Fishy Smells Improve Critical Thinking:

Explorations of the Embodiment of Suspicion

By

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Abstract

A suspicious mindset can alert people to not take information at face value, as circumstances may not be what they seem. In many languages, suspicion is metaphorically associated with smell; in English, this smell is “fishy”. This study examined the effects of an incidental exposure to fishy smell on cognitive reasoning processing styles. The Moses illusion question (Erickson & Mattson, 1981) and Wason’s (1960) rule discovery task served as dependent variables in this study. Participants who were exposed to an incidental fishy smell, as opposed to a neutral cue (i.e. no odor), were more likely to detect semantic distortions as tested by the Moses illusion (Study 1). They were also more likely to engage in negative hypothesis testing on the Wason rule discovery task (Study 2). These findings highlight the cognitive benefits of feelings of suspicion and advance our understanding of its elicitation through sensory cues.

Keywords: Moses illusion, Wason’s rule discovery task, suspicion, distrust, embodiment, metaphor, fishy smell, semantic distortion, hypothesis testing, critical thinking

Fishy smells improve critical thinking:

Explorations of the embodiment of suspicion and distrust

"Don't believe everything you think. Thoughts are just that - thoughts" (Lokos, 2010, p. 208)

Feelings can inform us about the nature of a situation and our progress towards our goals (Schwarz, 2002; Schwarz & Clore, 2007; Smith & Semin, 2004), which influences the likelihood that different cognitive procedures are applied. For example, benign feelings foster more heuristic, top-down processing that relies on pre-existing routines and involves less attention to detail. The opposite is true for feelings that signal a problem, e.g., negative feelings such as "sad moods" (Bless, Bohner, Schwarz, & Strack, 1990), "bodily avoidance feedback" (Friedman & Förster, 2000), and feelings with "high uncertainty appraisal" (Tiedens & Linton, 2001). Such feelings foster more systematic and bottom-up processing with higher attention to detail, more scrutiny, and less reliance on routines.

Suspicion and Distrust

Feelings of suspicion and distrust[1] alert people not to take information at face value by sending a signal that circumstances may potentially not be what they seem. This inclines people more towards scrutiny (Mayo, Alfasi & Schwarz, 2013; Schul, Mayo & Burnstein, 2004). In a situation that arouses suspicion, one's intuition may lead to recognition of strange aspects of the environment, even if the nature of the strangeness is uncertain. Due to this uncertainty, one's cognitive processes may differ under a suspicious mindset. For instance, one might be more careful and cautious. One may be more likely to ask, "How might things around me differ from what they seem?" and avoid "going with the flow" (Mayo et al., 2013).

When a context is uncertain, a suspicion-based (i.e., distrust-based) reasoning strategy may lead one to reason differently than one would in a non-suspicious (i.e., trustful) context. When one has feelings of trust, one is more likely to take information at face value without being skeptical or critical. On the other hand, when one has feelings of distrust, one processes information more carefully and pays attention to details. This may cause one to not only question assumptions but also find alternate ways to solve problems.

For example, a group of people were given a word and asked to choose related words. Given a word such as “transitory,” one might choose a synonym (“temporary”) or antonym (“permanent”). Those who had been recently exposed to incidental distrust were faster at recognizing antonyms rather than synonyms (Schul, Mayo, & Burnstein, 2004). Also, feelings of distrust promote construction of alternative interpretations (Fein, 1996; Schul, Burnstein, & Bardi, 1996), counter-scenarios (Kruglanski, 1989; Kruglanski & Freund, 1983), and more unusual solutions in creativity tasks (Mayer & Mussweiler, 2011; Schul, Mayo, & Burnstein, 2008). These findings support the perspective that induced incidental distrust affects one’s cognition. This affirms the prediction that feelings of distrust/suspicion can reduce biases related to heuristics, attenuate susceptibility to distortions, and increase non-routine solutions by generating possible alternatives to well-established routine solutions. Thus, it is possible that suspicion and distrust beget critical thinking.

Critical thinking. Thinking in situations of distrust shows patterns similar to critical thinking. There are many different ways of defining critical thinking, but broadly speaking it involves not accepting information at face value, questioning statements and assumptions, looking for potential flaws, and seeking alternate ways to think about information (Elder & Paul, 2008; Paul & Elder, 2008; Raiskums, 2008; McPeck, 1981). These are precursors for critical thinking that can arise via skepticism or distrust. Without critical thinking, people may be much more susceptible to cognitive illusions arising from misleading or distorted information. Being unable to recognize these errors or biases leads to difficulty in solving problems. Without critical thinking, it is hard for one to solve problems by generating and evaluating alternative perspectives. Along those lines, similar to the quote by Lokos (2010, p.

208) at the beginning of this thesis, believing everything one sees and thinks could cause one to fall prey to illusions and to not explore alternative solutions. Thus, being skeptical or suspicious of the one's own current thinking - which may be biased - can be an avenue that leads to critical thinking. This is what we tested in this study.

Experience of suspicion/distrust and smell

The experience of distrust can be elicited through several signals. The signals can be attributed to a target person (Burt & Knez, 1996), nonverbal behavior (Bond et al., 1992), facial features (Zebrowitz, 1997), or risk of betrayal (Bohnet & Zeckhauser, 2004). However, beyond these various suspicion cues, the experience of distrust can also be induced through sensory cues such as an olfactory sensation. This involves a process of exploring incidental cues that are not attached to a particular source, but metaphorically related to suspicion. In 18 languages reviewed in this regard, suspicion is metaphorically associated with smell (Soriano & Valenzuela, 2008). In English, this smell is "fishy." This is why the phrase "something smells fishy" is used to describe suspicious/distrustful situations.

Metaphorical embodiment. The relationship between smell and psychological effects is based on metaphorical embodiment. Historically, there has been a fair amount of interest in studies of metaphorical physical experiences, as well as cognitive linguistics and conceptual metaphor theories to understand the interplay between body and mind (Asch, 1955; Lakoff & Johnson, 1980; Lee & Schwarz, 2012b). What humans think about is spontaneously created in our minds on the basis of moods, feelings, goals, motives, and metacognition. This implies that people can also receive bodily feedback when they think of inherent invisibles as an interplay between body and mind. For example, holding a warm cup of coffee can lead to the perception of others as being "warm" and good-natured (Williams & Bargh, 2008) due to a phenomenon called embodiment (for reviews, see Barsalou, 2008; Meier, Schnall, Schwarz, & Bargh, 2012; Niedenthal, Barsalou, Winkielman, Krauth, & Ric, 2005; Spellman & Schnall, 2009). Metaphorical embodiment refers to how bodily experiences influence thinking, action, and decision-making based on metaphorically related objects such as fishy smells. Because judgment can be built on metaphorical ideas via bodily interactions within the sensory cues, it can be influenced by incidental bodily experiences of metaphors (Lee & Schwarz, 2012a; Lee & Schwarz, 2012b).

Fishy smell. Lee and Schwarz (2012a) found that “suspicious” and “fishy” are metaphorically associated in English native speakers’ knowledge structure and have bidirectional psychological consequences in social judgment. When suspicion was induced through a social interaction, people’s ability to notice and identify fishy smells and their number of fish-related thoughts increased compared to those in a control condition, who did not have suspicion activation (Lee & Schwarz, 2012a).

Incidental fishy smells made people less likely to trust others, and undermined people’s propensities to invest in economic trust and public good games (Lee & Schwarz, 2012a). Lee and Schwarz have also found that while smelling something fishy reduced investment in games, smelling an unpleasant but metaphorically irrelevant smell (a fart smell) did not have the same effect as that of fishy smells. This implies that the increase of suspicion/distrust under a fishy smell condition is indeed a metaphorical effect, not a result of simply smelling something unpleasant. These results not only show how a subtle environmental cue (i.e., incidental fishy smell) can influence social judgment, but also establish the presence of the bidirectional effects of embodied metaphors (Lee & Schwarz, 2012a). Since it is easy to expose people to a fishy smell in order to elicit suspicion, it can be considered an efficient way of manipulating feelings of suspicion/distrust. However, very few studies have investigated the effects of fishy smells, and the extent of the possible effects is still largely unknown. Therefore, this study tests whether exposure to fishy smells also affects reasoning processes related to critical thinking. This was done through two classic reasoning tasks: a semantic illusion task (Study 1), which tests scrutiny and accuracy in processing information, and the Wason (1960) rule generation task (Study 2), which tests the ability to find alternatives in problem solving.

Present Research

If distrust/suspicion influences the reasoning process, a fishy smell should also affect the semantic illusion task and Wason (1960) rule generation/discovery task. This agrees with the prediction that the suspicion elicited from a fishy smell would lead to scrutiny, systematic processing, and alternative thought processes. In turn, this would improve critical thinking and lead to accurate detection and negative hypothesis testing strategies (i.e., alternative thinking strategies). For this reason, extending previous research (Lee & Schwarz, 2012a; Mayo et al., 2013), our primary goal in these studies was to test whether a subtle sensory cue influences performance both on the Moses illusion (by increasing accurate detection), and on the Wason rule discovery task (by adopting negative hypothesis testing strategies). Accurate detection and negative hypothesis testing are introduced below.

We tested these predictions in two experiments.[2] In Study 1, we examined whether incidental fishy smells, which we expected would make people suspicious, reduce susceptibility to misleading information. Specifically, we tested whether it affected susceptibility to semantic distortions regarding the Moses illusion. We tested whether incidental fishy smells increases error recognition and improve accurate detection, which is a part of the reasoning process for critical thinking. Moreover, this also tests whether distrust from incidental fishy smells induces its own biases, which could lead individuals to falsely detect distortions in information that was not distorted. If distrust elicits closer scrutiny of the message, error identification should be limited to distorted messages and should not be extended to undistorted ones. In Study 2, we used the same incidental fishy smells and tested whether participants generated more negative hypothesis tests while working on the Wason

(1960) rule discovery task when exposed to fishy smells.

Study 1: Fishy smells improve accurate detection on a semantic illusion task[3]

Semantic illusion

One well-known illusion related to heuristics-and-biases in processing information is the semantic illusion. Below is an example of semantic illusion.

Consider the following question:

> If a plane crashes in the 38th Parallel, which is the border between North Korea and South Korea, should the survivors be buried in the Demilitarized Zone, North Korea, or South Korea?

Most people would immediately begin thinking about which place would make the most suitable burial ground. However, if one scrutinizes the question again, it becomes clear that it asks about the "survivors", who logically should not be buried. Following grounded theory suggested by Park and Reder (2003), this example shows how one may easily overlook distortions, which often occurs because distorted words often fit into the general context of the sentences, even if they do not make logical sense. In this case, the word "survivors" is easily overlooked because the phrase "plane crash" invokes the concept of accidents, cueing readers to think about death or death-related concepts. Yet, "survivors" itself still has some relation to "plane crash" as there may still be survivors. Just as illusion can distort reality to the point where one cannot recognize it, semantic illusion can cause the brain to be unable to discern subtle errors in sentences and situations (Economic and Social Research Council, 2012).

Moses illusion. "How many animals of each kind did Moses take on the Ark?"

Almost immediately, most people answer with "two," despite knowing it was actually Noah, not Moses, who took the animals on the Ark in the biblical story (Erickson & Mattson, 1981). This failure to detect distortion is known as the Moses illusion (Erickson &

Mattson, 1981; Park & Reder, 2003; Song & Schwarz, 2008). When new information similar to prior information is presented, the use of familiarity-based heuristics causes the new, different partial information to become an easy-to-ignore distortion. Detecting the distortion involves a two-step process, “the first to flag a potential mismatch and the second to invoke a careful inspection that might confirm an erroneous term in the question” (Park & Reder, 2003, p. 282). The “first stage” is cleared when one has knowledge that shares adequate semantic overlap with the distorted context of the question, causing a semantic illusion (Carpenter & Grossberg, 1995; Metcalfe, Schwarz, & Joaquim, 1993; Park & Reder, 2003; Song & Schwarz, 2008). For instance, because both Moses and Noah are characters in the Old Testament and followed commands from God related to water, there exists enough semantic overlap for the distorted word “Moses” to pass the first stage without the error being noticed, even with the knowledge that Noah was the real actor in the biblical story (Song & Schwarz, 2008). As the example illustrates, people fall prey to semantic illusion when the question feels familiar due to the semantic overlap with their prior knowledge. When the semantic overlap is low, however, such as replacing Noah with “Nixon” instead of Moses, the Moses illusion’s power is reduced (Park & Reder, 2003; Song & Schwarz, 2008).

When sufficient semantic overlap is present, people tend to forgo cautious matching operations, and use familiarity-based heuristics to ease the thinking process by making assumptions (Park & Reder, 2003). Extending the concept of familiarity-based heuristics beyond feature overlap in the Moses illusion, Song and Schwarz (2008) identified how to attenuate the illusion using the fluency effect. Considering that fluency influences both familiarity and the detection of distortions in a written text, they manipulated the level of fluency using fonts of varying legibility. They found that disfluency manipulations (e.g., difficult-to-read fonts) can lessen the effect of the Moses illusion and cause subjects to process the question more carefully, thereby helping them notice the distortions (for review, see Song & Schwarz, 2008).

Suspicion/distrust and Moses illusion

While Song and Schwarz (2008) manipulated the effect of fluency on the Moses illusion, this study uses a manipulation of suspicion (the fishy smell) in the paradigm of Lee and Schwarz (2012a). In a no fishy smell condition, the result is expected to be the same as that in Song and Schwarz (2008), since people tend to accept information without doubt and engage in heuristic processing (Schul et al., 2004). This processing may generate congruent accessibilities, resulting in immediate implications. Specifically, the word “Moses” primes subjects by evoking memories of the Old Testament and God’s commands related to water, which are congruent with the word “Noah” in the context of trust. This can lead to the prediction that the trust context potentially may play a role in overlooking semantic overlaps that increase susceptibility to misleading information. (Park & Reder, 2003; Song & Schwarz, 2008).

However, in suspicion/distrust context, feelings of suspicion/distrust alert people not to take information at face value, lessening susceptibility to misleading information. In the distrust context, people would doubt the given information, facilitating analysis of the incongruency of the information, which may reduce semantic overlapping. Specifically, the prime word “Moses” would invoke thoughts of the crossing of the Red Sea, which are incongruent with the prime word “Noah” which is related to floods (Schul et al., 2004; Schul et al., 2008; Schwarz & Clore, 2007; Song & Schwarz, 2008). Therefore, it is predicted that people exposed to fishy smells would be less likely to be deceived by the Moses illusion. Thus, participants would be less likely to answer, based on spontaneous association, “two”. Instead, they would be more likely to scrutinize the text when they are exposed to a subtle fishy smell and notice the distortion of “Moses” in the question. The main focus of this research was to discern whether the fishy smell—by eliciting suspicion, thus promoting more analytic and careful thinking—attenuates the Moses illusion.

Method

Participants

Seventy students (38 females) at the University of Michigan were recruited in public campus areas for this experiment for an alleged class project (debriefing was conducted after each experiment). They were randomly assigned a brief questionnaire to complete in two smell conditions in a between-participants experimental design. Each participant was in either a fishy-smelling (N=33) or a control booth (N = 37). The questionnaire contained a distorted question, “How many animals of each kind did Moses take on the Ark?” (the Moses question, from Erickson & Mattson, 1981), an undistorted question, “What country is famous for cuckoo clocks, chocolate, banks, and pocket knives?” (see Appendix A for the questionnaire), and demographic questions.

Materials

Smell substances were prepared in 2-ounce spray bottles so that they were easy to spray on a paper towel that was placed under the writing surface in a phone booth as needed. The fishy smell was derived from liquid cod liver oil (brand: CVS). Tap water was used for the odorless control condition.

A questionnaire containing the two questions was prepared for each participant to answer (Appendix A).

Procedure

Two smell conditions were set up in two separate phone booths on the first floor of the public area. Before the experiment, in the control phone booth, a paper towel was sprayed with 0.5 ounces of water. In the experimental phone booth, a paper towel was sprayed with 0.5 ounces of cod oil. Paper towels were secretly attached underneath the writing surface in each booth so that participants could not see the source of the smell.

At the same time, another experimenter, blind to the smell conditions, recruited and escorted individual participants to the randomly assigned phone booths. All instructions were given outside the booth and participants completed the questionnaire alone in the booth. In the phone booths, participants found the questionnaire on a shelf out of sight of the source of the smell. The participants entered the phone booth and were exposed to one of two smell conditions, water or fish. Participants then read the instructions for this experiment:

> Thank you for participating in the study. You will read a couple of trivia questions and answer them. You can write the answer in the blank. In case you do not know the answer, please write “don’t know.” You may or may not encounter ill formed questions which do not have correct answers if taken literally. For instance, you might see the question “Why was President Gerald Ford forced to resign his office?” In fact, Gerald Ford was not forced to resign. Please, write ‘can’t say’ for this type of questions. (modeled after Erickson & Mattson, 1981).

The first question below the instructions was the Moses illusion question. If participants successfully detected the semantic distortion in this question, they would answer “can’t say”. The second question was “What country is famous for cuckoo clocks, chocolate, banks, and pocket knives?” (modeled after Song & Schwarz, 2008, p.794). We included this control question to show that fishy smells do not influence people’s performance on undistorted questions. In addition, this question was administered to prevent participants from becoming suspicious of seeing only one question on the survey (a one-question survey may seem odd to some people).

After participants completed the questionnaire, they were asked the following questions, “did you notice anything unusual inside the booth?”, “did you smell anything?”, and “did you notice any fish-smell?”. These were intended to reveal whether our experimental manipulation was effective. Participants were also asked, “have you seen this exact Moses question before?” and “do you know who really took the animals on the Ark?” These were asked to distinguish between eligible and ineligible participants. We assumed that participants who had seen the exact Moses illusion task previously would know how to answer it without falling prey to the trap. We also needed to screen for those who did not know the biblical story of Noah so that they could be dropped from data analysis.

Exclusion Criteria

One participant in the experimental group was excluded from the analysis because she failed to complete the questionnaire. One participant from the control group who reported having seen the exact same intentionally distorted question before was also excluded. One participant reported having no sense of smell and hence could not detect any incidental fishy smell at all; this participant was also excluded. Additionally, we excluded two participants because they were not native speakers of English and had no the knowledge of the “something smells fishy” metaphor (Lee & Schwarz, 2012a). Finally, we excluded four participants who had no knowledge of the biblical story of Noah’s Ark. This resulted in a total exclusion of 9 participants (3 in the control out of 33 and 6 in the fishy condition out of 37), leaving 61 participants in the analysis (30 in the control and 31 in the experimental group).

Results

Distorted Question

As predicted, exposure to the fishy smell attenuated the Moses illusion (see Figure 1). Results showed that participants were more likely to detect the misleading nature of the question and respond correctly to the Moses question (“can’t say”) in the fishy smell condition (13 out of 31, 41.9%) than in the control condition (5 out of 30, 16.7%), $\chi^2(1, N = 61) = 4.680$, $p < .05$, for Pearson’s chi-square (Table 1).

Undistorted Question

For the undistorted question, none of the participants answered "can't say," except one person who thought the undistorted question was distorted in the fishy condition. The influence of fishy smells did not extend to the undistorted question, which implies that, in general, distrust/suspicion induced by the fishy smell did not elicit bias in the undistorted question (see Figure 2). Participants in the fishy condition (see Table 2) were likely to answer the undistorted question (the "Switzerland" question) correctly in both the induced suspicion condition (22 out of 31, 71.0%) and under the normal control condition (22 out of 30, 73.3%), χ^2 (1, N = 61) = 0.042, *ns*.

Based on the results shown above, fishy smells appear to improve the identification of distortions without inducing a bias causing undistorted questions to be wrongly identified as distorted.

We also considered the consistency between performance on the distorted and the undistorted questions. Specifically, we ran a logistic regression analysis to determine if performance on the distortion question was independent of performance on the undistorted question, and vice versa. The goal was to further support the notion that performances on each question should not be related. We observed that the correlation between performance on the two question, as indicated by Cox and Snell's R^2 = .002 and Nagelkerke R^2 = .003, was relatively low. Also, χ^2 (1) = .135, p = 0.714 (see Table 3), indicating that there is no statistically significant evidence to disprove the null hypothesis that performances between the two types of questions are independent of each other.

Discussion

This study demonstrates the powerful effects of olfactory distrust cues on how people deal with misleading information. Specifically, people who were exposed to a fishy smell, compared with those exposed to a control smell, were better able to detect semantic distortion and thus were less susceptible to the Moses illusion. Consistent with previous research (Lee & Schwarz, 2012a), our findings showed that metaphorically associated knowledge can interact with environmental cues to influence one's behavioral, cognitive, and perceptual outcomes. We propose that exposure to fishy smells may have elicited suspicion which allowed for systematic processing and helped to detect distortions. This is because uncertainty may lead to more careful scrutiny of a situation.

The most important element underpinning the Moses illusion is the semantic overlap between the question and one's knowledge (for a review, see Park & Reder, 2003), which triggers familiarity-heuristic processing (Song & Schwarz, 2008). Our results are consistent with Park and Reder (2003) who also highlighted how cognitive operations which are driven by heuristic or systematic processing affect the Moses illusion.

Bias and fishy smell

Study 1 showed that distrust is beneficial for detecting information accurately, and has advantages in lowering susceptibility to misleading information. Despite this positive effect, however, Thompson (2005) has suggested that distrust may induce its own biases, leading perceivers to falsely "detect" distortion in undistorted information. For example, distrust in a negotiations may lead to false distortion detection. In our study, if distrust from the fishy smells also induced its own biases, a number of participants in the fishy smell condition should have answered "can't say" for the undistorted Switzerland question rather than producing the correct answer. However, as the result of Study 1 shows, participants in the fishy smell condition responded almost equally correctly as those in the water condition. This implies that distrust driven by fishy smell does not produce bias itself.

Study 2: Fishy smells promotes negative hypothesis testing in Wason's rule discovery task

Wason's rule discovery task

Wason's rule discovery task (1960) is a classic reasoning task that involves the separation of hypothesis generation and hypothesis testing. Wason (1960) asked participants to find a rule that applies to sets of three numbers. Firstly, participants were given a series of numbers, [2 – 4 – 6], and asked to identify the rule that experimenter set. Most participants answered [+2 (add two)] as an initial hypothesis. In order to test the initial hypothesis, subjects were then asked to generate their own series of three numbers, which would then be marked as either consistent or inconsistent with the original correct rule. While the actual rule was [any increasing numbers] or [any ascending sequence], most participants thought the rule was indeed [+2 (add two)] because their initial hypothesis was primed by [2 – 4 – 6]. As they generated only examples that were consistent with their initial rule, participants tended to affirm rather than attempt to test their original hypothesis (Evans & Newstead, 1995). This is known as confirmation bias, which indicates a tendency to confirm a hypothesis that is consistent with the rule that has been devised (the left side of box in Figure 3) rather than try to reject it via a process of falsification (the right side of box in Figure 3) (Popper, 1977).

However, while the generation of sets of three numbers consistent with a hypothesis is considered to be confirmatory reasoning, Klayman and Ha (1987; 1989) argued that generating sets of three numbers consistent with a hypothesis is not necessarily a confirmation bias, but a use of positive hypothesis testing strategies. The opposite set of strategies, negative hypothesis testing, is the means by which falsification is performed.

Positive hypothesis testing. This testing strategy is considered to be a heuristic (Mayo et al., 2013), since it focuses on confirming an initial hypothesis by using a mental shortcut. Specifically, when people are given an opportunity to generate series of numbers to test, they are more likely to generate those that are consistent with their initial hypothesis [+2 (add two)]. For feedback, participants receive positive (✔ mark) feedback, since their generated hypotheses are consistent with correct rule, [any increasing numbers] (to review examples of positive hypothesis testing, see Figure 4). However, whether or not this testing strategy can be useful depends on the relative relationship between the correct rule and participants' initial hypotheses. If a person chooses an overly broad initial hypothesis, positive hypothesis testing is more useful than negative hypothesis testing. On the other hand, if the true correct rule is broader than their initial hypothesis, like in the Wason (1960) rule discovery task, positive hypothesis testing is less likely to be useful to in searching for that rule (Klayman & Ha, 1987; 1989).

Negative hypothesis testing. This method focuses on disproving the initial hypothesis by testing series that contradict the initial hypothesis. In this context, when participants are given the opportunity to generate series of numbers to test, they generate series that are inconsistent with their initial hypothesis [+2 (add two)] such as adding one number (e.g., [1-2-3]), decreasing numbers (e.g., [6-4-2]), using equal numbers (e.g., [1-1-1-]), or any random numbers with no relation(e.g., [11-15-30]). For decreasing numbers and equal numbers, because these are not consistent with the correct rule of any increasing numbers, participants are given negative feedback (✗ mark). Otherwise, they are given positive feedback (✔ mark) (to review examples of negative hypothesis testing, see Figure 5). After receiving more informative feedback, they are more likely to arrive at a different conclusion that is consequently more likely to be correct. This indicates that negative hypothesis testing uses reason in discovering the true rule. However, generating negative hypothesis tests entails a cognitive load. Nevertheless, the feedback is much more informative than positive hypothesis testing and one is more likely to arrive at a different conclusion to that of positive hypothesis testing.

Klayman and Ha (1987; 1989) do not consider positive hypothesis testing strategy a bias, but a necessary tool in deciding the accuracy of a given hypothesis. Specifically, when given [2 – 4 – 6], and asked to figure out what the rule is, one can predict three types of possible rules. The first type is when the initial hypothesized rule is embedded within the correct rule, which is what Wason (1960) intended. In this case, one cannot get the correct rule only by generating positive tests. The second type is the opposite; when the correct rule is embedded within the initial hypothesized rule. In this second type, to falsify the initial hypothesized rule, generating positive tests becomes crucial in finding the correct rule. The third type is when there is overlap between the initial hypothesized rule and the correct rule. In this case, either a negative or positive test can potentially falsify the initial hypothesized rule. In sum, depending on the relation between the initial hypothesis and correct rule, participants will generate some combination of positive and/or negative tests.

In the Wason rule discovery task, since it relates to the first type of rule, most participants use only positive hypothesis testing (e.g., [8 – 10 – 12]). However, because [+2 (add two)] is a subset of the correct rule ([any increasing numbers] or [any ascending sequence]), positive feedback (✔ mark) does not help them recognize that their initial hypothesis is wrong (Vartanina, Martindale, & Kwiatkowski, 2010). According to Klayman and Ha (1987, p.212), since participants generate “instances in which the property or event is expected to occur (to see if it does occur)” or “instances in which it is known to have occurred (to see if the hypothesized conditions prevail)”, this results in confirming the hypothesis, which ultimately hinders the task of finding the correct original rule.

Meanwhile, several previous studies suggested factors that increase the frequency of disconfirmatory strategies on Wason’s (1960) rule discovery task. Vartanina et al.’s (2010) findings suggest that more creative people are more likely to generate sequences of numbers that are inconsistent with their initial hypothesis (negative testing), leading to them finding the original correct rule. Similarly, Mayo et al. (2013), which this study is related to, illustrated how people low in dispositional trust are more likely to engage in negative hypothesis testing than those who are high in dispositional trust. Moreover, they also found that exposure to distrust-eliciting faces, compared to trust-eliciting faces, increased the distrust priming effect and promoted negative hypothesis testing on the Wason (1960) rule discovery task. Specifically, participants had to look at the face of a person (either a distrust-eliciting face or trust-eliciting face), form an impression of the person, and remember the person and impression for a later recall task. Wason's rule discovery task was then given as the alleged filler task between encoding and remembering the face of a person. This was to maintain the priming effect of incidental distrust feeling on the Wason rule discovery task.

The task distinguishes two steps: hypothesis generation and hypothesis testing. Hypothesis generation is the step where participants come up with their initial hypothesis only by looking at the given series of numbers (e.g., [2 – 4 – 6]). Hypothesis testing is the step where participants generate several numbers of test series to investigate whether their initial rule fits the original correct rule. Distrust-eliciting faces influence the hypothesis testing step by facilitating negative hypothesis testing instead of positive testing, which would not have helped in finding the correct original rule in Wason's rule discovery task. In summary, Mayo et al. (2013) found that distrust/suspicion elicited by exposure to faces increases negative hypothesis testing.

This study aims to replicate that result with a different manipulation of suspicion: fishy smells. This study proposes that the mere exposure to fishy smells is sufficient to induce the same shift. If incidental distrust cues (i.e., a fishy smell) do induce a focus on potentially incongruent information, this may influence the way people detect not only distorted information, as shown in Study 1, but also how they test their hypothesis, possibly by prompting them to engage in negative testing strategies on Wason's rule discovery task. This is expected because feelings of distrust warn us not to take information at face value, which increases the accessibility of context-incongruent information (Schul et al., 2004). Thus, the incidental distrust cue, which is unrelated to the Wason rule discovery task, is expected to help activate incongruent elaborations of the initially generated idea at the hypothesis evaluation and testing step, which guides individuals towards critical thinking. In contrast, in a non-suspicious setting, generating positive tests will be more common and participants may be overconfident in finding the rule without realizing that they have used the wrong thought process. This research explores whether exposure to olfactory cues, fishy smells, can also allow shifts in one's reasoning strategies. We tested this possibility by adopting Wason's (1960) rule discovery task as the dependent variable.

Method

Participants

A similar method to that in Study 1 was used for Study 2 except subjects were drawn from a student pool where students participated for course credit. Ninety four students (53 females) at the University of Michigan participated in this experiment. They were randomly assigned to complete a brief questionnaire in either a fishy-smelling (N = 45) room or a control lab room (N = 49).

Procedure

Two smell conditions were set up on different days in a lab room in the Psychology department building. The reason we set different days per condition was not only because we had limited lab room space, but also to provide enough buffer time to prevent smell contamination. For instance, since fishy smells last for a few hours, if we run the control condition experiment in the same lab room within a short period of time, this might contaminate the experiment due to remaining fishy smells.

Before the control experiment, an experimenter sprayed with 0.5 ounces of water on a plastic bag covering a small trash can placed under the desk where participants worked on the task. The plastic bag was then thrown away at the end of the day. On the experimental day, 0.5 ounces of fish oil was sprayed on a new plastic bag covering the same small trash can placed under the table, and was thrown out at the end of the day. Since the trash appeared empty and clean, participants could not notice where the smell originated from.

All instructions were given outside the room, and participants completed the Wason (1960) rule discovery task alone in the room. Four pages were provided to each participant (see Appendix B). On the first page, instructions were listed as follows (modeled after Mayo et al., 2013):

> On the next page, you will see a series of 3 numbers that conform to a rule. Your task is to find out what this rule is.
>
> To help you find out the rule, we will give you a chance to write down 6 series of numbers and have the experimenter tell you whether each series of numbers you generated fits the rule or not.
>
> Then, using this feedback, you will write down the rule that you think the original series was based on.

On the second page, a series of numbers was given, [2 – 4 – 6], and participants were to generate their initial hypothesis only by looking at the provided series. Participants wrote down the likely rule which governs the series [2 – 4 – 6]. Then, on the third page, they were asked to test their hypothesis by generating six series of numbers. Thus, all participants had six opportunities to find out whether their hypothesized rules were consistent with the original correct rule. Then, after they were done generating six series, the experimenter came into the room and told them whether the series they came up with were consistent or inconsistent with the true rule. Finally, on the last page, incorporating this feedback, participants wrote down their final hypothesized rule which they now believed to be the original correct/true rule. Then, they answered demographic questions.

Exclusion Criteria

Three participants were excluded. Two participants wrote more than one rule, which made it difficult to identify which rule they chose to test. One participant was a non-native English speaker, for whom fishy smells may not be associated with the same meaning (Lee & Schwarz, 2012a).

Results

Positive versus negative testing

This study investigated whether incidental exposure to a distrust cue influenced participants' reasoning or testing strategies. Each subject developed six series of three numbers, and those were coded as positive (0) or negative (1) tests of the participant's initial hypothesis. For example, the most common rule that participants came up was [+2 (add two)]. Thus, the series [10 – 12 – 14] would be considered as a positive (0) test, which is consistent with the initial hypothesis, but series such as [10 – 16 – 22], [4 – 8 – 12], or [1 – 2 – 3] would be considered a negative (1) test.

As predicted (see Figure 6), exposure to fishy smell improved the performance in Wason's rule discovery task by generating more negative hypothesis testing. As Table 4 shows, only 13 out of 47 (27.66%) participants who were in the water control group generated any number series that could be considered a negative test of their own hypothesis. On the other hand, 21 out of 44 (47.73%) participants who were exposed to fishy smells did so, χ^2 (1, N = 91) = 3.911, p < .05. Therefore, more participants who were distrust-primed by the fishy-smelling condition (versus those who were not distrust-primed) engaged in at least one negative hypothesis test. This implies that incidental distrust almost doubled the proportion of subjects whose rule testing included at least one negative test, similar to Mayo et al.'s (2013) observation that exposure to distrust eliciting faces increased negative testing.

Hypothesis rule changing

It is difficult for people to change their initial hypothesis to another one later on.

Although it is not statistically significant, there was a difference between the two conditions regarding the pattern of changing the initial hypothesis to another, different rule (Figure 7). Only 12 out of 47 participants (25.53%) in the control group changed their hypothesis, whereas in the experimental group, 19 out of 44 participants (43.18%) changed hypotheses, χ^2 (1, N = 91) = 3.152, p = .076 (see Table 5). Thus, as the changing pattern shows, it is also worthwhile to note that those in fishy smell condition were more likely to change their initial rule than those in no-fishy smell condition.

Discovery of the correct rule

Among the people in control condition who changed their initial rule to another (25.53%), only 3 (25%) discovered the correct rule of [any increasing number] (see Table 6). Among the participants in the experimental group who changed their initial rule to another (43.18%), a little less than half (9 participants; 47.37%) discovered the correct rule, χ^2 (1, N = 31) = 1.551, p = .213. This is not significant due to statistical limitation, but it shows a pattern (see Figure 8). Meanwhile, the 3 participants who discovered the original rule in the control group made up 6.38% of the 47 subjects. The 9 participants who discovered the original rule in the experimental group made up 20.45% of the 44 subjects, χ^2 (1, N = 91) = 3.931, p < .05 (see Table 7). Thus, exposure to fishy smells increased negative testing, which in turn improved changes of initial hypotheses and led to discovery of the correct rule (Figure 9). This also indicates that positive testing strategies promote erroneous confidence in one’s first intuition and hence impede performance on the Wason’s rule discovery task (Mayo et al., 2013; Oswald & Grosjean, 2004; Wason, 1960).

Mean of numbers of negative hypothesis testing per participant: control versus fishy condition

Lastly, there was a mean difference in the number of negative hypothesis tests per participant. Although this was not significant, on average (see Table 8), the mean number of negative hypothesis tests in the experimental group was higher (M = 1.36, SD = 1.77) than in the control group (M = .809, SD = 1.5), $F(1, 89) = 2.625$, $p = .109$, $d = 0.343$.

Discussion

Overall, an incidental fishy smell led to better performance on Wason's rule discovery task (1960). These results support the hypothesis that a fishy smell elicits suspicion/distrust, and this suspicion/distrust affects which reasoning strategy people adopt. This may occur because fishy smells activate metaphorically associated knowledge that leads people to think "there is something fishy" about their current surroundings (Lee & Schwarz, 2012a). In turn, this suspicious feeling leads to context-incongruent concepts. In Study 2, the context-incongruent concept were the rules that were inconsistent with [+2 (add two)], and context-congruent will be those rules consistent with [+2 (add two)]. As there is a larger proportion of participants under the distrust setting who adopted negative testing strategies and discovered the correct rule, a fishy smell works well as a tool to promote alternatives in problem solving and influence critical thinking.

General Discussion

In 18 languages, suspicion and distrust are associated with smell (Soriano & Valenzuela, 2008). Embodied metaphors are considered a reflection of higher order cognition's reuse of sensorimotor processes (Landau, Meier, & Keefer, 2010; Williams, Huang, & Bargh, 2009). However, although the origin of specific metaphors is relatively unknown, according to cognitive linguistic analysis, metaphorical mappings choose a level of properties which smell and suspicion share in common (Ibarretxe-Antunano, 1999; Sweetser, 1990). When it comes to suspicion, people intuitively feel something is questionable or problematic, but are uncertain about what the problem is. If they were certain what the problem is, they would recognize it immediately instead of doubting that there might be a problem.

In English, because of the metaphorical effect of "something smells fishy", native English speakers feel suspicion and distrust due to an incidental exposure to a fishy smell, as Lee and Schwarz (2012a) showed in trust games. Thus, one has to have the knowledge that the metaphor of "something smells fishy" is associated with suspicious situation. Although metaphorical embodiment affects all sensorimotor experiences (Meier et al., 2012), this phenomenon requires full knowledge of the metaphorical context at hand so that it can be discerned and hence applicable to the target. This supports our decision to exclude two participants from Study 1 and one participant from Study 2 because they were non-native English speakers who did not know the meaning of the metaphor, "something smells fishy." This lack of knowledge may have led to their failure to detect the Moses illusion and engage in negative hypothesis testing. Thus, in order for the sensorimotor process to be influenced, one has to have sufficient metaphorical knowledge (Lee & Schwarz, 2012a).

Going beyond Lee and Schwarz (2012a), this thesis showed that exposure to fishy smells, while undesirable, may be useful in improving the reasoning process. In Study 1, exposure to fishy smells attenuated susceptibility to the Moses illusion and increased the accurate detection of misleading information. However, it did not increase the erroneous detection of distortions when none were present. This implies that fishy smells may improve the identification of and reduce susceptibility to distortions, without inducing a bias in incorrectly identifying undistorted questions as distorted. In Study 2, fishy smells also attenuated positive or confirmatory hypothesis testing as subjects were more likely to test out alternatives and were not as fixated on initial thoughts. Hence, they became more successful at discovering the target rule due to their use of negative hypothesis testing strategies. These findings imply that fishy smells may have promising influences on reasoning processes.

Awareness: incidental versus direct

Incidental bodily experiences have metaphorical effects. However, if participants become aware of the source of the incidental experience, its impact is attenuated or eliminated. This is the case for exposure to metaphors (Lee & Schwarz, 2012b), semantic primes (Strack, Schwarz, Bless, Kübler, & Wänke, 1993), metacognitive experiences (Schwarz et al., 1991), arousal (Schwarz, Servay, & Kumpf, 1985), and the influence of moods (Schwarz & Clore, 1983). Specifically in our case, if participants had noticed that the smell came from a paper towel hidden under the writing surface in the phone booth (Study 1) or the plastic bag in the trash can under the desk (Study 2), we predict that they would have no longer been suspicious about the smell because they would know where it was coming from. This is supported by Chandler, Reinhard, and Schwarz's research (2012), which involved the hidden physical addition of a weight to reinforce the importance of a book. When participants became aware that the weight had been added to the book, it eliminated the metaphorical effect, which in turn affected the perception of its importance. This suggests that subtle and bodily incidental experiences have a greater influence on metaphorical effects than direct, noticeable, or salient stimulation (Lee & Schwarz, 2012a; Lee & Schwarz, 2012b).

In sum, these studies illustrate the powerful effects of subtle sensory cues, such as fishy smells, on how people structure reasoning. When a fishy smell elicits distrust, people are less likely to accept claims at face value and more likely to engage in critical thinking. This does not mean that distrust is the only path to critical thinking, but it can encourage critical thinking as these studies illustrate.

Reasoning is an automatic thinking process. How people frame their reasoning affects their decision-making processes and judgments. However, being able to think critically is sometimes difficult and requires effort. This study suggests a way to induce critical thinking automatically and easily by using embodiment effects. Since distrust/suspicion guides us to not take information at face value, a simple exposure to fishy smells can open up a way to critical thinking if the person does not know what is causing the smell. Thus, although it cannot be used as a self-help method, it would be potentially useful in creating environments that foster critical thinking. These findings have highlighted potential benefits of a distrustful mindset, which can be activated incidentally through olfactory sensory cues.

Implications and Future Directions

Our findings not only show that incidental environmental cues can influence reasoning styles and how problems are approached, but also highlight errors in basic processing that might have broader implications for everyday thinking. The priming of embodied metaphors has strong power over reasoning processes, and hence has the potential to reduce susceptibility to semantic illusions that may lead to faulty reasoning and fixation on limited initial thoughts.

Beyond improving reasoning, there are many interesting directions for future research: for example, how would distrust cues influence the processing of persuasive messages in negotiations or consumer contexts? Would people exposed to distrust cues be less likely to be persuaded by peripheral (vs. central) route cues (e.g., Petty & Cacioppo, 1986; Schwarz et al., 1991)? Moreover, how would distrust cues influence unethical behavior and perspectives? Future work may fruitfully address these and related questions.

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Footnotes

[1]Suspicion and distrust are used interchangeably in this thesis.

[2]Study 1 and 2 were approved by IRB.

[3]This section draws on the Honors Thesis for degree of Bachelor of Arts.

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Table 1.

Percentage of participants who did or did not detect distortion in the Moses question

	Distorted Question (Moses Question)		
	% Distortion not detected	% Distortion detected	Total
Control	83.3 (25/30)	16.7 (5/30)	100.0 (30/30)
Fishy smell	58.1 (18/31)	41.9 (13/31)	100.0 (31/31)

Chi-Square Tests

χ^2 (1, N = 61)	*Df*	p
4.680[a]	1	.031

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.85.

b. Computed only for a 2x2 table

Table 2.

Percentage of participants who answered for Switzerland question correctly or incorrectly

	Undistorted Question (Switzerland Question)		
	% Incorrect	% Correct	Total
Control	26.7 (8/30)	73.3 (22/30)	100.0 (30/30)
Fishy smell	26.5 (9/31)	73.5 (22/31)	100.0 (31/31)

Chi-Square Tests

χ^2 (1, N = 61)	*Df*	*p*
.042[a]	1	.837

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.73.

b. Computed only for a 2x2 table

Table 3.

Logistic regression analysis for consistency of performance between distorted and undistorted questions.

Omnibus Tests of Model Coefficients

		Chi-square	*Df*	*p*
Step 1	Step	.135	1	.714
	Block	.135	1	.714
	Model	.135	1	.714

Model Summary

	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
Step 1	82.435[a]	.002	.003

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Table 4.

Percentage of participants who generated negative hypothesis testing.

	Negative hypothesis testing
Control	27.66 (13/47)
Fishy smell	47.73 (21/44)

Chi-Square Tests

χ^2 (1, N = 91)	*Df*	*p*
3.911 [a]	1	.048

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.44.

b. Computed only for a 2x2 table

Table 5.

Percentage of participants whose rules are different from initial and final.

Negative hypothesis testing		
Control		25.53 (12/47)
Fishy smell		43.18 (19/44)
	Chi-Square Tests	
χ^2 (1, N = 91)	*Df*	*p*
3.152 [a]	1	.076

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.99.

b. Computed only for a 2x2 table

Table 6.

Percentage of participants who discovered the original correct/true rule among those who changed from initial to different final rule.

Negative hypothesis testing		
Control		25 (3/12)
Fishy smell		47.37 (9/19)
	Chi-Square Tests	
χ^2 (1, N = 31)	*Df*	*p*
1.551 [a]	1	.213

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 4.65.

b. Computed only for a 2x2 table

Table 7.

Percentage of participants who discovered the original correct/true rule out of total subjects in each condition.

Negative hypothesis testing		
Control		6.38 (3/47)
Fishy smell		20.45 (9/44)
	Chi-Square Tests	
χ^2 (1, N = 91)	*Df*	*p*
3.931 [a]	1	.047

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.80.

b. Computed only for a 2x2 table

Table 8.

Means (and standard deviations) of number of negative hypothesis testing series as a function of odorless condition versus fishy smell condition.

Condition			
Odorless	Fishy smell condition	$F(1, 89)$	p
.809 (1.5)	1.36 (1.77)	*2.625*	*.109*

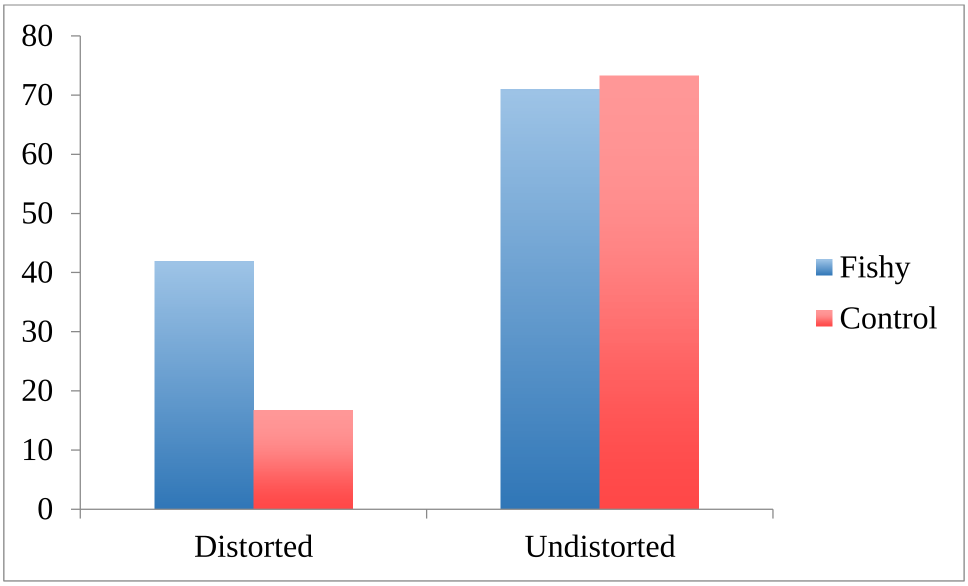

Figure 1. Figure above indicates the percentage of participants who correctly responded on distorted (i.e., Moses illusion) and undistorted (i.e., Switzerland) questions in the fishy smell and control odorless conditions. There are significant differences between fishy smell and control condition for distorted question ($p < .05$). No differences were found for the undistorted question.

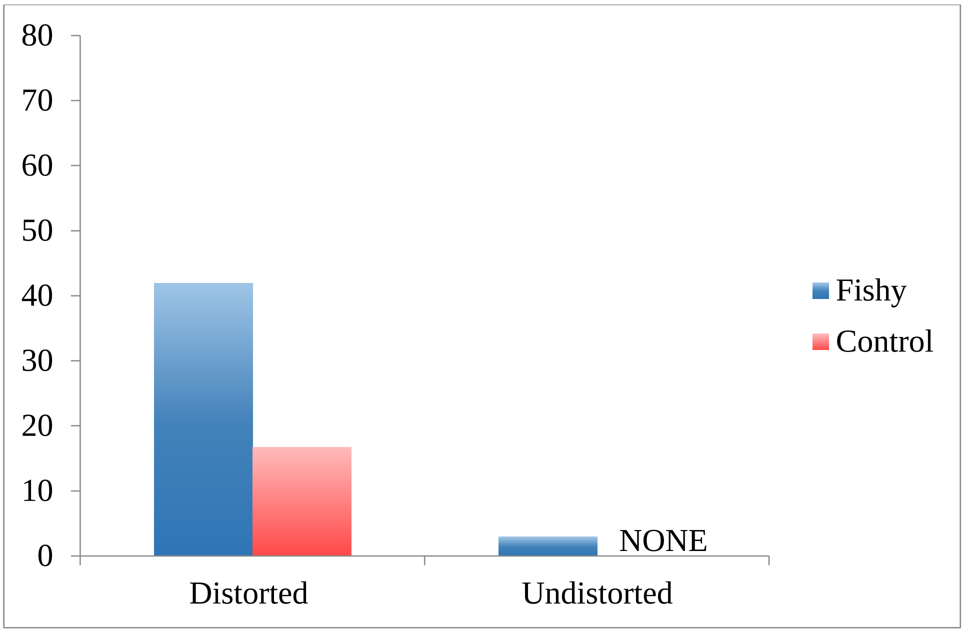

Figure 2. The percentage of participants who answered “can’t say” (correct for the distorted question, incorrect for the undistorted question).

Confirmation Bias	**Not confirmation bias**
Consistent / compatible / confirmatory rule of initial hypothesis	Inconsistent / incompatible / disconfirmatory / eliminative/ alternatives of initial hypothesis
4 – 6 - 8	1 – 2 - 3
10 – 12 - 14	4 – 6 - 9
20 – 22 - 24	6 – 4 - 2
102 – 104 - 106	1 – 1 - 1

Figure 3. Left side of the box above indicates examples of numbers of series, which participants usually generate by confirming their initial hypothesis [+2 (add two)]. Most examples are consistent with their initial hypothesized rule in this case. On the other hand, right side of the box above indicates examples of numbers of series, which participants rarely generate without fixated on their initial hypothesis. Most examples are not consistent with their initial hypothesized rule.

Generated numbers of series	Feedback
8-10-12	✔
12-14-16	✔
16-18-20	✔
100-102-104	✔
1-3-5	✔
5-7-9	✔

Figure 4. Positive hypothesis testing strategy. As the series of numbers in the box are all consistent with initially hypothesized rule, [+2 (add two)], positive hypothesis testing strategy is to generate numbers of series that are confirming initial hypothesis. Since this is also consistent with the correct rule of [any increasing numbers], participants are given positive (✔ mark) feedback.

Generated numbers of series	Feedback
8-10-12	✔
1-3-5	✔
1-2-3	✔
6-4-2	✗
1-1-1	✗
11-15-30	✔

Figure 5. Negative hypothesis testing strategy. As the series of numbers in the box are mostly inconsistent with initially hypothesized rule, [+2 (add two)], negative hypothesis testing strategy is to generate numbers of series that are disconfirming initial hypothesis through falsification of initial thoughts. However, the series of numbers in the box are all still consistent with the correct rule of [any increasing numbers] except [6-4-2] and [1-1-1], since [6-4-2] is decreasing numbers that are not consistent with the true rule, and [1-1-1] is equal numbers which are not also consistent with the true rule. Thus, they are given negative (✗ mark) feedbacks, which indicates inconsistency with the correct rule. Other than [6-4-2] and [1-1-1-], any random increasing series of numbers with no relations, [11-15-30], is given positive (✔ mark) feedback due to consistency with the true rule.

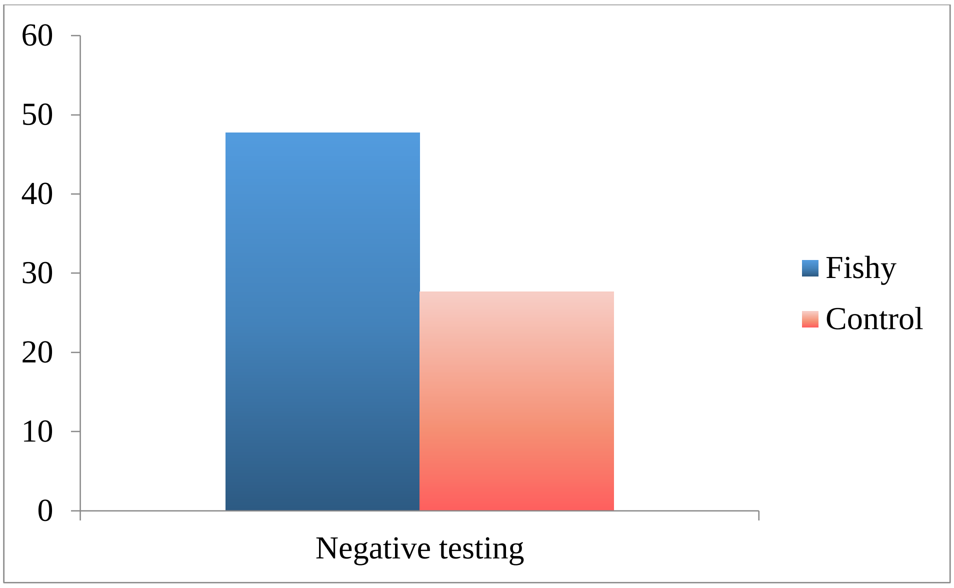

Figure 6. The percentage of participants who generated disconfirming hypotheses ($p < .05$).

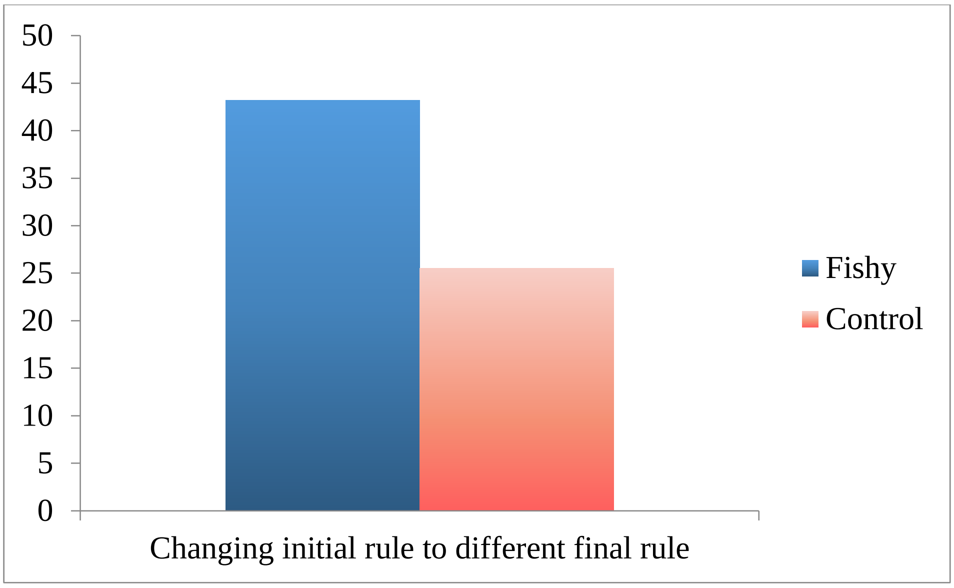

Figure 7. The percentage of participants who changed their initial rule to a different final rule (p = .076).

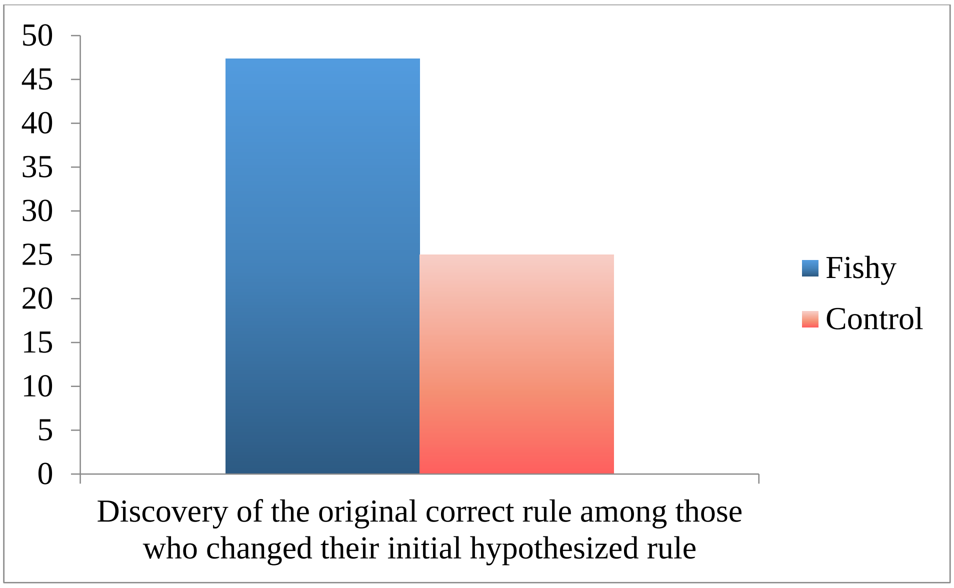

Figure 8. The percentage of participants who found the original correct rule among those who have changed their initial hypothesized rule to a different final rule (p = .213).

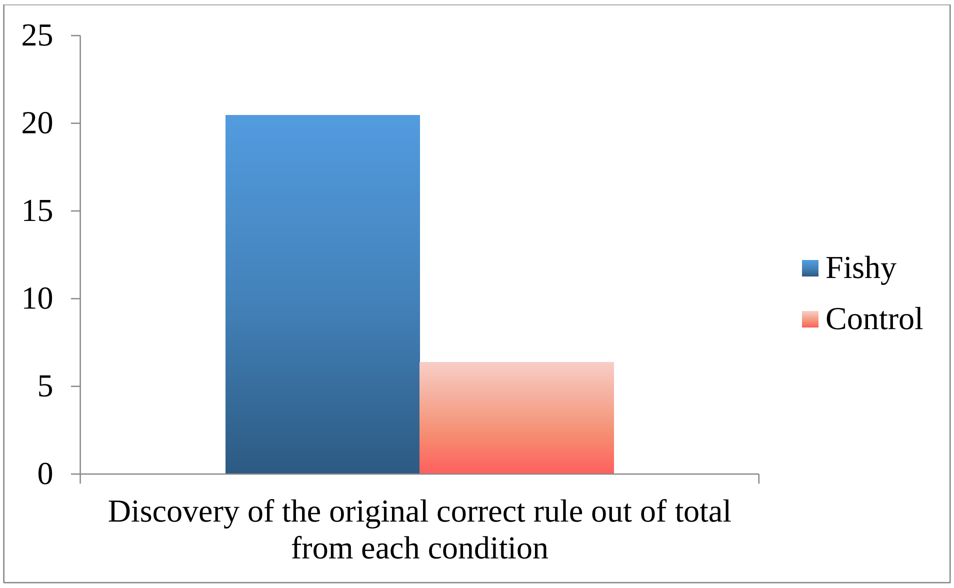

Figure 9. The percentage of participants who found the original correct rule in each condition ($p < .05$).

Appendix A

Before you proceed to answer the questions below, please make sure to read the instructions below.

Thank you for participating in the study. You will read a couple of trivia questions and answer them. You can write the answer in the blank. In case you do not know the answer, please write "don't know." You may or may not encounter ill formed questions which do not have correct answers if taken literally. For instance, you might see the question "Why was President Gerald Ford forced to resign his office?" In fact, Gerald Ford was not forced to resign. Please write "can't say" for this type of questions.

How many animals of each kind did Moses take on the Ark?

(*Can't say*)

What country is famous for cuckoo clocks, chocolate, banks, and pocket knives?

(*Switzerland*)

DO NOT PROCEED TO THE NEXT PAGE UNTIL YOU COMPLETE THIS PAGE

In the biblical story, who was it that took the animals on the Ark?

(Noah)

How do you feel right now?

Very bad								Very good
-4	-3	-2	-1	0	1	2	3	4

What do you think this research study is about?

How careful you have to approach when you read.

Do you notice something unusual?

This room smelled fishy.

Demographics

Gender: Male or Female Age: 20 Year in college: 1st

Ethnicity: Asian Country of origin: U.S.A.

How long have you lived in the U.S.A.? 20 years

What language are you most fluent in? English

How long have you used this language? 20 Years

Religion: (please circle)

Agnostic	Hindu
Atheist	Jewish
Buddhist	Muslim
Catholic	Other:__________
Christian (Protestant)	

Note: This sample was modified from Song and Schwarz's (2008) study material.

Song, H., & Schwarz, N. (2008). Fluency and the detection of misleading questions: Low processing fluency attenuates the Moses illusion. *Social Cognition*, 26(6), 791-799.

Appendix B

On the next page, you will see a series of 3 numbers that conform to a rule. Your task is to find out what this rule is.

To help you find out the rule, we will give you a chance to write down 6 series of numbers and have the experimenter tell you whether each series of numbers you generated fits the rule or not.

Then, using this feedback, you will write down the rule that you think the original series was based on.

The series: **2 4 6**

What do you think the rule is?

Add two

Please write down the series you would like to test (to get feedback for):

Series 1: 8 10 12 ✔

Series 2: 1 3 5 ✔

Series 3: 1 2 3 ✔

Series 4: 6 4 2 ✗

Series 5: 1 1 1 ✗

Series 6: 11 15 30 ✔

Incorporating the experimenter's feedback, what do you think the rule is?

Increasing number (any ascending number)

Have you seen this exact task before this experiment? Yes/No

1. How confident were you about the first rule you suggested?

Not at all						Very much
0	1	2	3	4	5	6

2. How confident were you about the second rule you suggested?

Not at all						Very much
0	1	2	3	4	5	6

3. Did anything seem strange in this experiment? Yes / No

4. If so, what seemed strange? Room smelled like fishy

Demographics

Year in college: ___1st_____

Age: __20___

Gender: ___Female_____

Ethnicity: ___Asian_____

Are you a native English speaker? Yes / No

Do you currently have a stuffy nose? Yes / No

If so, does it affect you to an extent you cannot smell anything? Yes / No

What does it usually mean when people say "something smells fishy?"

Surrounding or situation is suspicious or distrustful

Note: This sample was modified from Mayo, Alfasi, & Schwarz's (2013) study material.

Mayo, R., Alfasi, D., & Schwarz, N. (2013). Distrust and the positive test heuristic: Dispositional and situated social distrust improves performance on the Wason rule discovery task. *Journal of Experimental Psychology: General. Advance online publication*.