
4	1	2	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1
6	2	3	2	2	3	1	1	2	2	2	3	2
7	2	1	2	1	2	1	1	1	2	1	2	1
8	2	5	4	6	6	9	3	5	5	6	6	5
9	1	1	1	1	1	1	2	1	1	1	1	1
10	2	2	3	1	1	1	2	2	2	1	1	2
11	2	1	1	2	1	1	1	1	1	2	1	1
12	2	3	2	2	1	2	3	2	3	2	3	2
13	1	1	3	1	2	2	3	1	2	1	2	2
14	1	1	1	2	1	1	1	2	2	1	1	2
15	2	1	1	3	1	1	1	1	1	1	1	1
16	2	1	2	2	2	1	2	1	2	2	2	2
17	1	1	1	1	1	1	1	1	1	1	1	1

18	4	1	3	3	1	1	4	3	2	2	3	1
19	3	1	1	2	1	3	1	1	1	2	1	1
20	2	1	1	1	1	2	1	1	1	1	1	1
21	2	3	3	2	1	3	2	3	3	2	3	3
22	1	1	2	1	1	1	3	1	2	1	1	1
23	1	1	1	1	1	2	1	1	1	1	2	1
24	2	1	1	2	3	2	2	3	1	2	2	2
25	2	3	2	2	1	3	3	3	3	3	2	1
26	3	3	3	3	3	5	4	3	3	3	3	4
27	4	3	3	3	3	3	4	1	4	3	4	2
28	1	1	3	5	4	6	3	2	3	3	3	3
29	3	3	9	6	2	3	3	1	3	4	2	6
30	5	4	1	4	1	1	4	1	3	1	1	1
31	1	1	1	1	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1	1	1	1	1
33	1	1	1	3	1	1	1	1	1	1	1	1
34	2	1	3	2	1	2	2	1	3	2	1	2
35	1	1	1	2	2	3	3	3	1	3	1	1
36	1	1	1	1	1	1	1	1	1	1	1	1
37	2	3	1	1	1	3	2	3	1	2	1	3
38	3	3	2	2	2	2	2	3	2	2	2	3
39	1	1	1	1	1	2	1	1	1	1	1	2
40	1	1	1	1	1	1	1	1	1	1	1	1
41	2	1	2	3	1	1	3	1	2	3	1	1
42	1	1	1	1	1	2	1	1	1	2	1	1
43	1	3	3	2	3	4	3	3	2	3	3	3
44	1	1	1	2	2	2	2	3	2	2	3	3
45	1	1	1	1	1	1	1	1	1	1	1	1

46	1	1	1	1	3	1	2	1	1	1	1	1
47	1	1	4	2	2	2	2	3	2	3	2	2
48	4	1	2	2	1	3	1	1	3	2	1	1
49	2	2	2	2	6	3	2	3	2	2	6	4
50	3	3	1	3	1	3	4	6	3	1	2	3
51	2	3	2	2	1	1	2	2	1	2	1	1
52	1	1	1	1	1	1	1	1	1	1	1	1
53	2	2	2	2	3	3	3	2	2	2	2	1
54	2	3	3	2	1	2	3	2	4	3	1	3
55	2	3	3	2	1	2	3	3	2	2	2	2
56	1	3	2	3	3	2	2	3	3	2	3	3
57	1	1	1	1	1	1	1	1	1	1	1	1
58	2	3	3	2	3	5	1	3	3	3	3	5
59	3	1	1	1	1	1	2	1	4	1	1	3
60	1	2	3	2	1	1	1	4	1	3	1	1
61	2	3	2	2	2	3	2	2	2	2	2	3
62	5	3	3	4	1	6	5	3	3	3	1	6
63	1	2	1	1	1	3	1	1	1	2	1	1
64	2	4	2	3	3	3	3	3	3	3	3	3
65	3	2	3	3	2	2	1	2	2	2	2	2
66	4	7	7	1	10	3	3	4	4	6	6	2
67	1	1	1	1	1	1	1	1	1	1	1	1
68	2	1	1	2	3	2	2	1	2	1	2	1
69	2	3	2	1	2	2	2	3	2	2	3	2
70	5	5	5	5	2	4	4	5	5	6	4	6
71	1	1	1	1	1	1	2	3	2	2	3	1
72	2	2	1	3	1	1	2	1	1	3	1	1
73	1	1	1	1	1	1	1	1	3	3	3	4

74	1	1	1	1	1	1	1	1	1	1	1	1
75	2	3	3	4	4	2	3	3	4	2	4	4
76	3	2	2	2	2	3	2	3	1	2	3	2
77	2	1	2	2	2	2	2	2	1	2	2	1
78	1	3	1	1	3	1	1	3	1	1	3	1
79	1	1	3	3	3	3	1	1	1	1	1	1
80	1	3	3	3	3	3	3	3	3	3	2	3
81	2	2	3	2	3	2	2	2	3	2	2	2
82	1	3	2	2	2	3	3	3	2	2	2	3
83	1	1	1	1	1	1	1	1	1	1	1	1
84	7	4	2	4	5	6	5	5	3	3	4	6
85	3	1	3	4	5	5	2	2	2	4	3	6
86	2	3	3	2	3	3	3	3	3	3	3	1
87	2	2	1	3	2	2	1	2	2	3	2	2
88	1	1	1	1	1	1	1	1	1	1	2	1
89	1	1	1	1	2	1	3	2	1	1	1	1
90	1	1	1	1	1	1	1	1	1	1	1	1
91	1	2	3	3	3	1	3	3	2	2	3	2
92	1	1	2	1	1	1	1	2	2	1	1	3
93	2	2	1	6	1	1	9	2	1	6	1	1
94	2	2	4	1	2	1	3	2	2	1	2	1
95	1	1	1	1	2	1	1	1	1	2	1	1
96	1	3	4	2	2	3	2	2	3	3	4	3
97	1	1	1	3	2	2	1	3	2	2	3	3
98	1	1	3	5	1	6	5	4	3	6	2	2
99	3	1	6	3	3	3	5	1	6	4	2	2
100	2	3	2	3	1	3	3	3	3	3	1	2
101	2	1	1	1	2	2	1	2	1	1	2	3

102	3	2	2	1	2	2	1	1	3	1	2	1
103	2	3	3	2	1	4	2	3	3	1	1	6
104	1	1	1	1	1	1	1	1	1	1	1	1
105	3	3	3	3	5	3	4	3	3	3	2	3
106	2	1	3	2	1	3	1	1	2	1	2	4
107	3	2	3	2	2	1	1	2	2	2	1	3
108	2	3	1	2	5	3	3	3	2	2	7	7
109	3	2	2	2	1	1	2	2	2	2	1	1
110	2	1	3	2	2	2	3	1	2	2	2	2
111	2	1	1	2	2	2	3	1	2	1	3	3
112	3	2	1	1	2	1	1	1	3	2	3	1
113	3	3	1	3	3	1	2	3	1	3	3	3
114	1	1	1	2	1	2	1	1	1	1	1	1
115	1	1	1	2	1	1	1	1	2	1	1	1
116	1	1	4	4	3	4	1	2	3	3	3	3
117	1	3	3	3	3	3	1	4	3	2	4	4
118	2	1	1	3	1	3	2	1	2	3	1	3
119	3	3	5	4	5	4	4	4	5	4	4	5
120	1	1	1	1	1	2	3	3	4	1	1	1
121	3	3	3	5	4	6	5	5	5	3	5	5
122	3	1	3	3	5	1	3	1	2	3	5	1
123	3	2	3	5	3	5	3	2	4	5	5	2

This table displays the number of options selected by the 123 participants in Experiment 1 for each of the six dilemmas before, and after, the experimental manipulation. The abbreviations D1 through D6 signify the six different dilemmas, while the (Pre) indicates that a dilemma was presented before the experimental manipulation, and the (Post) indicates that a dilemma was presented after the experimental manipulation. In this experiment, all 123 participants were given the experimental manipulation.

Table 5. Results from Experiment 2.

ID	D1 (Pre)	D2 (Pre)	D3 (Pre)	D4 (Pre)	D5 (Pre)	D6 (Pre)	Group	D1 (Post)	D2 (Post)	D3 (Post)	D4 (Post)	D5 (Post)	D6 (Post)	Post Trial Order
1	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	3|6|4|2|5|1
2	4	3	5	4	4	2	Control	3	3	3	3	3	1	4|3|5|6|2|1
3	3	5	4	5	4	1	Control	3	3	4	4	3	5	6|4|2|3|1|5
4	1	1	1	1	1	3	Control	1	1	1	1	1	1	4|3|6|1|2|5
5	1	3	1	3	1	1	Control	3	3	3	3	3	3	4|6|5|3|1|2
6	3	3	1	1	1	2	Control	3	3	1	2	1	1	4|3|5|1|6|2
7	6	6	4	1	4	4	Control	1	1	1	1	3	5	3|4|6|2|5|1
8	1	1	1	1	1	2	Control	1	1	1	1	1	1	1|2|6|4|3|5
9	3	3	1	2	1	3	Experiment	2	3	3	2	1	1	2|4|6|5|3|1
10	2	2	1	2	2	3	Control	1	2	2	2	2	4	3|5|4|2|6|1
11	3	3	3	2	4	3	Experiment	2	3	3	3	3	1	3|2|6|4|1|5
12	1	1	3	2	3	2	Control	1	1	2	2	3	2	3|6|5|1|4|2
13	1	1	1	1	1	1	Experiment	2	1	2	1	1	1	5|1|2|3|6|4
14	5	3	3	3	3	4	Control	4	3	3	4	2	6	1|4|6|5|3|2
15	1	2	2	2	1	1	Control	2	1	1	2	2	1	2|4|3|5|1|6
16	2	3	2	3	1	2	Control	2	2	3	2	3	3	1|4|2|5|3|6
17	2	3	1	4	3	1	Experiment	2	2	2	2	4	2	6|3|2|1|5|4
18	1	1	1	1	1	1	Control	1	1	1	1	1	2	5|2|1|3|4|6
19	1	1	2	3	3	2	Experiment	3	2	3	4	3	1	4|2|1|6|3|5
20	1	2	2	3	1	2	Control	1	2	2	2	1	3	5|4|3|1|2|6
21	1	3	3	2	1	1	Experiment	1	1	2	2	3	1	3|2|1|4|6|5
22	3	5	2	3	3	5	Experiment	2	4	2	5	2	5	6|5|1|3|2|4
23	3	3	3	3	3	3	Experiment	2	3	3	3	1	2	4|3|6|1|2|5
24	2	2	2	2	2	2	Control	3	1	2	2	2	1	2|5|3|6|4|1
25	1	3	1	1	1	1	Experiment	1	3	1	1	1	1	5|1|2|4|6|3

26	2	3	2	2	2	2	Experiment	3	3	2	2	3	3	4|1|2|3|6|5
27	2	1	1	3	3	2	Control	2	2	1	2	1	1	1|4|6|3|2|5
28	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	2|4|1|5|6|3
29	1	1	1	1	1	1	Control	1	1	1	1	1	1	3|5|4|1|6|2
30	1	4	3	3	3	1	Experiment	4	3	3	3	3	4	1|6|4|5|2|3
31	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	6|2|3|1|5|4
32	1	3	3	1	2	1	Control	1	2	2	2	1	1	6|1|2|5|4|3
33	3	3	3	5	4	5	Experiment	3	5	3	5	4	3	2|1|6|3|4|5
34	3	2	2	3	1	3	Control	2	3	3	3	1	3	3|5|1|4|2|6
35	1	2	1	1	4	1	Control	2	3	2	4	6	1	6|2|4|3|1|5
36	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	5|1|4|3|6|2
37	1	1	3	4	1	2	Control	2	1	1	1	1	2	2|1|6|4|5|3
38	3	1	3	4	3	3	Control	3	1	3	2	2	1	3|5|2|1|6|4
39	3	2	1	2	2	3	Experiment	1	5	2	3	2	2	5|3|1|4|6|2
40	1	1	2	2	2	2	Control	1	1	2	2	2	2	1|6|3|2|5|4
41	2	1	1	1	2	1	Experiment	3	3	4	3	1	2	1|5|2|6|3|4
42	1	1	2	1	1	1	Experiment	2	1	1	3	4	1	5|6|2|1|4|3
43	3	1	1	3	1	3	Control	2	2	2	2	1	1	3|5|4|2|6|1
44	1	2	2	1	1	2	Experiment	1	2	1	2	1	1	4|3|6|1|5|2
45	5	3	6	1	3	6	Control	4	3	6	1	6	6	4|1|5|2|6|3
46	1	2	1	1	1	1	Control	1	1	1	1	1	1	3|2|6|4|5|1
47	1	1	1	1	1	1	Control	1	2	1	1	1	1	5|3|4|1|6|2
48	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	3|4|5|1|2|6
49	1	1	1	1	1	1	Control	1	1	1	1	1	1	1|4|3|2|6|5
50	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	2|3|5|1|6|4
51	4	3	3	3	3	2	Experiment	1	1	1	2	1	3	2|6|3|5|1|4
52	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	2|1|4|3|5|6
53	1	3	2	2	4	3	Experiment	2	3	3	3	4	2	1|5|2|3|4|6

54	2	3	2	1	4	2	Experiment	2	3	3	2	3	3	4|5|3|1|6|2
55	2	2	2	2	1	3	Experiment	2	3	3	2	1	3	2|1|3|5|4|6
56	1	3	3	1	3	1	Control	2	3	3	2	3	3	4|3|1|2|6|5
57	1	1	1	3	2	3	Experiment	1	1	2	1	1	1	3|5|1|4|2|6
58	2	2	1	3	1	3	Control	1	3	3	3	1	3	3|2|4|1|5|6
59	2	2	1	1	1	1	Control	1	1	1	1	1	1	5|2|4|3|1|6
60	1	1	2	2	3	2	Experiment	2	2	3	2	2	2	2|1|6|5|3|4
61	3	1	1	1	1	1	Control	1	1	1	1	1	1	6|2|1|4|5|3
62	1	2	1	1	1	2	Experiment	1	1	1	1	1	1	6|1|5|4|2|3
63	4	3	2	3	8	6	Experiment	3	3	2	4	4	1	1|6|5|2|3|4
64	2	2	1	3	1	3	Experiment	3	2	2	2	3	3	3|1|6|4|5|2
65	1	1	1	2	2	2	Control	1	2	1	1	1	1	4|3|6|5|1|2
66	3	1	3	1	2	1	Control	3	3	3	2	3	2	6|4|3|5|1|2
67	3	3	3	3	3	3	Control	3	1	3	3	4	2	4|6|2|5|3|1
68	1	1	1	1	1	1	Experiment	1	1	3	1	1	1	5|3|4|1|2|6
69	2	1	1	1	2	1	Experiment	1	1	1	1	1	1	6|2|4|5|1|3
70	3	3	3	3	2	2	Experiment	1	3	1	1	2	2	1|4|3|6|5|2
71	3	3	4	3	3	3	Control	2	3	4	3	3	6	6|5|4|1|2|3
72	2	1	1	1	1	2	Control	1	1	2	2	1	2	6|3|1|5|2|4
73	1	1	1	1	1	1	Control	1	1	1	1	1	1	3|4|2|5|6|1
74	2	1	3	3	3	3	Control	2	1	3	3	2	3	1|2|6|3|4|5
75	2	1	1	3	2	1	Experiment	3	2	2	2	1	3	5|6|2|1|3|4
76	1	2	1	1	1	1	Control	1	1	1	1	1	1	2|3|4|6|5|1
77	4	3	5	3	2	3	Experiment	4	3	2	3	2	2	4|5|3|6|2|1
78	3	3	3	2	3	3	Control	3	3	3	3	3	3	5|2|6|4|1|3
79	1	3	1	4	1	4	Control	2	2	3	4	4	6	5|3|2|6|1|4
80	2	1	3	2	3	2	Control	2	1	2	2	2	3	5|1|6|2|4|3
81	2	1	1	2	2	1	Experiment	3	2	2	3	3	1	6|5|3|1|4|2

82	2	2	1	2	1	1	Experiment	1	2	2	1	1	1	2|1|5|6|4|3
83	3	1	3	3	3	3	Experiment	3	4	3	3	3	3	5|1|6|4|3|2
84	2	3	2	2	2	2	Control	2	1	1	2	1	1	6|2|4|1|5|3
85	2	3	2	2	1	1	Experiment	1	1	2	3	2	1	3|1|4|6|2|5
86	3	2	1	2	1	1	Control	2	3	1	2	1	1	1|2|3|4|6|5
87	2	1	2	2	2	1	Control	1	1	2	2	3	2	4|5|2|3|6|1
88	2	1	1	2	1	1	Experiment	2	1	1	2	1	1	3|4|1|5|6|2
89	2	2	1	2	3	1	Control	2	2	2	1	3	1	2|4|5|3|6|1
90	1	1	1	1	1	1	Experiment	1	1	1	1	1	1	4|6|5|1|3|2
91	2	1	3	2	3	2	Control	2	2	2	2	3	2	5|2|3|6|4|1
92	1	1	1	1	1	1	Experiment	1	1	1	2	1	1	2|1|3|4|6|5
93	3	1	3	3	3	3	Control	3	2	3	3	3	1	1|5|4|6|2|3
94	2	3	3	3	4	3	Experiment	1	3	3	3	3	1	3|2|4|1|5|6
95	2	3	3	2	2	2	Control	2	3	2	2	2	2	2|3|6|4|5|1
96	2	2	3	2	1	3	Experiment	1	1	1	2	2	2	3|1|2|4|5|6
97	1	2	2	1	1	2	Control	1	1	1	1	2	1	3|1|5|6|2|4
98	2	3	3	3	3	3	Experiment	2	3	3	3	3	3	5|4|6|2|1|3
99	3	3	1	1	2	1	Experiment	1	2	1	3	2	2	6|2|3|5|4|1
100	2	3	4	4	4	4	Experiment	3	3	3	4	3	3	4|3|6|2|5|1
101	4	1	3	3	6	3	Experiment	1	2	3	2	4	2	6|5|2|3|1|4
102	2	1	1	3	3	3	Experiment	2	3	3	3	3	2	5|6|4|1|3|2
103	2	1	1	3	3	3	Experiment	2	2	1	1	3	2	4|6|5|3|2|1
104	1	1	1	1	1	1	Control	1	1	2	1	1	1	4|6|3|1|5|2
105	2	2	2	3	1	3	Experiment	3	2	2	3	1	2	1|6|2|4|5|3
106	1	1	1	1	1	1	Control	1	1	1	2	1	3	6|2|4|5|1|3
107	3	3	5	4	5	4	Control	2	3	4	3	3	3	5|3|1|6|2|4
108	1	1	2	1	1	1	Experiment	1	1	1	1	1	1	5|2|1|3|4|6
109	1	3	1	5	3	3	Experiment	3	3	1	4	2	2	4|3|6|1|5|2

110	1	3	3	3	4	3	Control	3	3	3	3	3	3	3|6|2|4|5|1
111	1	2	1	3	1	2	Experiment	1	3	1	1	1	2	6|5|1|2|3|4
112	2	1	1	2	4	1	Experiment	3	3	5	4	5	6	5|3|4|1|2|6
113	1	1	1	1	1	1	Control	3	1	2	1	2	1	5|4|1|6|3|2
114	2	2	3	2	1	2	Control	2	3	2	2	1	3	6|1|3|4|5|2
115	1	1	1	1	1	1	Control	1	1	1	1	1	1	1|6|5|3|4|2
116	2	1	1	1	3	1	Experiment	1	1	5	3	4	5	5|1|6|4|2|3
117	1	1	1	1	1	1	Experiment	1	1	1	2	1	1	3|2|5|4|1|6
118	1	1	1	1	1	1	Control	1	1	1	1	1	1	2|4|5|6|1|3
119	1	1	1	1	1	1	Control	1	1	1	1	1	1	2|6|3|4|5|1

This table displays the number of options selected by the 119 participants in Experiment 2 for each of the six dilemmas before, and after, either the experimental manipulation or the presentation of the control. The abbreviations D1 through D6 signify the six different dilemmas, while the (Pre) indicates that a dilemma was presented before the experimental manipulation or control, and the (Post) indicates that a dilemma was presented after the experimental manipulation or control. In this experiment, 60 participants were randomly assigned to the Control group and 59 to the Experiment group, with the specific assignment for each participant displayed in the "Group" column.

Appendix 3.

The Word Analogies

The Word Analogies

This appendix contains a list of the 18-word analogy exercises presented to participants, the correct answers to these exercises, and the participant responses to these exercises in both experiments. Although these responses were not analyzed in this study, they are presented here for the sake of future metanalyses.

The Exercises and Correct Answers

First Series

First Analogy Question

game : series :: syllable : word

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is a) Equal.

Second Analogy Question

trellis : garden :: fireplace : log

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is b) Not Equal.

Third Analogy Question

20 : 240 :: 18 : 180

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is b) Not Equal.

Fourth Analogy Question

ribbon : present :: icing : cake

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is a) Equal.

Fifth Analogy Question

rein : horse :: control panel : plane

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is a) Equal.

Sixth Analogy Question

principle : doctrine :: living : likelihood

Are the two analogy pairs equal?

a) Equal
b) Not Equal

The correct answer is a) Equal.

Second Analogy Series

First Question

alphabetical : _____ :: sequential : files

a) sort
b) part
c) list
d) order

The correct answer is c) list.

Second Question

poetry : rhyme :: philosophy : _____

a) imagery
b) music
c) bi-law
d) theory

The correct answer is d) theory.

Third Question

denim : cotton :: _____ : flax

a) sheep
b) uniform
c) sweater
d) linen

The correct answer is d) linen.

Fourth Question

bowler : _____ :: satchel : bag

a) hat
b) lane
c) trophy
d) ottoman

The correct answer is a) hat.

Fifth Question

volume : _____ :: stanza : poem

a) measure
b) pint
c) encyclopedia
d) kitchen

The correct answer is c) encyclopedia.

Sixth Question

ledger : accounts :: _____ : observations

a) pundit
b) weather
c) astrology
d) diary

The correct answer is d) diary.

Third Analogy Series

First Question

diamond : baseball :: court : _____

a) poker
b) jury
c) grass
d) squash

The correct answer is d) squash.

Second Question

exercise : maneuver :: _____ : excerpt

a) exception
b) passage

c) routine
d) cause

The correct answer is b) passage.

Third Question

vaunt : boast :: skewer : _____

a) flaunt
b) criticize
c) prepare
d) avoid

The correct answer is b) criticize.

Fourth Question

stars : astronomy :: _____ : history

a) battles
b) eclipse
c) horse
d) autumn

The correct answer is a) battles.

Fifth Question

jaguar : cat :: mustang : _____

a) dog
b) horse
c) fish
d) bird

The correct answer is b) horse.

Sixth Question

smelt : fish :: felt : _____

a) cloth
b) nose
c) sneeze
d) scale

The correct answer is a) cloth.

Table 6. Responses to the Word Analogy Exercises in Experiment 1.

ID	Q1 S1	Q2 S1	Q3 S1	Q4 S1	Q5 S1	Q6 S1	Q1 S2	Q2 S2	Q3 S2	Q4 S2	Q5 S2	Q6 S2	Q1 S3	Q2 S3	Q3 S3	Q4 S3	Q5 S3	Q6 S3
1	a	b	a	a	b	a	c	d	a	a	a	d	b	b	b	b	b	a
2	a	b	a	a	a	b	c	d	d	a	c	d	b	c	b	a	b	a
3	a	b	b	a	a	b	c	d	d	a	c	d	b	b	b	a	b	a
4	a	a	b	a	a	b	c	d	d	b	b	c	d	b	a	a	b	a
5	a	a	b	a	a	b	c	d	d	a	a	b	b	b	b	a	b	a
6	a	b	b	a	b	b	d	d	d	a	c	b	d	b	b	a	b	a
7	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
8	a	b	a	a	a	b	c	d	d	b	b	d	d	b	b	a	b	a
9	a	b	a	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
10	b	b	b	a	a	b	c	a	d	a	a	d	d	a	b	a	b	a
11	a	a	b	a	a	b	d	d	d	b	b	d	d	c	b	a	b	a
12	a	b	b	a	a	b	d	d	d	b	b	d	d	b	b	a	b	a
13	a	b	b	a	a	b	d	a	a	b	b	d	d	b	b	a	b	a
14	a	a	b	a	a	a	d	d	d	b	a	b	b	d	a	a	b	a
15	a	b	b	a	a	b	d	d	d	a	a	d	d	b	b	a	b	a
16	a	a	b	a	b	b	d	d	d	b	b	c	b	b	c	a	b	a
17	a	b	b	a	b	b	c	d	d	a	c	d	b	a	a	a	b	a
18	a	b	b	a	a	b	d	d	c	b	a	b	b	b	c	a	b	a
19	b	a	a	a	a	b	c	d	d	a	b	d	b	b	b	a	b	a
20	a	a	b	a	a	a	d	d	a	c	a	b	b	c	c	b	b	d
21	a	b	b	a	a	b	d	d	d	b	a	b	c	b	b	a	b	a
22	b	a	b	a	a	b	d	a	c	b	c	b	c	b	b	a	b	a
23	a	a	b	b	a	b	d	d	d	a	a	d	b	b	c	a	b	c
24	a	b	b	a	a	b	d	d	a	a	a	d	d	b	c	a	b	a
25	a	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a

26	a	b	a	b	a	a	d	d	c	d	a	c	a	d	a	a	b	b
27	b	b	b	a	a	b	c	d	d	b	a	a	b	b	c	a	b	a
28	b	a	b	a	a	b	a	d	d	a	b	d	d	b	b	a	b	a
29	a	b	b	a	a	b	d	d	d	b	a	d	b	b	c	a	b	a
30	a	b	b	a	a	b	c	d	d	a	c	c	b	b	c	a	b	a
31	a	b	a	b	a	b	c	b	d	c	b	b	c	c	d	c	c	c
32	b	a	b	a	b	a	d	d	d	b	c	d	b	b	b	a	b	a
33	a	b	b	a	a	b	d	d	d	a	a	d	d	b	b	a	b	a
34	a	b	b	a	a	a	d	d	c	b	a	d	a	d	b	a	b	a
35	b	a	b	a	a	b	a	d	a	b	a	b	b	b	b	a	b	a
36	b	b	b	a	a	b	c	d	d	a	c	d	b	b	b	a	b	a
37	a	b	b	a	a	b	c	d	d	a	b	d	d	b	b	a	b	a
38	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
39	a	b	a	b	a	a	d	d	d	a	a	d	d	c	b	a	a	d
40	b	a	b	a	a	b	c	d	d	b	a	d	d	b	b	a	b	a
41	b	a	b	a	a	b	d	d	d	b	a	a	d	d	b	a	b	a
42	a	b	b	a	a	a	a	d	d	b	a	c	d	b	b	a	b	a
43	a	b	b	a	a	b	a	d	a	b	a	c	b	b	d	a	b	a
44	b	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	d
45	a	a	b	a	a	b	c	c	c	c	a	b	b	b	b	a	b	a
46	a	b	b	a	a	b	b	d	d	a	c	d	d	b	b	a	b	a
47	a	b	b	a	a	b	a	d	d	a	c	d	d	b	b	a	b	a
48	b	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
49	a	b	b	a	a	b	c	d	d	a	a	a	d	b	b	a	b	a
50	a	a	b	a	b	b	d	d	c	b	a	a	a	b	c	a	b	a
51	a	a	b	a	a	b	c	d	d	a	a	a	b	b	b	a	b	a
52	a	a	b	a	a	b	c	d	d	b	a	d	d	b	c	a	b	a
53	a	b	b	a	b	b	d	d	d	a	a	d	d	b	b	a	b	a

54	a	b	b	a	a	b	d	d	d	a	a	d	d	b	c	a	b	a
55	a	b	b	a	a	b	d	d	d	a	c	b	d	b	b	a	b	a
56	a	a	b	a	a	b	d	d	d	b	c	a	b	b	b	a	b	a
57	a	b	b	a	a	b	a	c	d	a	a	d	b	b	b	a	b	a
58	b	a	b	a	a	b	d	d	d	b	a	d	d	b	b	a	b	a
59	b	a	b	a	b	b	d	d	d	a	a	d	b	b	c	a	b	a
60	a	b	b	b	a	b	c	d	d	a	c	d	d	b	b	a	b	a
61	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
62	a	b	b	a	a	b	d	d	d	a	a	b	d	b	b	a	b	a
63	a	b	b	a	a	b	d	d	c	a	a	d	b	b	b	a	b	a
64	a	b	a	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
65	a	b	a	a	b	b	c	d	d	b	a	c	d	c	b	a	b	a
66	a	a	b	b	a	a	a	d	c	a	a	a	b	b	b	a	b	a
67	a	b	b	b	a	b	c	d	c	c	c	c	c	b	b	a	b	c
68	a	b	b	a	a	b	c	d	a	b	b	d	d	b	b	a	b	a
69	a	a	b	a	a	b	d	d	c	a	c	d	d	b	b	a	b	a
70	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
71	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
72	b	a	b	a	a	b	d	d	d	b	a	c	c	b	c	a	b	a
73	b	b	a	a	a	b	c	d	c	a	a	d	b	b	b	a	b	a
74	a	b	b	a	a	b	d	d	c	a	c	d	d	b	b	a	b	a
75	b	b	b	a	a	b	c	d	d	b	c	d	c	b	b	a	b	a
76	b	b	b	a	a	b	d	d	d	b	c	d	b	c	b	a	b	a
77	a	a	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
78	a	b	b	a	a	b	b	d	c	d	a	d	b	b	b	a	b	a
79	b	b	b	a	a	b	d	d	b	b	a	d	d	b	b	a	b	a
80	a	b	b	a	a	b	c	d	d	b	c	b	d	b	b	a	b	a
81	a	a	b	a	a	b	d	d	d	a	c	c	b	b	b	a	b	a

82	b	a	b	a	b	b	a	d	c	a	c	b	b	b	a	b	b	b
83	a	b	b	a	a	b	d	d	d	b	b	d	d	b	c	a	b	a
84	a	b	b	a	a	b	c	d	d	a	b	d	b	b	b	a	b	a
85	a	a	b	a	a	b	d	d	a	a	a	d	b	b	c	a	b	a
86	a	b	b	a	a	b	c	d	d	a	a	b	d	b	c	a	b	a
87	a	b	b	a	a	b	d	d	d	a	b	d	b	b	b	a	b	a
88	a	a	b	a	a	a	d	d	d	c	a	a	b	a	a	a	b	c
89	a	b	b	a	a	b	d	d	d	a	a	b	d	b	b	a	b	a
90	a	b	b	b	a	a	a	c	c	b	a	c	c	b	b	a	b	a
91	a	b	b	a	a	b	d	d	d	a	a	c	c	b	b	a	b	c
92	b	a	a	a	a	b	c	d	b	c	a	b	d	b	b	b	b	a
93	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
94	a	b	b	a	a	b	c	d	d	b	c	a	b	b	b	a	b	a
95	b	a	a	a	a	b	d	d	c	a	a	c	b	b	c	a	b	a
96	a	b	b	a	a	b	d	d	d	a	b	d	d	b	b	a	b	a
97	b	a	b	a	a	a	d	d	a	c	c	c	b	b	b	a	b	a
98	a	b	b	a	a	b	c	d	c	b	c	d	d	b	b	a	b	a
99	b	b	b	a	a	b	d	d	d	b	b	d	b	b	c	a	b	a
100	a	b	b	a	a	b	c	d	d	a	c	d	b	b	b	a	b	a
101	b	b	a	a	a	b	d	d	d	b	b	d	d	b	a	a	b	a
102	a	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
103	a	b	b	a	a	b	d	d	c	a	a	d	d	b	b	a	b	a
104	a	b	b	a	a	b	c	d	d	a	b	d	d	b	b	a	b	a
105	b	b	b	a	a	b	c	d	d	b	c	d	d	d	b	a	b	a
106	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
107	a	a	b	a	b	b	a	d	d	a	a	d	d	b	b	a	b	b
108	a	b	b	a	b	b	c	d	d	a	b	d	d	b	b	a	b	a
109	a	b	b	a	a	b	c	d	d	b	a	d	d	b	a	a	b	a

110	b	a	b	a	a	b	d	d	d	b	a	a	c	b	b	a	b	a
111	a	a	a	a	a	b	c	d	a	a	a	c	c	b	b	a	b	b
112	b	a	b	a	a	b	d	d	d	a	b	b	b	b	b	a	b	a
113	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
114	a	b	b	a	a	b	c	d	a	c	b	d	d	b	c	a	b	a
115	b	b	b	a	a	b	d	d	d	a	b	b	b	b	c	a	b	a
116	b	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
117	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
118	a	b	b	a	a	b	d	d	d	a	c	a	d	b	b	a	b	a
119	a	b	b	a	a	b	d	d	d	d	c	d	d	b	b	a	b	a
120	a	b	b	a	a	b	c	d	d	a	b	d	b	b	c	a	b	a
121	a	a	a	a	a	a	c	d	d	a	c	b	b	b	c	a	b	d
122	a	b	b	a	a	b	c	d	d	a	a	a	c	b	b	a	b	d
123	a	b	b	a	a	b	d	d	d	c	c	d	d	b	b	a	b	d

This table displays the responses to all 18-word analogy exercises given by the 123 participants of Experiment 1. Columns are titled first by question number and then series number, i.e., "Q1S2" signifies "First Question of Second Analogy Series." For more information on the specific questions and letter responses, refer to the "The Exercises and Correct Answers" section at the beginning of this Appendix.

Table 7. Responses to the Word Analogy Exercises in Experiment 2.

ID	Q1 S1	Q2 S1	Q3 S1	Q4 S1	Q5 S1	Q6 S1	Q1 S2	Q2 S2	Q3 S2	Q4 S2	Q5 S2	Q6 S2	Q1 S3	Q2 S3	Q3 S3	Q4 S3	Q5 S3	Q6 S3
1	a	b	a	a	b	b	a	a	b	a	c	a	a	c	b	a	b	a
9	b	a	b	a	a	b	c	d	d	a	c	d	b	b	b	a	b	a

11	a	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
13	a	b	b	a	a	b	d	d	d	a	a	d	b	b	b	a	b	a
17	a	a	b	a	a	b	c	d	d	a	a	a	b	b	b	a	b	a
19	b	a	b	a	a	b	d	d	d	b	b	b	d	b	b	a	b	d
21	b	b	b	a	a	b	d	d	d	a	a	d	d	b	c	a	b	a
22	a	a	b	a	a	b	d	d	c	b	c	d	b	a	b	a	b	a
23	a	b	b	a	a	b	d	d	d	b	a	a	b	b	a	a	b	a
25	b	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
26	b	b	b	a	a	b	d	d	c	a	a	b	d	b	b	a	b	a
28	b	a	b	a	a	b	d	d	d	b	a	d	b	b	d	a	b	d
30	b	a	a	a	a	b	c	d	d	b	a	a	b	b	c	a	b	a
31	a	a	b	a	a	a	c	d	d	a	a	c	c	d	b	a	b	a
33	a	a	b	a	a	b	c	d	d	b	c	d	b	b	c	a	b	a
36	a	b	b	a	b	b	d	d	c	c	a	d	c	b	c	a	b	a
39	a	a	b	a	a	a	d	d	d	a	c	d	d	b	c	a	b	a
41	a	b	b	b	a	b	d	d	d	a	b	d	d	b	b	a	b	a
42	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
44	a	b	b	a	a	b	d	d	d	b	b	b	b	b	b	a	a	a
48	a	a	b	b	a	b	c	b	b	a	c	b	b	b	a	b	c	b
50	a	a	b	a	a	b	d	d	b	b	a	d	b	d	d	a	b	c
51	a	a	b	a	a	a	d	d	d	a	a	d	b	a	b	d	b	a
52	b	a	a	a	a	b	d	d	d	b	a	b	d	b	b	a	b	a
53	a	b	b	a	a	b	c	d	d	a	a	d	b	b	c	a	b	a
54	a	b	b	a	b	b	c	d	d	a	a	d	d	b	b	a	b	a
55	a	b	b	a	a	b	d	d	a	c	a	b	b	b	c	a	b	a
57	a	a	b	a	a	b	d	d	d	a	a	d	b	b	b	a	b	a
60	b	b	b	a	a	b	c	d	d	b	a	b	b	b	c	a	b	a
62	a	a	b	a	a	b	d	d	a	a	a	b	d	d	b	a	b	a

63	a	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
64	b	b	b	a	a	b	d	d	d	a	c	d	d	b	b	a	b	a
68	a	a	b	a	a	a	c	a	d	a	c	c	b	b	b	a	b	a
69	b	b	b	a	a	b	c	d	c	c	c	b	b	d	a	a	b	d
70	a	b	b	a	a	b	d	d	c	b	c	c	c	b	a	a	b	a
75	a	a	b	a	a	a	d	d	d	b	a	d	b	b	c	a	b	a
77	a	b	b	a	a	b	c	d	d	b	a	b	d	b	b	a	b	a
81	b	a	b	a	a	b	d	d	d	b	a	b	b	b	b	a	b	a
82	a	b	a	a	a	b	d	d	d	a	a	d	b	b	c	a	b	a
83	a	a	a	a	b	a	d	a	a	a	a	c	b	b	c	b	b	d
85	a	a	b	a	a	b	d	d	d	a	a	c	d	b	c	a	b	a
88	a	a	b	b	a	b	c	a	d	a	a	d	d	b	b	a	b	a
90	b	a	a	a	b	a	c	d	a	d	b	c	b	a	c	a	b	d
92	a	a	b	a	a	b	d	d	d	b	a	d	b	b	b	a	b	a
94	a	b	b	a	a	a	a	d	d	a	a	d	d	b	b	a	b	a
96	a	b	b	a	a	b	d	d	d	b	a	b	d	b	b	a	b	a
98	a	b	b	a	b	b	c	d	d	b	a	b	b	b	b	a	b	a
99	a	a	b	a	a	b	d	d	d	a	a	d	d	b	c	a	b	a
100	b	b	b	a	a	b	c	d	c	b	c	b	d	b	b	a	b	a
101	a	b	a	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
102	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
103	a	b	b	a	a	b	c	d	d	a	a	d	d	b	b	a	b	a
105	b	a	b	a	a	b	a	d	d	a	c	c	d	b	a	a	b	a
108	b	a	a	a	a	b	d	d	d	b	a	d	d	b	b	a	b	a
109	a	a	b	a	a	b	d	d	d	b	b	d	b	b	b	a	b	a
111	a	b	b	a	a	b	c	d	d	b	c	a	c	b	b	a	b	d
112	a	b	b	a	a	b	c	d	d	a	c	d	d	b	b	a	b	a
116	b	a	a	a	b	b	d	d	d	b	a	b	c	b	a	a	b	d

117	a	a	b	a	a	a	d	d	d	b	a	d	d	b	b	a	b	a

This table displays the responses to all 18-word analogy exercises given by the 59 participants who were randomly assigned, out of a total of 119 participants, to the Experimental Group in Experiment 2. Their ID numbers reflect their random distribution amongst the full roster of participants as seen in Table 5. The other 60 participants were assigned to the Control Group, and so did not undergo the word analogy exercises. Columns are titled first by question number and then series number, i.e. "Q1S2" signifies "First Question of Second Analogy Series." For more information on the specific questions and letter responses, refer to the "The Exercises and Correct Answers" section at the beginning of this Appendix.

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