Journal of Experimental Social Psychology 59 (2015) 47–50

Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

FlashReport

Something smells fishy: Olfactory suspicion cues improve performance on the Moses illusion and Wason rule discovery task

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HIGHLIGHTS

- Incidental exposure to fishy smells induces suspicion.
- Suspicion improves the detection of misleading implicatures in questions.
- Suspicion improves performance on the Wason rule discover task.

ARTICLE INFO

Article history:
Received 17 March 2015
Available online 2 April 2015

Keywords:
Suspicion
Embodiment
Smell
Information processing
Hypothesis testing
Metaphor

ABSTRACT

Feelings of suspicion alert people not to take information at face value. In many languages, suspicion is metaphorically associated with smell; in English, this smell is "fishy". We tested whether incidental exposure to fishy smells influences information processing. In Study 1, participants exposed to incidental fishy smells (vs. no odor) while answering questions were more likely to detect a semantic distortion (the "Moses illusion"), but not more likely to falsely identify an undistorted question as misleading. In Study 2, participants exposed to fishy smells (vs. no odor) were more likely to engage in negative hypothesis testing (falsifying their own initial hunch), resulting in better performance on the Wason rule discovery task. These findings show that incidental olfactory suspicion cues can affect performance on social as well as nonsocial reasoning tasks.

Introduction

Suspicion is metaphorically associated with smell in many languages (Soriano & Valenzuela, 2008). In English, this smell is "fishy". When something "smells fishy", it may not quite be what it seems. Hence, exposure to an incidental fishy smell could shift people's attention to how things may differ from what meets the eye. Drawing from research into the influence of socially induced suspicion on information processing (e.g., Schul, Mayo, & Burnstein, 2004) and on embodied metaphors (Lee & Schwarz, 2014), we contribute to both research programs by testing the influence of incidental fishy smells on people's performance on two well-understood reasoning tasks: Erickson and Mattson's (1981) Moses illusion and Wason's (1960) rule discovery task.

Sensory experience and embodied metaphors

Recent research highlights the role of sensory experience in cognition and emotion (for reviews, see Barsalou, 2008; Landau, Meier, & Keefer, 2010; Lee & Schwarz, 2014). The influences of interest are often reflected in metaphors that link an abstract target concept with a more concrete source concept derived from perceptual experience. For example, saying that a "warm" person discusses "weighty" matters with a "close" friend conveys social meanings through reference to the physical dimensions of temperature, weight, and spatial distance. More important, variations in perceivers' sensory experience have metaphor-consistent social effects: people perceive others as socially warmer after holding a warm (vs. cold) cup of coffee (Williams & Bargh, 2008a), consider a heavy (vs. light) book more important (Chandler, Reinhard, & Schwarz, 2012), and experience more emotional distance after having marked spatially distant (vs. close) points on a Cartesian plane (Williams & Bargh, 2008b).

The sensory experience metaphorically associated with suspicion is smell (Lakoff & Johnson, 1980; Soriano & Valenzuela, 2008). The smell of suspicion is the smell of decaying organic matter that may be used as food, suggesting that the smell–suspicion link may be an evolved

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http://dx.doi.org/10.1016/j.jesp.2015.03.006
0022-1031/

mechanism that protects against premature ingestion of "suspicious" material. In English, this smell is "fishy". Testing the behavioral consequences of this metaphor, Lee and Schwarz (2012) found that incidental exposure to fishy smells undermines interpersonal trust. Specifically, participants invested less money in economic trust games and public good games when they were exposed to fishy smells (vs. no smell or an unpleasant smell without metaphorical meaning). However, no research has examined whether non-social olfactory distrust cues influence more sophisticated cognitive processes (e.g., information processing, reasoning).

Distrust and its cognitive consequences

In daily life, distrust and suspicion are usually elicited by attributes of an interaction or interaction partner. For instance, a person may discover the other's ulterior motives and intentions (Kramer, 1999) or may have detected "cues" believed to signal deception (e.g., fidgeting; DePaulo et al., 2003). Under such conditions, people scrutinize, and often discount, information the other provides. However, distrust may also be elicited by incidental social cues, such as an "untrustworthy" face (Schul et al., 2004). Under incidental conditions, people presumably suspect that something is wrong but are uncertain about what it might be. They are therefore likely to attend to how things may be different from what meets the eye and may entertain alternative perspectives and interpretations. For example, exposure to a given concept (e.g., "temporary") usually facilitates the subsequent identification of related congruent concepts (e.g., "transitory"); yet, distrust reverses this effect and facilitates the identification of concept-incongruent terms (e.g., "permanent"; Schul et al., 2004). Moreover, people in a distrustful mindset are more likely to entertain alternative interpretations of utterances (Fein, 1996; Schul, Burnstein, & Bardi, 1996) and to generate more unusual solutions on creativity tasks (Mayer & Mussweiler, 2011). Furthermore, Mayo, Alfasi, and Schwarz (2014) reported that distrust improves performance on Wason's (1960) rule discovery task by increasing the prevalence of negative hypothesis testing. Collectively, these findings suggest that distrust fosters critical thinking by directing attention to how things might differ from what meets the eye. This conclusion is consistent with feelings-as-information theory, which assumes that feelings inform us about the nature of our current situation and that cognitive processes are tuned to meet the requirements signaled by our feelings (Schwarz, 1990, 2002).

Current research

Building on these lines of research we address a gap of theoretical interest. To date, all studies that observed beneficial effects of distrust on reasoning have induced distrust through social tasks, such as exposure to an untrustworthy face (e.g., Schul et al., 2004) or memories of having been taken advantage of (e.g., Kramer, 1996). Conversely, research on the power of olfactory distrust cues is limited to the context of exchanging money in trust and public good games (Lee & Schwarz, 2012), a behavior that is highly social and does not require sophisticated processing. It is therefore unknown (i) whether cognitive benefits of distrust require social involvement and (ii) whether the effects of olfactory distrust cues extend to influencing reasoning strategies. To address these issues, we examine whether fishy smells increase the detection of misleading presuppositions (Study 1) and the prevalence of negative hypothesis testing (Study 2), thus improving performance on Wason's (1960) rule discovery task.

Study 1: something is fishy about Moses

When asked, "How many animals of each kind did Moses take on the Ark?" most people answer "Two" despite knowing that Noah was the biblical actor (Erickson & Mattson, 1981). People fall prey to such distortions when the question feels familiar due to its semantic overlap (Park & Reder, 2003). Previous research has shown that disfluency manipulations (e.g., a difficult to read print font) can attenuate the Moses illusion by making the question feel less familiar, which prompts more careful processing (Song & Schwarz, 2008).

If suspicion alerts people not to take information at face value, it should attenuate susceptibility to misleading information. If this attenuation reflects closer scrutiny of the message, it should be limited to distorted messages and should not extend to undistorted ones.

Method

Participants

Seventy students (38 females) were recruited for an alleged class project and randomly assigned to complete a brief questionnaire in either a fishy-smelling ($N = 33$) or a control booth ($N = 37$). Sample size was determined by doubling Song and Schwarz's (2008) *N*, based on the assumption that olfactory cues may be a weaker manipulation.

Procedures

Before each session, one experimenter sprayed either a .5-ounce of fish oil (fishy condition) or a .5-ounce of water (control condition) on a small piece of paper and attached it underneath the writing surface in the booth. Another experimenter, blind to condition, escorted participants to the randomly assigned booth, where they completed a questionnaire that included a distorted question (the Moses question), an undistorted question ("What country is famous for cuckoo clocks, chocolate, banks, and pocket knives?"), a mood question ("How do you feel now?" on a scale of -4 = *very bad* to 4 = *very good*), and demographic questions.

The instructions (modeled after Erickson & Mattson, 1981) read: "You will read a couple of trivia questions and answer them. […] 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. […] Please, write 'can't say' for this type of question."

Exclusion criteria

Because recognizing the Moses question as distorted requires knowledge of the biblical story of Noah, a funneled debriefing was conducted to assess participants' knowledge; four participants were not familiar with the story. Only in English is the smell associated with suspicion specified as "fishy"; two participants were not native English speakers. One participant each failed to complete the questionnaire, reported knowing the Moses illusion, or reported having no sense of smell. These 9 participants were excluded (3 in the control condition), leaving 61 participants in the analysis; the exclusion rate did not differ significantly between conditions, $\chi^2(1, N = 70) = .79$, $p = .37$.

Results and discussion

As predicted, olfactory suspicion cues attenuated the Moses illusion (Fig. 1). Participants were more likely to detect the misleading nature of the question and respond "Can't say" in the fishy condition (13 out of 31, 41.9%) than in the control condition (5 out of 30, 16.7%), $\chi^2(1, N = 61) = 4.68$, $p = .03$. However, smell did not influence responses to the undistorted question, $\chi^2(1, N = 61) = .04$, $p = .84$. Thus, fishy smells improved the identification of a semantic distortion without inducing a bias to "overthink" and falsely identify an undistorted question as distorted.

Smell did not influence participants' self-reported mood, $t(59) = 1.20$, $p = .23$, neither did an analysis that treated mood as a continuous predictor variable indicate a condition × mood interaction, $p = .63$. This indicates that participants' performance on the Moses task was not driven by smell induced changes in mood.

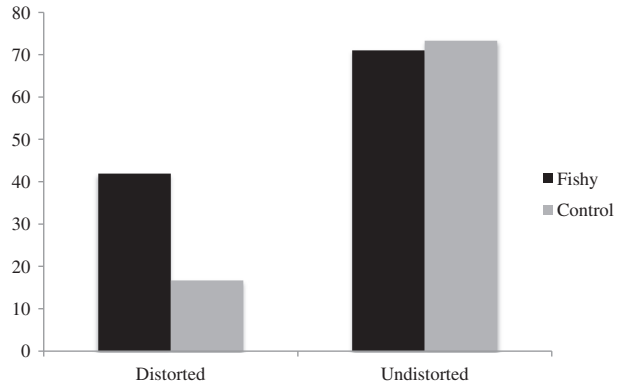

Fig. 1. Percentage of participants who correctly responded to the distorted vs. undistorted question.

Study 2: something is fishy about my thoughts

Whereas Study 1 tested whether olfactory suspicion cues improve the scrutiny of information presented by others, Study 2 tests whether they also improve scrutiny of one's own, self-generated hypothesis. When asked to discover the rule underlying the number series 2–4–6, most people hypothesize a "+2" rule (Wason, 1960). When instructed to test their hypothesis by generating a number series that would be marked as consistent or inconsistent with the correct rule, people overwhelmingly rely on a positive-testing strategy (Klayman & Ha, 1987) by generating a series that is consistent with their hypothesis (e.g., 6–8–10). The feedback they receive is affirmative and does not allow them to recognize their hypothesis is false. The correct rule is "any increasing series of numbers", which can only be discovered by generating series that falsify more narrow rules. Accordingly, a positive testing strategy results in hypothesis confirmation and impairs rule discovery, which is facilitated by a negative-testing strategy (for a review, see Oswald & Grosjean, 2004).

Mayo et al. (2014) observed that being very low in dispositional trust or being primed with an untrustworthy face increased the prevalence of negative hypothesis testing, resulting in improved rule discovery. Study 2 tests whether this beneficial influence can also be observed when suspicion is induced through metaphorically relevant olfactory cues, rather than a social distrust manipulation. Given that mood was not affected by a fishy smell in Study 1, and measured mood was irrelevant in Mayo et al.'s (2014) studies, mood was no longer assessed.

Method

Participants

Ninety-four students (53 females) participated in this study for partial course credit. Similar to Study 1, participants were randomly assigned to a fishy-smelling room ($N = 45$) or a control room ($N = 49$). Sample size was determined by doubling Mayo et al.'s (2014) N, based on the assumption that olfactory cues may be a weaker manipulation.

Procedures

Before each session, the experimenter (blind to the study hypothesis) sprayed either a .5-ounce of fish oil (fishy condition) or a .5-ounce of water (control) into a trash bin underneath the desk on which participants completed the questionnaire. All instructions were given in a waiting room, before participants entered the experiment room, where they completed the Wason task in individual sessions. Participants first wrote down their own hypothesis and subsequently generated 6 number series to test it. When done, they called the experimenter and received feedback on whether each series was congruent or incongruent with the underlying rule. Using this feedback, participants generated a final hypothesis. Finally, participants answered demographic questions and were debriefed.

Exclusion criteria

Two participants generated multiple initial hypotheses, which made it impossible to identify their hypothesis testing strategies; one participant was a non-native English speaker. These participants were excluded from analyses.

Results and discussion

Rule generation

As is common for the Wason task, all but two participants generated a "+2" or "even-numbers" rule. This is consistent with Mayo et al. (2014), who also observed no effect of distrust on hypothesis generation.

Negative and positive testing strategies

Participants' number series were coded as positive (0) or negative (1) tests of each participant's initial hypothesis; for a "+2" initial hypothesis, the series 10–12–14 would be coded as a positive test, but 2–3–4 as a negative test.

Overall, positive testing dominated; 57 of 91 (62.6%) participants had zero negative tests in their number series. This highly skewed distribution calls for a dichotomized analysis (MacCallum, Zhang, Preacher, & Rucker, 2002) that compares participants who generated at least one negative test with those who generated none. As predicted, participants were more likely to generate at least one negative test in the fishy condition (21 out of 44, 47.7%) than in the control condition (13 out of 47, 27.7%), $\chi^2(1, N = 91) = 3.91$, $p = 0.048$.

Correct solutions

Overall, negative testing increased the likelihood of discovering the correct rule. Of the 34 participants who generated at least one negative test, 12 (35.3%) discovered the correct rule, whereas none of the 57 participants who generated only positive tests did so, $\chi^2(1) = 23.17$, $p = 0.000001$. Given the close relationship between suspicion and negative testing, 20.5% of the participants in the fishy condition discovered the correct rule, whereas only 6.4% of the participants in the control condition did so, $\chi^2(1) = 3.93$, $p = 0.047$.

Summary

As predicted, incidental exposure to a metaphorically relevant olfactory distrust cue increased the share of participants who used at least one negative hypothesis test, which led to improved performance on the Wason (1960) rule discovery task. These findings extend Mayo et al.'s (2014) results by demonstrating that mere exposure to a metaphorically relevant olfactory cue is sufficient to increase the use of negative hypothesis testing.

General discussion

Two experiments used classic reasoning tasks to test how incidental olfactory cues of metaphorical relevance to suspicion affect information processing. Study 1 revealed that incidental exposure to fishy smells improves detection of misleading information without inducing a bias to identify undistorted information as distorted. Study 2 revealed that incidental exposure to fishy smells increases use of a negative hypothesis testing strategy, which facilitates correct solutions. These findings show that exposure to fishy smells is sufficient to elicit feelings of suspicion and distrust, which are associated with a focus on how things may differ

from what meets the eye. Thus, the impact of fishy smells is not limited to exchange situations of low cognitive complexity, and neither does the impact of distrust on complex cognitive performance require a high level of social involvement.

Our findings are consistent with the assumption that cognitive processes are tuned to meet situational requirements (Schwarz, 2002; Schwarz & Clore, 1996). From this perspective, incidental olfactory cues of metaphorical relevance elicit feelings of distrust, as previously observed in the context of economic trust games (Lee & Schwarz, 2012). These feelings convey that something may be wrong, prompting people to attend to how things might differ from what meets the eye, as previously observed when distrust was induced through social manipulations (Mayo et al., 2014; Schul, Mayo, & Burnstein, 2008). Importantly, however, neither a social induction of distrust nor a social task is necessary to observe the cognitive benefits of a distrustful mindset, as the present studies illustrate.

Theoretically, improved performance should only be observed on tasks that benefit from a consideration of alternatives. Moreover, incidental sensory cues should cede to influence processing when people are aware of their incidental nature, consistent with the logic of feelings-as-information theory (Schwarz, 2002; Schwarz & Clore, 1983). Future research may fruitfully address these boundary conditions. In addition, the observation that smells of distrust can affect reasoning (present studies) and behavior (Lee & Schwarz, 2012) calls for an exploration of the potential influence of smells of trust. Would the smell of chocolate cookies impair reasoning, much as the smell of fish improves it? Unfortunately, an analysis of metaphors and aphorisms shows little consensus on what trust even smells like, consistent with the assumption that trust may be the unmarked default in most social contexts (Schul et al., 2004, 2008).

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