Our mind is peculiar. Countless people walking this earth is under the impression that their point of view is unbiased and objective. The cognitive abilities required to override our erroneous inferences are inaccessible to many. Understanding these processes and how one can inhibit flawed cognition is critical to attain more rational thought, and evolve human apprehension.

Table of contents

1. Abstract ………………………………………………….. **p. 1**

2. Preface …………………………………………………... **p. 2**

3. Theory …………………………………………………... **p. 3**

3.1 The cognitive reflection test ………………… **p. 5**

3.2 Teleological thinking and evolution ………... **p. 6**

3.3 Other cognitive biases ……………………..... **p. 9**

3.4 Illusory pattern perception ………………….. **p. 11**

3.5 Aim of the current study …………………… **p. 12**

4. Method ……………………………………………… **p. 13**

4.1 Results …………………………………….... **p. 15**

5. Discussion ………………………………………….. **p. 22**

6. Conclusion …………………………………………. **p. 27**

7. References …………………………………………. **p. 28**

8. Appendix …………………………………………... **p. 32**

8.1 Cognitive reflection test …………………….. **p. 32**

8.2 Card sorting task …………………………..... **p. 34**

8.3 Snowy pictures task ………………………... **p. 35**

8.4 Teleological/physical explanations ……….... **p. 37**

1. Abstract

The author presents an experiment which tests whether lacking control increases illusory pattern perception and teleological thinking. Illusory pattern perception is defined as the identification of meaningful interrelationship among a set of random stimuli. Teleological thinking is the tendency humans have to favor purpose- and intention-based explanations of natural phenomena. Participants manipulated to feel a lack of control display a significantly more conservative bias and lower performance rate than the baseline participants on the pattern task. Evidence for the suggested direction of illusory pattern perception and the theorized compensatory mechanism is not found, failing to replicate earlier research. Lacking control does not increase teleological thinking or affect decision criterion in our participants, but the Norwegian participants, especially females, displayed a bias to favor invalid intention- and functional based explanations of nature, independent of the manipulation. The duration of the manipulation paradigm is investigated, non-contingent feedback as means to induce low control, providing relevant data for future research. The author also replicates earlier found gender differences on the cognitive reflection test (CRT), with males tending to perform better, and discusses the implications of the findings in detail.

2. Preface

The present study is the concluding, main thesis of Kristian A. Fjellskaalnes, sixth year student at the Norwegian University of Science and Technology's clinical psychology program. With support from my two supervisors, associate professor Robert Biegler and post doctor Gerit Pfuhl, I have conducted an experimental study on perception and decision-making. The idea of investigating whether a lack of control might have an impact on rationality and perception occurred during a discussion with Robert Biegler, years ago. I have always been interested in the cognitive processes responsible for irrational decisions, especially involving religious convictions, and Robert put me on track of teleology and human's ontogenetically early tendency to perceive intention and meaning where there is none. I have learned tremendously from my dialogues with Robert, who is one of the most knowledgeable people I have ever met. Gerit was of particular assistance with getting the rather large amount of participants, and instructing them during the experiment. Both supervisors have proved to be important when it comes to setting up some of the inferential statistics, and restrictive when it comes to input on the result interpretation and thesis writing, everything which I am grateful for.

3. Theory

3.1 The cognitive reflection test

A significant number of researchers started in the 1990's to focus on a dual categorization of human cognition (Epstein, 1994; Sloman, 1996; Kahneman and Frederick, 2002). System 1 processes are executed quickly with little attentional effort, while system 2 processes are slower, more reflective and requires a higher amount of resources. Recognizing the face of your neighbor involves system 1 processes, as it is immediate, effortless and unrelated to your motivation and alertness. When he asks you to continuously subtract 17 from 412 though, your central nervous system activates mental operations that require effort and concentration, i.e. system 2 processes. These processes enable us to solve a wide range of novel problems with great accuracy, but at the cost of interfering with other thoughts and actions, making the exhausting nature of it aversive to most people. Processes can change, for instance the ability to read is cognitively effortful and dependent on motivation for first graders, but becomes gradually automated and more of a system 1 process by practice.

People tend to be cognitive misers, preferring effortless and low cost thinking. Frederick (2005) developed a simple test that measures the individual's ability to override an intuitive, system 1 response, and activate a more deliberate system 2 response. This test was named "Cognitive Reflection Test" (CRT) and proved to be an attractive test for researchers, as it originally only involved three items, was administered in a couple of minutes, and had a predictive value that exceeded other cognitive tests which took up to 3.5 hours to complete (Frederick, 2005).

Consider the first and most well known item in the CRT:

A bat and a ball cost $1.10. The bat costs $1.00 more than the ball. How much does the ball cost? __ cents.

A majority of people would intuitively give the same, wrong answer: “10 cents”. Many students at prominent schools like MIT, Princeton and Harvard did the same (Frederick, 2005), and 59% of a sample in Buenos Aires did not get any of the items correct (Campitelli & Labollita, 2010). But if the bat costs a dollar more than the ball, and the ball costs 10 cents, the total cost would be $1.20. 5 cent is the correct answer, and it requires an override of a prepotent system 1 response, and engagement in further reflection to get it right.

Toplak, West and Stanovich did in 2011 assemble 15 rational thinking tasks from a variety of domains within the intelligence and bias literature, and found that the CRT was a better predictor of rational performance than other well established measures of intelligence or executive functioning (Toplak, West & Stanovich, 2011). For instance, performance is correlated with cognitive tasks like syllogistic reasoning and WASI (Toplak et al., 2014). It has also been found that high CRT-scorers are significantly better at being patient and delaying gratification (Frederick, 2005), also when the delayed reward is substantially higher. This bias is thought to be adaptive in uncertain and scarce environments, but a liability in modern times. In fact, being able to execute self-control in order to attain delayed rewards predicts higher IQ, higher SAT-score, and a large number of positive social, cognitive and mental health outcomes later in life (Shoda et al., 1990; Mischel et al., 2011). The bias to favor immediate gratification, often even when it yields lower long-term average payoff, is widespread in the wild, and has been observed in non-human subjects like pigeons, monkeys and rats (Alexander & Brown, 2011).

35% of the participants scoring 0 at the CRT preferred the patient response of $3800 next month instead of $3400 this month, while 60% of the participants getting all the items in CRT right preferred the $3800 (Frederick, 2005). The low scorers was also willing to pay more than double for overnight shipping for a book than the high scorers, a sign of them being less tolerant of the “pain” of waiting. The high CRT scorers were additionally more willing to gamble and take “rational” risks, possibly somewhat explainable by the gender differences: men scoring significantly higher than women. This effect remains even after controlling for the participant’s SAT score, making it evident that the men were more likely to reflect on their answers and not rush to their intuitive responses. Studies using self-report would give a different conclusion though, as women reported significantly higher scores than men on the item "How long do you deliberate before reaching a conclusion?" (Frederick, 2005). Campitelli and Gerrans replicated these gender differences on 2019 participants in 2013, and Toplak et al. did the same in 2014, raising the question why males tend to implement activation of system 2 responses more than women in test settings (Campitelly & Gerrans, 2013; Toplak, West & Stanovich, 2014). Neither of the authors discusses these findings in detail, besides concluding that there are indeed significant differences. Not all mistakes made on the CRT can be attributed to miserly processing though, as less rational responses may also occur due to poor knowledge when it comes to scientific thinking, probabilistic reasoning and economic literacy (Toplak, West & Stanovich, 2014). Campitelli and Gerrans investigate whether the CRT measures mathematical abilities instead of cognitive reflection however, and concludes that CRT is clearly not just a mathematical test (Campitelly & Gerrans, 2013).

As the popularity for CRT has increased, the three questions have become well known. For instance, Daniel Kahneman's popular book "Thinking, Fast and Slow" has them featured, making the items appearing in magazines and countless of classrooms. That is why Toplak et al. developed an expansion with additional 4 questions, having a .58 correlation with the original version, and a combined reliability of .72 (Toplak, West & Stanovich, 2014; see appendix 8.1). A 3-item questionnaire will also have a problem with floor effects, as some populations will have a mean of below 1 item correct. CRT7 proved all in all to be a better predictor than the original CRT3 of performance on rational thinking tasks. The authors also conclude that one can substitute the 3 original CRT items with the 4 new ones when the familiarity problem occurs. In the present study, all 7 items are administered to the participants with the option of writing if you have seen the question before, investigating how common the items are among the undergraduates of Norwegian University of Science and Technology (NTNU).

3.2 Teleological thinking and evolution

From cradle to grave, humans act like naïve scientists, attempting to understand and explain the immense complexity of the surrounding environment. Aristotle famously explained objects and events by reference to its "final cause", which implicates its goal or function. For instance, we have eyes so we can see, and forks so we can eat. Teleology is derived from the Greek words "telos", meaning end, goal, purpose, and "logos", meaning reason, explanation. His writings had a major impact on the years to come, as it was taught to scholars for almost two millennia, until pioneers such as Copernicus, Galileo and Newton rejected the idea of Aristotelian physics. In modern times teleological explanations are viewed as valid only when they involve actual goals or functions, and invalid when concerning physical properties. The valid teleological sentence "people wear contact lenses in order to see more clearly" makes sense, while the "stars twinkle in order to light up the night sky" is clearly invalid, as the stars and other physical matter have no intrinsic goals or functions. When one attribute intention or function to non-intentional agents like this, it is called teleological thinking, and a growing amount of empirical work illuminate the impact of this widespread cognitive bias.

Teleological thinking occurs in all levels of human cognition, from infants (Kamawari et al., 2005; Fields 2014) to academically successful physicists (Kelemen, Rottman & Seston, 2012). Teleology has been named "the explanation that bedevils biology" (Hanke, 2004). When children are asked about properties of physical matter like pointy rocks, they generally prefer teleological explanations like that they are pointy "so that animals won't sit on them", over physical ones like because "bits of stuff piled up over time" (Keil, 1995; Kelemen, 1999). As children grow up they tend to lose some of this promiscuous teleological bias, a sign of cognitive maturation, and Alzheimer's patients show an inclination to reassert teleological intuitions when causal knowledge is eroded by disease (Lombrozo, Kelemen, & Zaitchik, 2007). Several studies have found that time restrictions have an impact on information processing in adults, making them more likely to accept unwarranted teleological explanations (Kelemen & Rosset, 2009; Kelemen, Rottman & Seston, 2012). The tendency to perceive agency in our surroundings seems to be a cognitive default starting in infancy, shown by a large numbers of studies following the classic 1944 study by Heider and Simmel (Heider & Simmel, 1944; reviewed in Fields, 2014). This bias is often attributed to the social brain hypothesis: that our cognitive architecture is an evolutionary adaptation from a social environment where the false positives were favorably selected over false negatives (Dunbar, 2003; Dunbar & Schultz, 2007; Fields, 2014). Not detecting actual malicious intent, a false negative, had a greater cost than a high frequency of false positives. The humans perceiving the moving grass to be an aggressive predator and activate the fight-or-flight response proved to have higher evolutionary fitness than the one deducing it is just wind. Some researchers are advocating the existence of a theory of mind module, a domain-specific capacity only processing social inference data (Scholl & Leslie, 1999). Understanding and being able to predict the behavior of others around us has been an adaptive trait to the overall fitness of individuals and social groups, even at the evolutionary cost of enabling a broad spectrum of psychopathological conditions (Brüne & Brüne-Cohrs, 2005). The over-application of agency to our surroundings seems in other words to be a byproduct of an adaptive cognitive mechanism, and "agent" appears to be an innate, ontological category in human infants (Fields, 2014).

This is an important field of research, considering the fact that teleological thinking has been evidently linked with anti-scientific views like creationism and the rejection of evolution (Kelemen, 2011; Blancke et al., 2014). Gallup numbers from 2014 describe a disturbingly stable trend in U.S, as more than four in 10 Americans believe a God created humans and the earth 10 000 years ago, numbers that have not changed in 3 decades (Gallup, 2014). If you add the population that answered "Humans evolved, with God guiding", another 31%, you end up with a minority of 19% who believe "Humans evolved, but God had no part in process". In comparison, among Norwegians, only 11% believe in creationism (Elgmork, 2003). What makes the majority of Americans able to partially or fully reject theories that are well established as consensus in all domains of science, 300 years after the age of enlightenment? Scientific thinking systematically contradicts religious dogma taught all over the world, undoubtedly leading to intellectual incongruity. Deborah Kelemen argues that several of the misunderstandings present in Americans are caused by cognitive biases observable from preschoolers to adults (Kelemen, 2011).

Evolution is evidently a complex topic; as even undergraduates, biology majors, science teachers and medical students all display low levels of understanding and a high number of misconceptions when it comes to its core principles (Nehm & Schonfeld, 2007). In fact, these rationale deviations from the actual mechanisms of natural selection seem to occur even after instruction (e.g. Kelemen, 2011). Invalid explanations involving anthropomorphism and teleology seem to be recurrent when it comes to explaining evolutionary adaptions (Clough & Wood-Robinson, 1985). A recent study shows that even explicitly non-religious people display the teleological bias under processing constraints (Järnefelt, Canfield & Kelemen, 2015), revealing the complexity of the phenomenon.

Natural selection can be explained as random variations within the genetic pool of a population that gives certain individuals a higher likelihood of surviving, providing the descendants who inherit these traits an adaptive advantage, making the successful traits more dominant in the populations to come. The typical explanation participants provide on the other hand, can be categorized as either "basic function-based", "basic need-based" and "elaborated need-based" (Gregory, 2009). For instance, "humans develop eyes so they can see", or "giraffes grow a long neck in order to reach food that are high up". Explaining prehistoric evolutionary adaptions in organisms by its a posteriori function insinuates an intention to a process that is random and blind. A bird does not grow wings in order to fly, but its DNA coded for this specific structure, a result of the natural selection that over millions of years has favored the ancestors whose genes provided them with an adaptive advantage. It can be hard to watch one's step when describing complex natural phenomena in layman terms. Or does one only need knowledge and the ability to know when system 2 should be activated?

Anthropomorphism. Gervais and Norenzayan find in their study that religious beliefs and intuitions are closely linked with system 1 processing, and that analytic system 2 processing increases religious disbelief (Gervais & Norenzayan, 2012). Recent evidence also indicates that the perception of mind is both cause and consequence of many religious beliefs (Gervais, 2013). Anthropomorphism is the attribution of humanlike characteristics, intentions and mental states to non-human objects, especially animals and deities. It requires going beyond that which is directly observable and make inferences about unobservable humanlike characteristics. Studies have found that experimentally induced feelings of loneliness increase the process of anthropomorphizing one's pet, and increase one's belief in Gods and angels (Epley, Monteleone, Gao & Cacioppo, 2008). Participants in this study also anthropomorphized an unpredictable dog significantly more than a predictable one, when having a low feeling of control. Neuroimaging data shows that the neural correlates for anthropomorphizing are parallel to those activated when mentalizing other humans (Waytz et al., 2010). Waytz et al. also found that the more frequently the participants' computers malfunctioned, the more they believed their computer had a mind of its own, and the more unpredictable a technical gadget was, the more the participants anthropomorphized them. Pittman and Pittman found that increasing participant's need for predictability and control also heightened the likelihood that they would explain other's behavior using dispositional attributions (Pittman & Pittman, 1980). These processes may in certain instances be adaptive, as they will make one's environment feel more predictable and understandable, and reintroduce feelings of being in control. It is well established that an absence of perceived control may lead to depression, pessimism and withdrawal from challenging situations (Abramson, Seligman & Teasdale, 1978; Peterson & Seligman, 1984; Price, Choi & Vinokur, 2002). Experiencing power on the other hand, can lead to an overestimation of perceived control (Fast et al., 2009). This illusory control can cause a person to believe he has influence over outcomes unrelated to the power; like the national economy and national election, or outcomes purely dependent on random chance.

3.3 Other cognitive biases

People display a variety of other perceptual and judgmental biases. These systematic patterns of deviations from objectivity have a major impact on rationality, and may lead to distorted and inaccurate judgments. Adding to this phenomenon: people show a tendency to deny their own bias, while recognizing them in others (Pronin, 2006). Such unwarranted claims of objectivity also persist after being informed about the biases, and invited to acknowledge their influence

(Pronin et al., 2002). Why does not knowledge about a specific bias help the individual overriding it? Pronin found that people put too much emphasis on their introspective abilities when assessing their own bias, despite the fact that most biases occur subconsciously. In addition to this, people display an unfounded confidence that their biased perception directly reflect reality. The implications of such biases can be profound, and they seem to cause misunderstanding and interpersonal conflicts (Thompson & Nadler, 2000; Kahneman & Tversky, 2000).

Cognitive biases arise from different processes like social influence, emotional activation, and from the tendency we have to be cognitive misers. Information processing requires substantial amounts of resources, making it adaptive for our central nervous systems to save as much time and effort as possible. Some cognitive biases are adaptive, as heuristics generally will help with mental shortcuts, at the cost of the occasional logical misstep. Kahneman and Tversky demonstrated how people rely upon certain heuristics in order to save time and energy, like the availability, anchoring and representativeness heuristic (Kahneman & Tversky 1973, 1974). The first mentioned concerns the tendency to judge a likelihood of something happening based on the ease of finding examples in your memory. For instance, people are more afraid of dying from shark attacks than mosquitoes as the memory of front page news about fatal shark attacks are more easily available than fatal malaria incidents, even though malaria-carrying mosquitoes kill a lot more people annually (WHO, 2015). Anchoring heuristic is the inclination to place too much emphasis on the importance of the initial piece of information one gets. In the study Tversky and Kahneman conducted in 1974, they asked participants to estimate how many African countries were part of the United Nations after they spun a wheel of fortune. The wheel was rigged to always land on 10 or 65, and it was found that the people who's wheel "randomly" landed on 10 guessed that around 25% of Africa was a part of U.N, and those who landed on 65 guesses around 45%. Representativeness heuristic is the tendency to assign certain attributes to an individual the more he matches the prototype of that group. For instance, one study found that psychologists use this heuristic when they are setting diagnoses on their patients, by judging how similar patients are to the stereotypical patient with that respective disorder (Garb, 1996).

3.4 Illusory pattern perception

Pattern detection is the identification of coherent and meaningful relationships among a set of stimuli. There is evidence of perception processes being manipulated and biased by a person's current needs, e.g. children of lower economic status overestimating the size of coins compared with the wealthy (Bruner & Goodman, 1947), and hungry participants showing a tendency to perceive food in ambiguous images (Levine & Chein, 1942). Having a high desire for control has been associated with increased use of biased attribution processes and distortions of objective reality (Burger & Hemans, 1988).

In recent years the interest in motivational influence on perception and reasoning has blossomed. Inducing a lack of control to participants seems to lead to increased illusory pattern detection (Whitson & Galinsky, 2008) anthropomorphism (Epley et al. 2008), belief in precognition (Greenaway, Louis & Hornsey, 2013), beliefs in superstitions and conspiracies (Keinan, 2002; Whitson & Galinsky, 2008) increase approach motivation (Greenaway et al., 2015) and beliefs in a controlling God and government (Kay, Whitson, Gaucher & Galinsky, 2008). Kay et al. propose that humans have a wide arsenal of compensatory mechanisms that serves the function of preserving a sense of control and non-randomness when faced with a lack of personal control. These mechanisms are thought to be adaptive, even as they reinstate feelings of control at the cost of more objective perception and decision-making. The model differs from terror management and meaning maintenance, and demonstrates external validity as participants from across 67 nations display stronger beliefs in a controlling God and government when experiencing low feelings of control (Kay, Gaucher, Napier, Callan & Laurin, 2008).

Aim of the current study

Reproducibility is a cornerstone of empirical science. Independent researchers should be able to replicate findings and accumulate evidence that form theoretical models, and be able to make predictions accordingly. Recent collaborations among scientists across nations find a disturbingly low replication rate among 100 experimental and correlational studies within psychology; e.g. mean effect size of replication effects (M = 0.197, SD = 0.257) was half the magnitude of the original mean effect size (M = 0.403, SD = 0.188) (Open Science Collaboration, 2015). In the current research, the author seeks to both replicate earlier research and investigate new hypotheses. Kelemen & Rosset did in 2009 find that situational factors like time-restriction influenced the amount of unwarranted teleological explanations embraced, but not unwarranted physical explanations. As discussed earlier, the induced feeling of low control has been found to increase anthropomorphism, beliefs in God and conspiracy theories, all related to attribution of agency and intent in different ways, and we hypothesize it might increase endorsement of invalid teleological explanations as well. The author also seeks to replicate one of the experiments in Whitson & Galinsky's influential 2008-paper, where the participants feeling low control displayed increased illusory pattern perception in pictures filled with noise. Lastly, the CRT will be included along with the standard demographics, as the ability to override system 1 response might be related to the experiment's decision-making processes, and the author wishes to see if the earlier found gender differences exist in a Norwegian sample.

The following hypotheses are introduced:

1. Participants induced to feel low control will have a significantly lower d' and have a more liberal criterion in the snowy pictures task, compared with baseline participants.
2. Low control participants will display a significantly lower d' and a more liberal criterion on the teleological explanations, compared with baseline participants.

3. Participants will have a significantly lower d’ and have a more liberal criterion towards the teleological explanations, compared with the physical explanations, independent of the control manipulation.

4. Males will perform better at the CRT than females, replicating findings from Frederick 2005, Campitelly & Gerrans, 2013, and Toplak et al., 2014.

4. Method

Participants. Sixty undergraduates (34 female, 26 male, majority between 18-25 years old) were voluntarily recruited through a course or an online forum, and received either course credit or a scratch card with a value of $5 for their participation. They were told the study was about visual perception and rationality, and were randomly divided into two baseline and two low control groups. Six participants were excluded from the teleological data and one from the pattern perception, because of incomplete input.

Procedure. A majority of the participants completed the tasks in a classroom setting, seated in front of their respective computer. After filling out demographics anonymously, and completing the seven items in the extended CRT (Toplak, West & Stanovich, 2014), lack of control was manipulated using a concept-identification task with non-contingent feedback, specifically designed to induce a feeling of low control (Pittman & Pittman, 1979; Whitson & Galinsky 2008). The two baseline groups did not receive any feedback, and were told their responses did not matter (see Appendix 8.2). Whitson and Galinsky found that participants lacking control in the concept identification task showed an increase in their personal need for structure, compared with those in the baseline condition. The stimulus used to measure pattern perception is a modified version of the snowy pictures task. Twelve of the 24 pictures have been manipulated with noise to make the embedded image difficult to perceive, while the other 12 pictures are noisy without any actual image embedded.

Data analysis. All reasoning and decision-making takes place in presence of uncertainty and noise. Signal detection theory (SDT) provides valuable information on both performance, i.e. how well the subject discriminate between signals, and his bias, the extent to which one type of response is more probable than the other (Macmillan & Creelman, 1991). The bias will hereafter be named decision threshold or criterion, to avoid confusion. CRT: calculations on the proportion of correct answers were based only on the items not familiar to the subject, and then arcsine transformation was applied to make the data usable for parametric statistics (Zar, 1999).

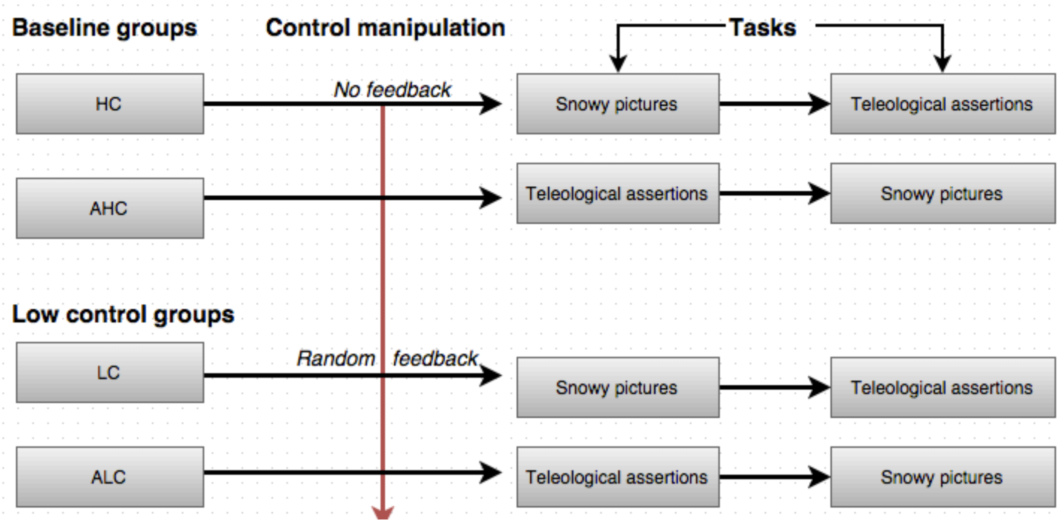

Figure 1

Half of the participants completed the randomized teleological/physical explanations (see appendix 8.4) from Kelemen & Rosset (2009) right after the manipulation, and the other half the snowy pictures from the Whitson & Galinsky paper (2008), making it four possible paths to complete the same experiment (see figure 1). This way one could investigate the duration and the potential effects of the manipulation more thoroughly.

4.1. Results

Combined analysis:

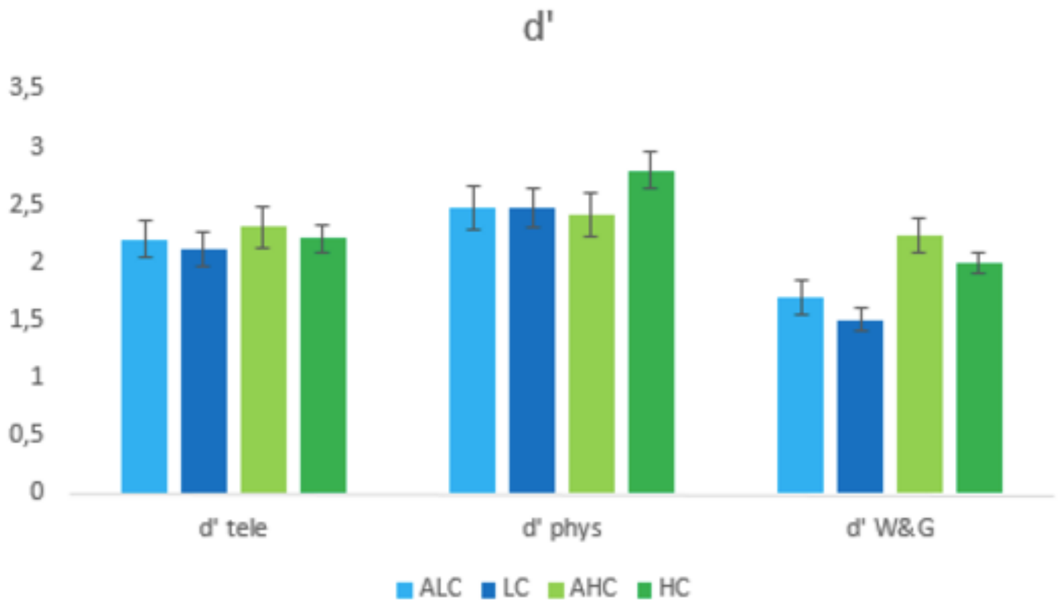

Figure 2[1]

Looking at all of the d-primes from pattern task (d' = 1.87, SD =.55), teleological (d' = 2.23, SD = .56) and physical (d' = 2.56, SD= .65) explanations together, we find a small, overall effect of the control manipulation ($F(1, 155) = 7.05$, $p < .01$, $\eta^2 = .04$), mostly driven by the pattern task, but no order effect ($F(1, 155) = .12$, $p = .74$) or significant interaction of task and control ($F(2, 155) = 2.78$, $p = .07$, $\eta^2 = .04$).

[1] d' tele and d' phys refers to the teleological and physical explanations, respectively. d' W&G is performance on the pattern task. ALC/LC are the two low control groups, while AHC/HC are the two baseline groups.

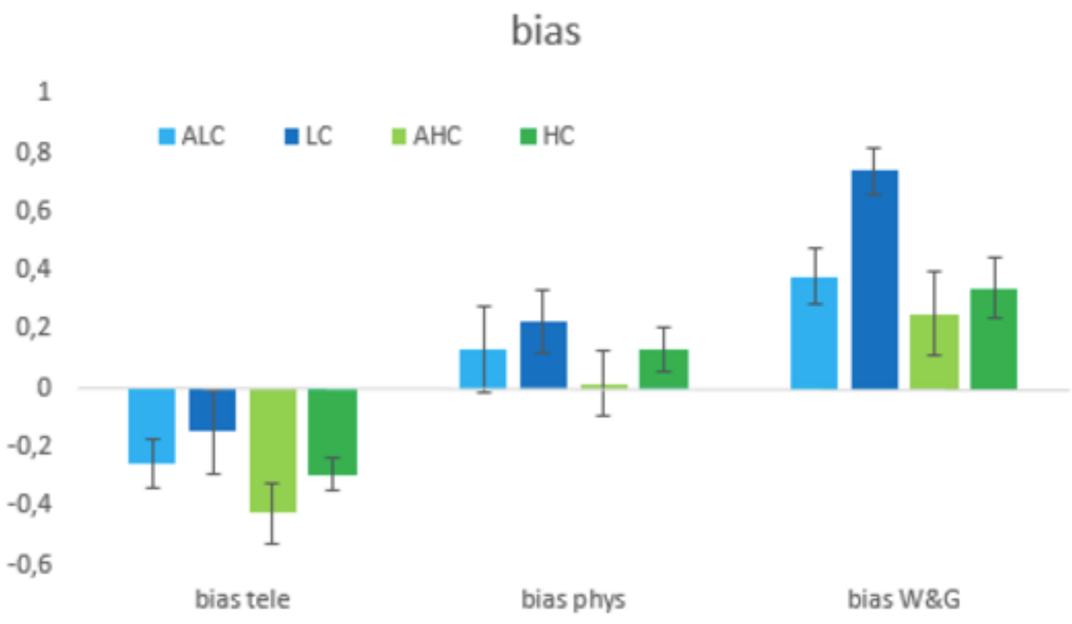

Figure 3[2]

When doing the same overall analysis on the decision threshold from pattern task, physical and teleological explanations, large differences between where our participants set the criterion is found ($F(1, 155) = 46.31$, $p < .01$, $\eta^2 = .37$). Some of the differences in bias are explainable by the control effect ($F(1, 155) = 7.69$, $p < .01$, $\eta^2 = .05$), and some from the order ($F(1, 155) = 6.24$, $p = .014$, $\eta^2 = .04$). There was not any significant interaction with task and control ($F(2, 155) = .74$, $p = .48$). On the direction of the bias, notice the footnote below figure 3 to get acquainted with the inconsistencies in the sources on SDT.

[2] Note: a negative bias is here counted as liberal (tendency to say yes), and positive bias conservative (tendency to say no). Some statisticians naturally do it the other way around. In Macmillan and Creelman's book on detection theory (1991), their 5.1 table presents it the current way, which the author and supervisors chose to follow.

Pattern perception:

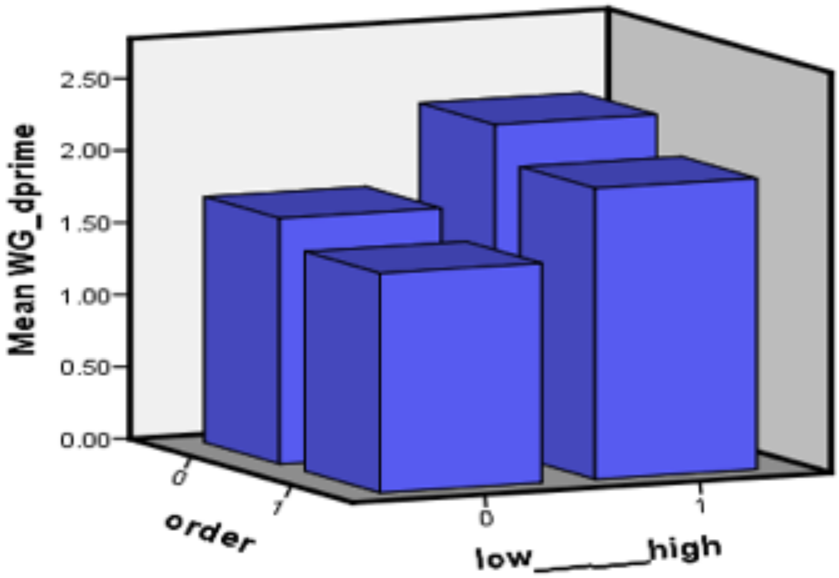

Figure 4[3]

Looking at the more specific statistics, the two low control groups LC (d' = 1.51, SD = .39) and ALC (d' = 1.70, SD = .60) perform poorer than the two baseline groups HC (d' = 2.00, SD = .37) and AHC (d' = 2.24, SD = .52). An analysis of variance (ANOVA) reveals significant effects of the control manipulation ($F(1, 54) = 16.8$, $p < .01$, $\eta^2 = .24$), confirming that low control affects performance. There were no significant gender differences ($F(1, 54) = 1.19$, p = .28). Although it may look like the manipulation wore some off for the ALC/AHC groups in the descriptive statistics, the analysis find no significant order effect on performance ($F(1, 54) = 2.45$, p = .12). The effect of low control on d' lasted throughout our experiment, making our participants in the ALC group perform worse at the snowy pictures than AHC even after both completed 110 true/false explanations about the

3 Figure 4 displays performance on the pattern perception task in d-prime. LC/ALC is the two labeled as "low" control, HC/AHC labeled as "high" (baseline) control. ALC and AHC is further labeled as "0" in order, while LC and HC is "1".

world. Looking at what caused the difference in sensitivity, it is actually found that both low control and baseline groups have the exact same amount of false alarms (1.07), and that the effect derives from different number of hits (low control groups mean hits: 7.00, baseline groups mean: 8.96). The decision threshold of the two low control groups LC (C = .74, SD = .31) and ALC (C = .38, SD = .36) does also diverge from the baseline groups HC (C = .34, SD = .40) and AHC (C = .25, SD = .51). This can be attributed to both the control manipulation ($F(1, 54) = 6.4$, $p = .01$, $n^2 = .11$) and somewhat order ($F(1, 54) = 4.64$, $p = .04$, $\eta^2 = .08$). The low control groups display a conservative strategy, saying "no" more often at the pattern task. The effect further manifests itself at a higher rate for the participants doing the task right after the control manipulation. Illusory pattern perception should be manifested as a decrease in performance, mainly caused by a heightened number of false alarms and a more liberal decision threshold, therefore evidence to support our hypothesis #1 and a replication of Whitson and Galinsky (2008) is not found.

Teleology*:*

Looking at the data from the teleological explanations, the two low control groups LC (d' = 2.11, SD = .57) and ALC (d' = 2.21, SD = .56) perform about the same as the two baseline groups HC (d' = 2.10, SD = .65) and AHC (d' = 2.31, SD = .62). Using ANOVA, there was no significant effects from the control manipulation ($F(1, 51) = .03$, $p = .88$), or the order ($F(1, 51) = .59$, $p = .44$) on d'. The two low control groups LC (C = -.15, SD = .54) and ALC (C = -.25, SD = .29) also set about the same decision threshold as the baseline groups HC (C = -.29, SD = .21) and AHC (C = -.42, SD = .37). ANOVA does not reveal any effects from the manipulation ($F(1, 50) = 3.2$, $p = .08$), or the order ($F(1, 50) = 2.22$, $p = .14$). Experiencing a lack of control or different order of tasks did not affect performance on teleological explanations, or cause a change in decision threshold, failing to find support for hypothesis #2.

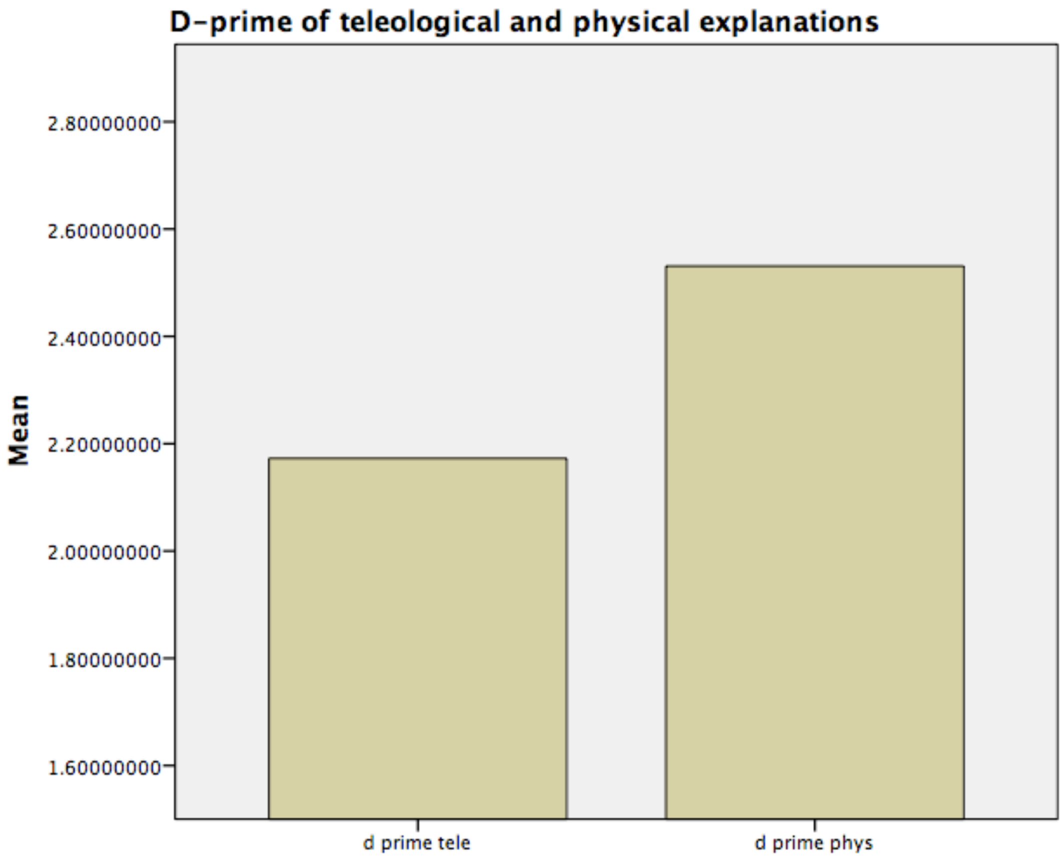

Figure 5

The participants display teleological thinking, independent of order and control manipulation. A paired t-test comparing the mean d-prime of the teleological (d' = 2.17, SD = .59) with the physical explanations (d' = 2.52, SD = .69) across all groups find significant differences: $T(58) = 4.11$, $p < .01$, cohen's d = .55. This might be related to the differences in decision thresholds (teleological C = -.25, SD = .41, vs physical C = .16, SD = .41): $T(58) = 7.89$, $p < .01$, cohen's d = 1.0.

While the manipulation and order did not have any effect on performance or decision threshold, a strong teleological bias was still present throughout all groups. The participants favored invalid intentional- and meaning-based explanations over invalid physical ones, independent of time restrictions or other situational factors like low control, providing new evidence of the widespread phenomenon. The results support hypothesis #3.

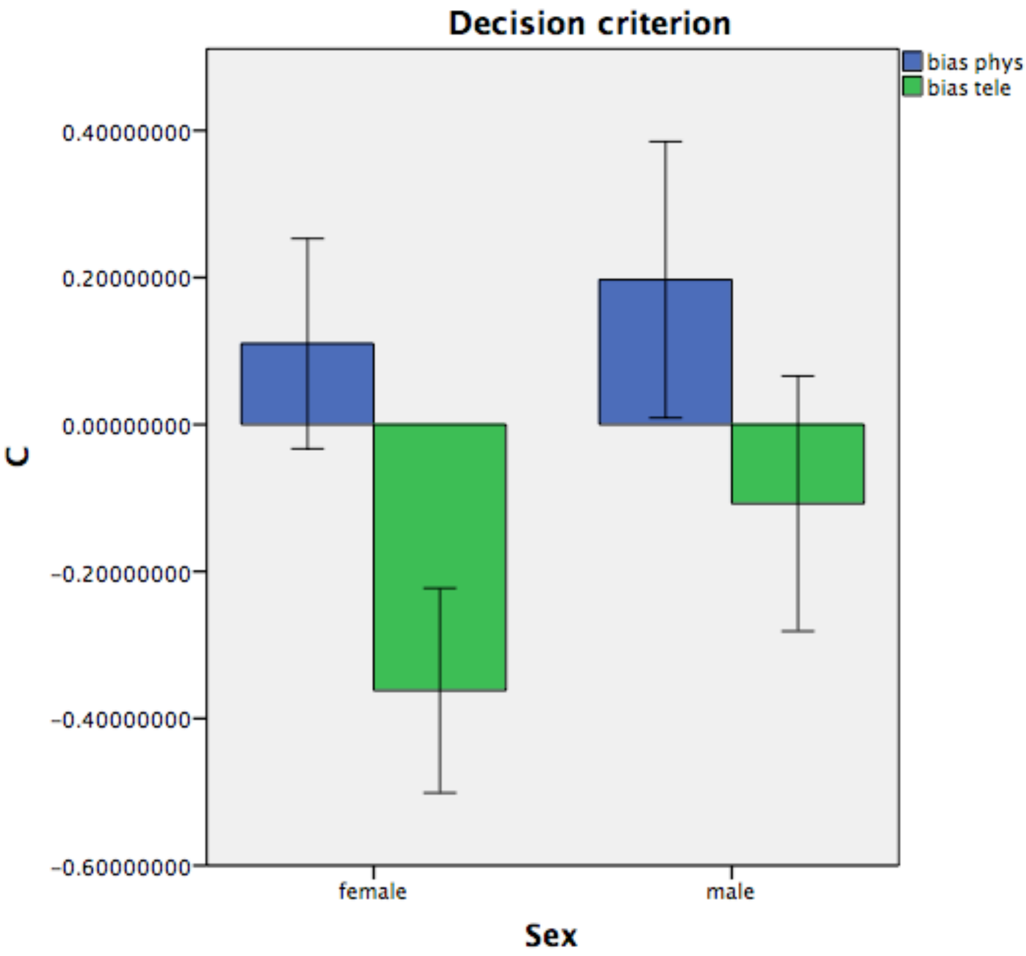

Figure 6

There were no gender differences in participants teleological d' (*F*(1, 51) = 1.50, *p* = .23). Females did display a significantly larger bias, in absolute numbers, (C = -.36, SD = .39) on the teleological explanations than males (C = -.11, SD = .41) though: $F(1, 50) = 6.13$, $p = .02$, $\eta^2 = .11$ (see figure 6). This effect is not present in the physical explanations bias ($F(1, 50) = .39$, $p = .54$). Females showed a stronger bias towards saying "yes" on teleological items compared with male, regardless of manipulation and order.

Cognitive Reflection Test:

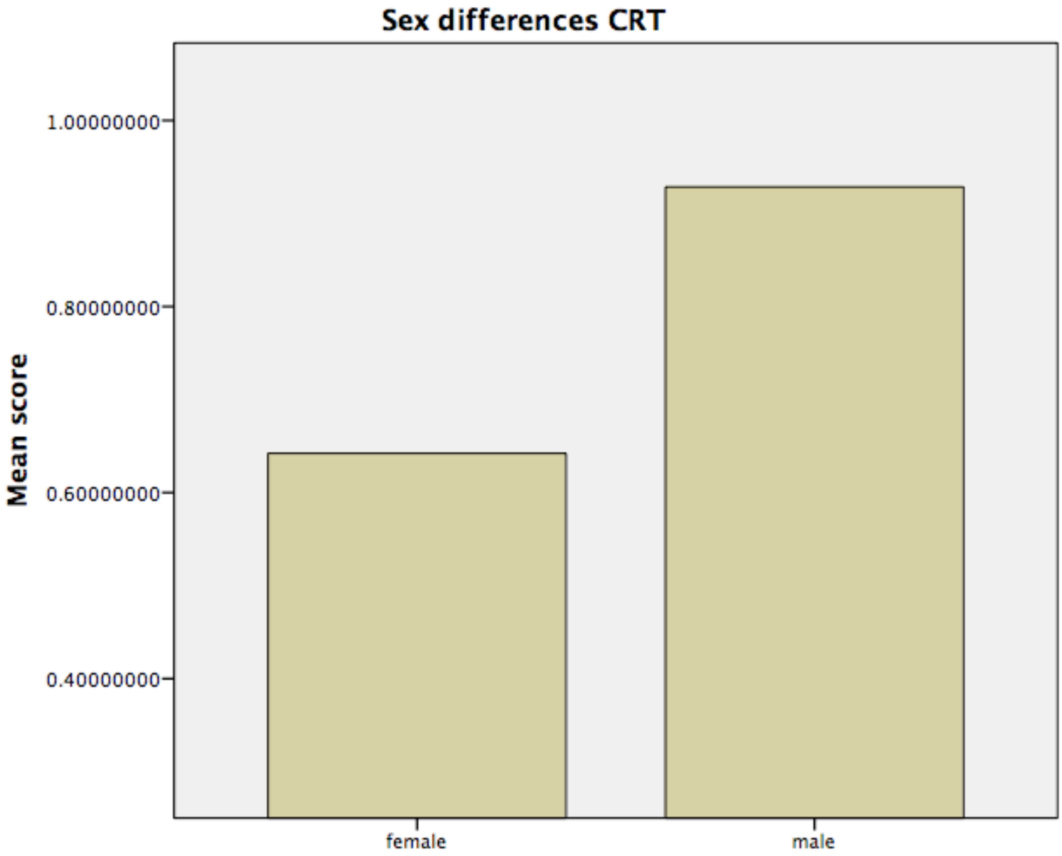

Figure 7

There are 7 items in the extended CRT, and the participants had the option of writing whether they had seen the item before. 13 out of 60 participants were familiar with some or all of the 3 first items, an issue Toplak et al. discussed in 2014. The female participants displayed a significantly lower score (mean = .64, SD = 0.36) than males (mean = .93, SD = .38): $t(58) = 2.98$, $p < .01$, cohen's d = .78, supporting hypothesis #4.

Our participants' score on the CRT correlate with performance on the teleological ($r(52) = .31$, $p < .05$) and physical assertions ($r(52) = .40$, $p < .01$), indicating that these tasks in part reflect rationality.

Regression analyses find that gender, CRT and decision threshold weakly predict teleological score ($R^2 = .15$, $F(3, 50) = 2.84$, $p = .047$), with none of the factors standing out, and that gender, CRT and physical bias predict physical explanation score (R^2 = .20, $F(3, 50) = 4.21$, $p < .01$). In the last mentioned, the CRT explains significantly more of the variance (b = .69, $t(50) = 2.83$, $p < .01$).

5. Discussion

Combined analysis: A small effect of the control manipulation is found on the three d-primes. This is mainly driven by the pattern perception task, as both LC and ALC groups displayed a significantly lower performance. No overall interaction of task and control or any order effect, meaning the sequencing of tasks did not affect our participants' performance combined. Large differences between decision thresholds are found, caused by the liberal teleological bias versus conservative perception bias. Generally, participants were more likely to say "yes" to a teleological explanation of the world, than a physical one or the pattern task. Some of these differences are attributable to the manipulation, with especially the LC group having a highly conservative threshold at the snowy pictures task. A certain order effect is found, showing that the decision threshold was changed somewhat according to the sequencing of the tasks.

Pattern perception: The participants who had their feeling of control manipulated by the card sorting task, displayed a significant lower d' compared with the baseline groups. This would initially seem consistent with Whitson & Galinsky's studies from 2008, but when investigating the raw statistics there was found the exact same number of false alarms in low control and baseline groups. The difference results from fewer hits in low control groups, meaning those participants perceived fewer actual images than baseline. This is a result of where they set the decision threshold; with the low control participants displaying a more skewed bias than the baseline ones, making them say "no" significantly more. In signal detection theory, the participant setting the optimal criterion has a C of 0 (Abdi, 2010), assuming the benefits of hits and correct rejections, and the cost of false alarms and misses, are the same, and images with pattern are as common as images without patterns. The baseline participants are .30 away from this mean, and low control participants .56.

The fact that the random feedback manipulation caused half of our participants to set the criterion more conservative is surprising, as the work by Whitson & Galinsky predicted the opposite. Their studies had approximately half the amount of participants as the present study though, and their participants had a mean true positive rate of 11.4 out of 12 possible, while our low control participants had 7.00 and baseline 8.96. Interestingly, their low control participants had a false alarm rate of 5.16 and baseline 3.47, while our participants had 1.07 across groups. The American sample generally set the criterion for seeing a picture a lot more liberal than the Norwegian sample, an effect that also might be related to cultural differences.

The low control participants displayed a stronger bias towards saying there is no image, especially the ones doing the pattern task right after the manipulation. Although there was not a significant order effect on overall performance, the performance and criterion of the ALC group was closer to the baseline groups, due to the control manipulation wearing some off. The mean completion time on the explanations for the ALC/AHC groups before doing the pattern task were about 15 minutes (SD = 5.86), which provides information for future research of a certain time window for the manipulation. One should seek to initiate the relevant tasks right after the manipulation, for maximum effect.

One earlier study found that situation valence moderated the psychological consequences of lacking control, where participants also saw significantly fewer images after retrieving a *positive* memory where they lacked control than the baseline group (Quan et al., 2011). These researchers discuss their results compared with Whitson & Galinsky's with people subconsciously prioritizing to make sense of a negative event, a compensatory mechanism, as a means to speed up the emotional recovery. While for an event inducing positive emotions, recovery is not desired, as experiencing positive feelings are wanted (Wilson & Gilbert, 2003). The control manipulation used in the present study was non-contingent feedback on a seemingly simple task though, and should induce some frustration and uncertainty rather than positive emotions. Our results diverge from earlier findings, which complicate the exact nature of perceptive processes when one is experiencing a lack of control. This specific manipulation definitely appears to affect perception, but the direction and nature of the mechanism seems unclear. As the original findings had small sample sizes and not strong effect sizes, more research is needed before one can conclude either way.

Teleological thinking: The results do not reflect any effects of low control on the d-primes or decision threshold for the teleological or physical explanations. Earlier mentioned research has found that low control increases attribution of various types of intent; anthropomorphism, and belief in a controlling God and Government, and time restrictions leading to a higher amount of teleological items endorsed. In our data, on the other hand, the situational factor of low control does not have any effect, providing evidence of the bias not being a part of the theoretical compensatory mechanism.

There was nonetheless found evidence of teleological thinking in our participants, independent of manipulation and order. Comparing the d-prime of the teleological and physical items, a moderate to large cohen's d of .55 is found. This is related to the more liberal bias on the teleological items, resulting in a higher amount of false positives. For instance, the participants showed a high endorsement of explanations like: "Lemurs have adapted in order to avoid extinction" and "The fittest animals survive so that species can grow stronger". Earlier discussions highlighted the problems of anthropomorphism and teleology when it comes to explaining evolutionary adaptions (Clough & Wood-Robinson, 1985), and that also highly educated individuals have troubles explaining the core principles of evolution correctly (Nehm & Schonfeld, 2007). The notion that there is meaning and intention behind blind processes in nature is thus found in additional participants outside of North America. Accumulating academic experience reduces a substantial portion of teleological thinking (Kelemen et al., 2012), but far from it all, illuminating the perseverance of this cognitive bias. An implication of this is that participants recruited from outside a university without any higher education might display a larger discrepancy between teleological and physical explanations.

Interestingly, there were found significant gender differences on decision threshold, but not d' and performance. Although the participants discriminated between the false and true statements with the same performance rate, the women were a lot more likely to say “yes” every time a valid/invalid teleological statement appeared. A commonly held stereotype is that females have superior social cognition skills compared with males, and one could assume these skills within theory of mind would facilitate the detection of intent, also where there is none. However, a study from 2007 did actually find the opposite, with male participants performing better than females at attributing mental and physical states to Happés’ cartoon task (Russell, Tchanturia, Rahman & Schmidt, 2007). On the other hand, research within the systemizing-empathizing quotient by Baron-Cohen recurrently finds that the female brain is predominantly hard-wired for empathy, and male brain for understanding and building systems (e.g. Baron-Cohen, 2002; Baron-Cohen, 2009; Focquaert et al., 2007). Researchers suggest that there exists an “extreme male brain”, which is high in systemizing and low in empathizing, which cause autism to occur at a much higher rate in males. A study from 2012 found that especially women with low waist-to-hip ratios, often found rated as more attractive, healthier and fertile, excelled at identifying emotional states of other people, and favored empathizing over systemizing (Bremser & Gallup, 2012). These differences in cognitive processing might be related to the bias the females in the current study displayed towards accepting teleological explanations, as they might be better at detecting intent and do not activate system 2 processing as much as males.

The phenomenon of promiscuous teleology has up until recently been argued to be a cognitive default (Järnefelt, Canfield & Kelemen, 2015), which find some support in the current results, as scores on CRT has a small to moderate correlation of .31 with teleological d-prime. Regression analysis shows that score on CRT does not contribute significantly more to explaining the teleological d-prime than gender and SDT-bias though. Indeed, CRT has a correlation of .40 with physical d-prime, and stands out significantly as a predictor. Being good at inhibiting the intuitive system 1 response and activate analytic processing might decrease some teleological thinking, but it will decrease invalid physical and scientific thinking more, which provides a different angle to a complex phenomenon.

CRT: Our results replicate earlier findings on gender differences (Frederick, 2005; Campitelly & Gerrans, 2013; Toplak, West & Stanovich, 2014), with a large effect size of .78. One study found the same direction in gender differences, but it was not significant (Campitelli & Labollita, 2010). This may be caused by a floor effect though, as 59% of the participants did not get any of the items correct. The male participants in our sample were better at overriding the intuitive system 1 response, and activating system 2, raising the question why these results keep showing up. Some of the variance might be explained by different preferences in cognitive style. Epstein criticized in 1996 the dual processing theories with being too devoted to explaining the nature of the processes, and not the individual differences or styles that people use (Epstein, Pacini & Denes-Raj, 1996). He and his colleagues developed the Rational-Experiential Inventory (REI), which is a combined version of a modified Need for Cognition scale (NFC) and Faith in Intuition (FI). Small to moderate gender differences has been frequently reported when using this inventory, where women generally prefer experiential and intuitive reasoning, and men a more analytic style, across a wide age span (Sladek, Bond & Phillips, 2010). An example of a NFC item is "I would prefer complex to simple problems" and "I would rather do something that requires little thought than something that is sure to challenge my thinking abilities (reversed)", while a typical FI item is "my initial impression of people are almost always right" and "I believe in trusting my hunches", which both appearing to be related to the theoretical groundwork behind CRT. Another similar and related construct, which has been discussed above, is the systemizing-empathizing quotient. Self-report data on rationality can deviate from experimental data though, for instance as seen in Frederick's (2005) work, where the women performing poorer than male nonetheless rated themselves as using longer time on deliberating before concluding. As high CRT-scorers display a tendency towards taking risks, there is accumulating evidence on relevant neurobiological differences. One study on young males found no differences in grey matter volume and white matter integrity between low and high risk-taking groups when comparing with self-report personality data (Kwon et al., 2014). When comparing the different risk takers with experimental risk-taking behavior on the other hand, they found higher white matter integrity in the high-risk taking group. The researchers find that risk seeking stimulates the central nervous system in a positive manner, and that although some take unnecessary and harmful risks, a group of "skillful risk-takers" were identified in their sample. Using fMRI, the same group of researchers did indeed find that taking a risk activated the adolescent brain much more than a decision to stay safe (Vorobyev et al., 2015). As CRT measures the ability to activate deliberate cognitive processing, it may be that the same group of individuals is identified from a different angle.

Although attaining high scores on CRT is associated with a wide amount of positive life outcomes, there are many situations where following your gut feeling and intuition would prove more fruitful than resourceful and deliberate thinking. The core of the skill seems to be the ability to distinguish *when* a system 1 and system 2 response is most profitable to the individual, and males tend to execute this better in test-settings. While a number of studies on general intelligence are pointing in both sexes' favor, one meta-analysis of 57 studies finds a slight general intelligence advantage in males, equivalent of 3-5 IQ points (Lynn & Irwing, 2004). As CRT is moderately correlated with performance on WASI (Toplak et al., 2014), the gender differences on both types of cognitive tasks might be interlaced. Future research should investigate both cognitive style differences and experimental data, i.e. with neuroimaging techniques, and explore the connection with performance on CRT.

6. Conclusion

The results diverge somewhat and fully from hypothesis 1 and 2, respectively, while supporting hypothesis 3 and 4. Although the low control participants performed worse on the pattern perception task, which is according to the predictions, they proved to have a more *conservative* decision threshold, with fewer hits and the same amount of false alarms. The direction was opposite in various earlier studies, and the true nature of illusory pattern perception seems to be unclear. As the American participants generally saw a lot more images than the Norwegians, the difference might be caused by cultural differences. The induced state of lacking control did not decrease the participants' teleological d', or change their criterion more liberally. The participants did display a medium to large teleological bias nonetheless, with especially females having a significantly more liberal decision threshold, while performing at the same rate as males. Previously found gender differences on the cognitive reflection test are replicated quite convincingly, with a large effect size. This might be related to differences in cognitive style, and further research is encouraged.

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8. Appendix

This appendix will include all relevant research material used in our experiment, and more detailed information not included in the thesis.

8.1: *Cognitive Reflection Test (CRT).* The participants were told these tasks were regarding rationality and cognitive reflection, and encouraged to mention each task they had seen before. The participants that were familiar with one or more items were not excluded from the data, as Toplak et al. (2014) argues that the CRT4 can replace CRT3 without reluctance, and that the predictive values of the new items are similar, if not better. They do not present data that demonstrates the effects of experience though; whether knowledge about one or three items is generalizable to the other items. One would intuitively assume that learning about human aversion towards effortful thinking should facilitate the activation of a system 2 response in a test-setting. This study did not collect information on whether the 13 participants who were familiar with the CRT possessed this information though, or whether they had only been researched on beforehand and never been debriefed about the nature of the test. People seldom recognize bias in oneself, even when told about the bias' existence (Pronin et al., 2002; Pronin, 2006), so it is not very likely that the participants who had seen one item would have a significant advantage.

1. A bat and a ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost? ____ cents [Correct answer = 5 cents; intuitive answer = 10 cents]

2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ minutes [Correct answer = 5 minutes; intuitive answer = 100 minutes]

3. In a lake, there is a patch of lilypads. Everyday, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days [Correct answer 47 days; intuitive answer 24 days]

The following 4 items were added in 2014 (Toplak et al., 2014):

4. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? _____ days [correct answer 4 days; intuitive answer 9]

5. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? ______ students [correct answer 29 students; intuitive answer 30]

6. A man buys a pig for $60, sells it for $70, buys it back for $80, and sells it finally for $90. How much has he made? _____ dollars [correct answer $20; intuitive

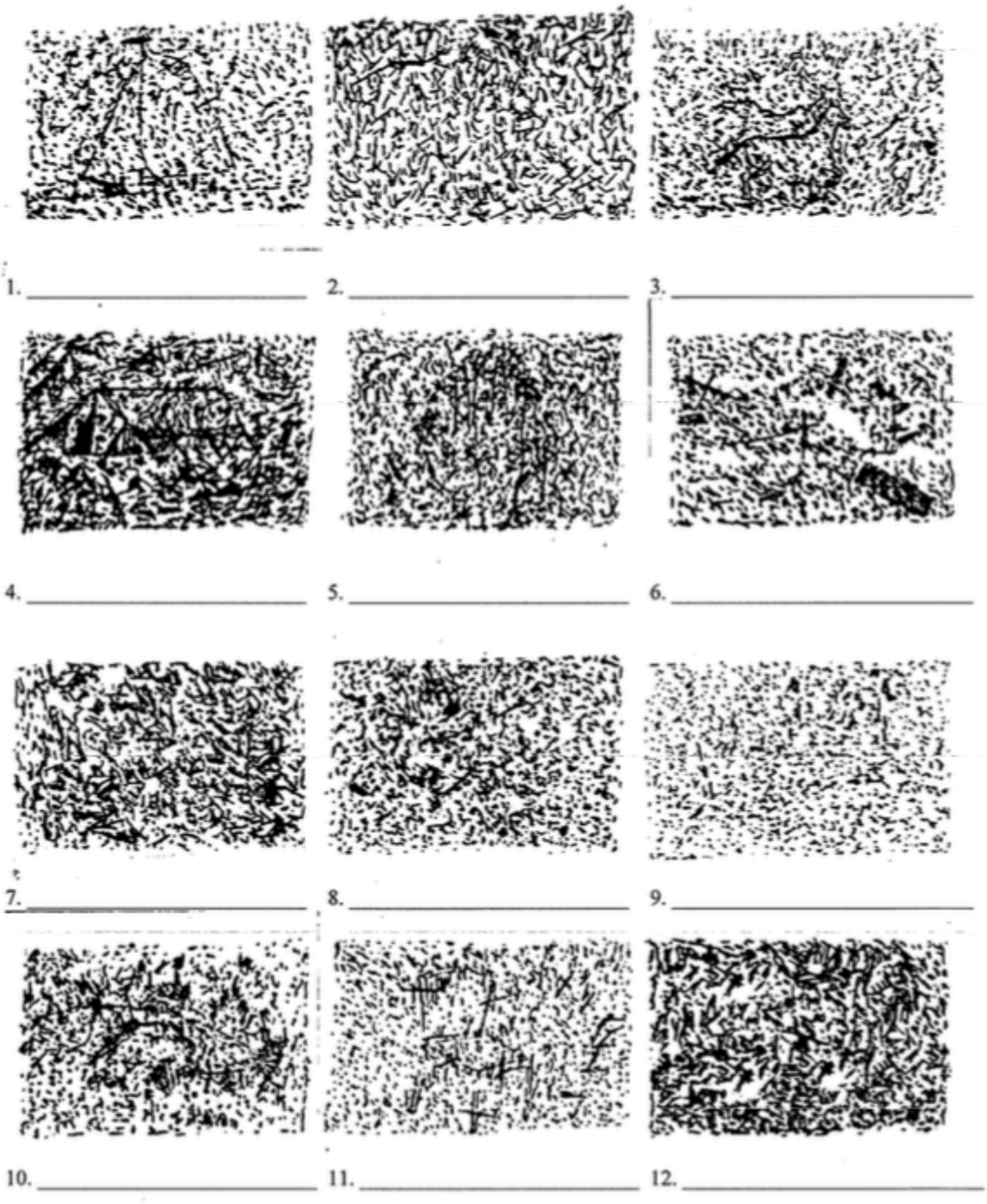
answer $10]

7. Simon decided to invest $8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had pur- chased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money [correct answer C, because the value at this point is $7,000; intuitive response B].

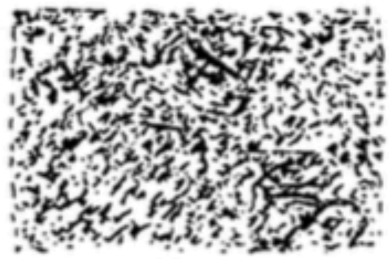
8.2: *Card sorting task* (Pittman & Pittman, 1979). This task was administered to manipulate feelings of control in our participants. They were told each "card" would contain two different letters, in different sizes and different colors. Only one of these concepts will be correct, and the task is to figure out which one that is. You learn the concepts by receiving feedback after each card, and are encouraged to change your answer accordingly. After the five introduction tasks an additional concept is introduced: whether the letter is having a blue ring around it or not. The participants randomly assigned to the low control condition received predetermined, random feedback ("wrong" and "correct", about 50/50), independent of their answers, while the two baseline groups received no feedback and were told their answers was unimportant. They were told to follow their instincts, and that the reaction of feeling confused was normal.

All of the cards were developed by the author using a graphical editor. Below is an example of one of the cards presented.

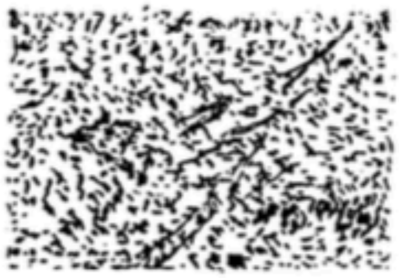
8.3: *Snowy pictures task.* The participant is briefly explained how our ability to percept objects quickly is adaptive, and that the following task measures this. If the participants do not percept anything, they click on a box saying “nothing”, if they see something, they write down the name of the object. They are asked to work as fast as they can without losing accuracy. There is an image in items 1, 3, 4, 5, 6, 10, 11, 17, 19, 21, 22, and 24. The other items (2, 7, 8, 9, 12, 13, 14, 15, 16, 18, 20, and 23) were manipulated using digital software so that no traces of the original pictures remain (Whitson & Galinsky, 2008). If an object is seen where there is none, it is calculated as a false alarm, and if an object is seen where there actually is one, it is calculated as correct independent on content of reported image.



13. ____________________

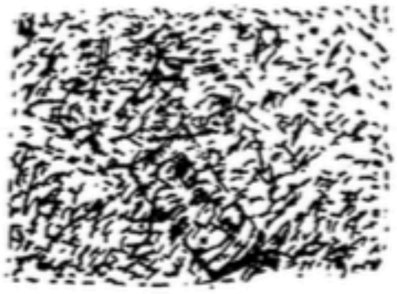


14. ____________________



15. ____________________

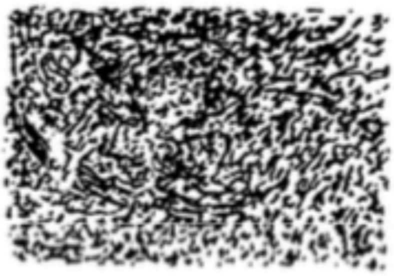
16. ____________________



17. ____________________

18. ____________________

19. ____________________



20. ____________________

21. ____________________

22. ____________________

23. ____________________

24. ____________________

8.4: *Teleological and physical explanations*. The participants were told they were about to get a list of explanations about the nature around us, and that their job was to find out whether they are false or true. They were encouraged to read the explanations thoroughly as the words of choice are of importance, and the participants in the classroom setting could ask the English speaking supervisor if there were words they were uncertain of. The sentences below were randomized within their blocks of 10 each page, so the participant would not be able to detect the pattern of false/true explanations.

1. False teleological explanation.
2. True teleological explanation.
3. False physical explanation
4. False physical explanation.
5. False physical explanation.
6. True physical explanation.
7. True physical explanation.
8. False teleological explanation.
9. False teleological explanation.
10. False teleological explanation.

Block 1:

1. Skyscrapers are built so that cities have landmarks.
2. Parties happen in order to help celebrate special occasions.
3. Viruses replicate because they are microscopic.
4. Insects have antennae because they have exoskeletons.
5. Trucks move because of internal combustion engines.
6. Cigarettes produce smoke because tobacco burns.
7. Leaves change color because chlorophyll deteriorates.
8. The sun radiates heat because warmth nurtures life.
9. Grass grows so that herbivores can graze on it.
10. Stars twinkle in order to light the night sky.

Block 2:

1. Hair becomes grey so that people can look older.
2. Schools exist in order to help people learn new things.
3. Spiders spin intricate webs because they have eight legs.
4. Potatoes contain starch because they grow in the ground.
5. Cleaning fluids are corrosive because they have pungent odors.
6. Objects fall downwards because they are affected by gravity.
7. Lollipops are sweet because sugar is a main ingredient.
8. Lemurs have adapted in order to avoid extinction.
9. Earthquakes happen because tectonic plates must realign.
10. Molecules fuse in order to create matter.

Block 3:

1. Musicians have two hands in order to play instruments.
2. People wear contact lenses in order to see more clearly.
3. Snowflakes are white because they are symmetrical.
4. Rivers have rapids because a lot of fish swim in them.
5. Soup is hot because it is primarily liquid.
6. Magnets stick together because their poles attract.
7. Tadpoles become frogs because they undergo metamorphosis.
8. Microbes convert nitrogen in order to enrich the soil.
9. Oceans dissolve rocks in order to retain ocean minerals.
10. Trees produce oxygen so that animals can breathe.

Block 4:

1. Window blinds have slats so that they can capture dust.
2. Alarm clocks beep in order to wake people up.
3. Snakes make hissing noises because they move by slithering on the ground.
4. Keys open locked doors because they are made of metal.
5. Male lions have large manes because they are carnivores.
6. Butter is greasy because it contains a great deal of fat.
7. Redwood trees stay firmly planted because they have strong roots.
8. Germs mutate in order to become drug resistant.
9. Volcanoes erupt in order to release underground pressure.
10. The sun makes light so that plants can photosynthesize.

Block 5:

1. Houses have doorbells in order to make dogs bark.
2. Pencils exist so that people can write with them.
3. Toads make croaking noises because they catch flies with their tongues.
4. Paper towels are absorbent because they are thin.
5. Rocks are heavy because they are made of inorganic material.
6. Mushrooms grow in the forest because the soil has the right nutrients.
7. Fireworks explode because gunpowder ignites when a fuse is lit.
8. Earthworms tunnel underground in order to aerate the soil.
9. Glaciers compact snow in order to conserve volume.
10. Bees frequent flowers in order to aid pollination.

Block 6:

1. Mice run away from cats in order to get exercise.
2. People buy microwaves in order to heat their food.
3. Saturn is a planet because it has rings surrounding it.
4. The moon shines brightly because it has many craters.
5. Soda cans are cylindrical because they are made of aluminum.
6. Lizards shed their skins because they outgrow them.
7. Otters are water resistant because their fur has natural oils.
8. The fittest animals survive so that species can grow stronger.
9. The Earth has an ozone layer in order to protect it from UV light.
10. Rain falls in order to allow plants to grow.

Block 7:

1. Lamps shine brightly so that they can produce heat.
2. Stoplights change color in order to control traffic.
3. Cellphones receive text messages because they are portable.
4. Cows make mooing noises because they graze on grass.
5. Roses have delicate petals because they have prickly thorns.
6. Clothes cling in the dryer because tumbling together produces static.
7. Icicles melt because the temperature increases.
8. Ferns grow at ground level in order to conserve humidity.
9. Lightning releases electricity in order to travel.
10. Birds transfer seeds in order to help plants germinate.

Block 8:

1. Kittens have soft fur so that people will want to pet them.
2. Children wear mittens in the winter in order to keep their hands warm.
3. Raspberries are bright red because they grow on bushes.
4. Peppermint gum is chewy because it freshens peoples' breath.
5. Sea lions have a thick layer of blubber because they feed on fish.
6. Suction cups stick because they create a pressure vacuum.
7. Soda fizzes because carbon dioxide gas is released.
8. Parasites multiply in order to infect a host.
9. Geysers blow in order to discharge underground heat.
10. Particles collide in order to produce chemical reactions.

Block 9:

1. People chew food in order to strengthen their jaw muscles.
2. Women put on perfume in order to smell pleasant.
3. Chocolate is brown because it contains a significant amount of sugar.
4. Polar bears are white because they swim in icy ocean water.
5. Pebbles have rounded edges because they are little.
6. A lightbulb shines because electricity passes through its filaments.
7. Candles melt because the wax becomes very hot.
8. Water exists so that life can survive on Earth.
9. Mountains fold inwards in order to maintain mass.
10. Bats hunt mosquitoes in order to control over-population.

Block 10:

1. Cows have udders in order to allow farmers to milk them.
2. Doctors prescribe antibiotics in order to treat infections.
3. Oceans have waves because they contain a lot of saltwater.
4. Chipmunks hibernate in the winter because they eat nuts.
5. American prairies are flat because they are covered with grass.
6. Butcher knives slice through meat because they have sharp edges.
7. Conception occurs because sperm and egg cells fuse together.
8. Finches diversified in order to survive.
9. The Earth rotates around the sun so that it can receive light.
10. Sand dunes form in order to stop waves eroding vegetation.

Block 11:

1. People put coins into meters in order to get rid of spare change.
2. Bicycles have handlebars so that people can steer them.
3. Pruning shears have sharp blades because they have handles.
4. Billboards are brightly colored because they are large.
5. Coyotes howl because they live in the hot desert.
6. Lily pads float on the water because they have a large surface area.
7. Teeth decay because the enamels are dissolved.
8. Moss forms around rocks in order to stop soil erosion.
9. Hurricanes circulate seawater in order to gather energy.
10. Mites live on skin in order to eliminate dead skin cells.