



[AAAS.ORG](#) | [FEEDBACK](#) | [HELP](#) | [LIBRARIANS](#)

Daily News

Enter Search Term

ADVANCED

[ALERTS](#) | [ACCESS RIGHTS](#) | [MY ACCOUNT](#) | [SIGN IN](#)

[News Home](#) | [ScienceNOW](#) | [ScienceInsider](#) | [Premium Content from Science](#) | [About Science News](#)

[Home](#) > [News](#) > [ScienceNOW](#) > [October 2008](#) > This Is Getting Out of Control

Science NOW UP TO THE MINUTE NEWS FROM SCIENCE

This Is Getting Out of Control

by Greg Miller on October 2, 2008 12:00 AM | [Permanent Link](#)

[Email](#) | [Print](#) |

[More](#)

[PREVIOUS ARTICLE](#)

[NEXT ARTICLE](#)

With the meltdown of the global economy, many people think that their financial future is beyond their control. In such uncertain times, it's probably a good idea to take a deep breath before making any big decisions, because, according to a new study, the mind can play tricks on people when they think they've lost control of a situation.

When life gets chaotic, it's natural to try to figure out what's going on. But sometimes, the desire for an explanation may lead us to perceive patterns that don't exist, says Jennifer Whitson, a management scholar at the University of Texas, Austin. A study conducted in the 1970s, for example, found a correlation between bad stock market performance and an increase in the amount of space newspapers devoted to horoscopes and articles about astrology. Failing to find an explanation for their falling fortunes in the economic data, people apparently started looking to the stars. Another study found that parachute jumpers are more likely to see a nonexistent figure in a picture of random dots and squiggles just before they jump.

Intrigued by such findings, Whitson teamed up with Adam Galinsky, a social psychologist at Northwestern University in Evanston, Illinois. In one experiment, the researchers asked 41 undergraduates to recall a situation in which they'd lacked control (such as being a passenger in a car accident) and another group to recall a situation in which they'd had full control (such as going into an exam well-prepared). Then the subjects read passages describing an event preceded by an action that may or may not have influenced the event. One passage asked them to imagine that they were successful marketers whose ideas were rejected after they failed to perform their customary ritual of stomping the ground three times before the meeting. The subjects who previously recalled an in-control experience were more likely to write this off as mere coincidence than were those who'd recalled being out of control, Whitson and Galinsky report in tomorrow's issue of *Science*.

Those in the loss-of-control group were also more likely to see nonexistent objects in fuzzy images that looked like a snowy TV screen and to suspect a conspiracy in ambiguous stories they'd read--about an office worker who was denied a promotion after a flurry of e-mails between his boss and a co-worker, for example. But when these subjects first did a self-affirmation exercise that asked them to reflect on an aspect of their lives they considered to be important, such as helping other people or pursuing political influence, they were no more likely than subjects in the in-control group to see illusory patterns. Whitson says she now plans to follow up to see if the perception of illusory patterns actually contributes to poor decisions.

If so, there may be important lessons for people trying to weather uncertain times, says Dan Ariely, a behavioral economist at Duke University in Durham, North Carolina. "This suggests that we're going to exhibit these tendencies at the times when they're most dangerous for us," Ariely says. His advice: Question your intuitions more and consult the experts, whose knowledge and experience may give them a better sense of control.

ENLARGE IMAGE



Market gyrations. When people feel a loss of control, their perceptions of events may become unreliable.

Credit: Brendan McDermaid/Reuters

ADVERTISEMENT

Graduate Programs
search by university,
topic, or location

click here

ADVERTISEMENT

Choose QIAGEN
for detection

QIAGEN

Sample & Assay Technologies

[Email](#) | [Print](#) |

[Digg](#) [submit](#)

0 [tweet](#)

[Share](#) | [More](#)

- WT levels when expressed in Lag1/Lac1 double yeast mutants (10).
10. J.-C. Martinou, H. Riezman, personal communication.
 11. Y. Pewzner-Jung, S. Ben-Dor, A. H. Futerman, *J. Biol. Chem.* **281**, 25001 (2006).
 12. A small amount of C16:0 ceramide with a C17 sphingosine base (2% of the amount of the most abundant species C22:0:1) can be detected in *C. elegans* extracts (13).
 13. H. Riezman, personal communication.
 14. T. A. Taha *et al.*, *FASEB J.* **20**, 482 (2006).
 15. X. Deng *et al.*, *Nat. Genet.* **36**, 906 (2004).
 16. B. Schumacher *et al.*, *Cell Death Differ.* **12**, 153 (2005).
 17. J. S. Duerr, in *Worm Book* (The *C. elegans* Research Community, WormBook, 2007), www.wormbook.org.
 18. A. M. Labrousse, M. D. Zappaterra, D. A. Rube, A. M. van der Bliek, *Mol. Cell* **4**, 815 (1999).
 19. K. De Vos *et al.*, *J. Biol. Chem.* **273**, 9673 (1998).
 20. L. del Peso, V. M. Gonzalez, N. Inohara, R. E. Ellis, G. Nunez, *J. Biol. Chem.* **275**, 27205 (2000).
 21. B. Conradt, H. R. Horvitz, *Cell* **93**, 519 (1998).
 22. W. D. Fairlie *et al.*, *Cell Death Differ.* **13**, 426 (2006).
 23. F. Chen *et al.*, *Science* **287**, 1485 (2000).
 24. N. Yan *et al.*, *Mol. Cell* **15**, 999 (2004).
 25. Y. Zermati *et al.*, *Mol. Cell* **28**, 624 (2007).
 26. We thank Caenorhabditis Genetics Center and National BioResource Project-Japan for the strains provided; H. R. Horvitz for the anti-CED-4 antibody; Y. Gruenbaum for the anti-Ce-lamin-antibody; M. O. Hengartner for the strain opls219; and S. Davidor, D. Chau, H. Lee, J. Mesicek, and the Molecular Cytology and Genomics Core Laboratory of MSKCC for the technical assistance. This work was supported by grants CA85704 (R.K.), CA105125-03 (A.H.-F.), and 2R01HD42680-06 (S.S.).

Supporting Online Material

www.sciencemag.org/cgi/content/full/322/5898/110/DC1

Materials and Methods

Figs. S1 to S5

Tables S1 to S3

References

20 March 2008; accepted 9 September 2008

10.1126/science.1158111

Lacking Control Increases Illusory Pattern Perception

Jennifer A. Whitson^{1*} and Adam D. Galinsky²

We present six experiments that tested whether lacking control increases illusory pattern perception, which we define as the identification of a coherent and meaningful interrelationship among a set of random or unrelated stimuli. Participants who lacked control were more likely to perceive a variety of illusory patterns, including seeing images in noise, forming illusory correlations in stock market information, perceiving conspiracies, and developing superstitions. Additionally, we demonstrated that increased pattern perception has a motivational basis by measuring the need for structure directly and showing that the causal link between lack of control and illusory pattern perception is reduced by affirming the self. Although these many disparate forms of pattern perception are typically discussed as separate phenomena, the current results suggest that there is a common motive underlying them.

The desire to combat uncertainty and maintain control has long been considered a primary and fundamental motivating force in human life (1–3) and one of the most important variables governing psychological well-being and physical health (4–6). For example, when individuals can control, or even just perceive that they can control, the duration of painful shocks, they show lower arousal (7); similarly, learning details about a painful medical procedure can reduce anxiety and even lead to shorter recovery time (8). In contrast, lacking control is an unsettling and aversive state, activating the amygdala, which indicates a fear response (9). It is not surprising, then, that individuals actively try to reestablish control when it disappears or is taken away (10).

We propose that when individuals are unable to gain a sense of control objectively, they will try to gain it perceptually. Faced with a lack of control, people will turn to pattern perception, the identification of a coherent and meaningful interrelationship among a set of stimuli. Through pattern perception, individuals can make sense of events and develop predictions for the future (11–13). For instance, spontaneous causal attributions (identifying a cause-and-effect pattern in a sequence of events) are best predicted by unexpected events rather than negative ones, sug-

gesting that a major determinant of sense-making behavior is whether an individual lacks control (14, 15). Indeed, researchers have designated “desire for control as a motivational force behind the attribution process” (16).

Related to our theoretical framework, research has found that current needs can shape and even bias perceptual processes. For example, children of lower economic status overestimate the size of coins as compared with the wealthy (17), and hungry individuals are more likely to see food in ambiguous images (18). This research has established that specific needs alter the perception of stimuli directly relevant to those needs. The current research explores a much broader phenomenon: whether lacking control creates a tendency to see patterns more generally.

Because these feelings of control are so essential for psychological well-being, our main hypothesis is that lacking control will lead to illusory pattern perception, which we define as the identification of a coherent and meaningful interrelationship among a set of random or unrelated stimuli (such as the tendency to perceive false correlations, see imaginary figures, form superstitious rituals, and embrace conspiracy beliefs, among others). In fact, a high desire for control has been associated with distortions of objective reality (19), and studies have found that lacking control produces attributional biases to restore feelings of control (16). We suggest that a lack of control provokes seeing and seeking patterns because pattern perception is a compensatory mechanism designed to restore feelings of

control. Conspiracy beliefs are one example of how this process might work: They have been described as giving “causes and motives to events that are more rationally seen as accidents . . . [in order to] bring the disturbing vagaries of reality under . . . control” (20).

There are a number of findings that circumstantially support our specific hypothesis that lacking control leads to illusory pattern perception. Such disparate groups as preindustrial fisherman, skydivers, baseball players, and first-year MBA students have all displayed a connection between a lack of control and perceiving illusory patterns in one’s environment. Tribes of the Trobriand islands who fish in the deep sea, where sudden storms and unmapped waters are constant concerns, have far more rituals associated with fishing than do those who fish in shallow waters (21). Parachute jumpers are more likely to see a nonexistent figure in a picture of visual noise just before a jump than at an earlier time (22). Baseball players create rituals in direct proportion to the capriciousness of their position (for example, pitchers are particularly likely to see connections between the shirt they wear and success) (23). First-year MBA students are more susceptible to conspiratorial perceptions than are second-year students (24). Even on a national level, when times are economically uncertain, superstitions increase (25). These anthropological observations and correlational studies all provide suggestive but nonconclusive evidence that lacking control leads to the perception of illusory patterns.

To test whether a lack of control directly increases illusory pattern perception, we conducted six experiments that used multiple methods to induce a lack of control and measured illusory pattern perception by using a variety of stimuli. Our definition of pattern perception, both illusory and accurate, encompasses a range of phenomena that were previously studied independently. Despite their surface disparities, seeing figures in noise, forming illusory correlations, creating superstitious rituals, and perceiving conspiracy beliefs all represent the same underlying process: the identification of a coherent and meaningful interrelationship among a set of random or unrelated stimuli.

In the first experiment, we sought to establish that lacking control creates a need to see patterns. We manipulated lack of control by using a concept-identification paradigm specifically created to re-

¹Department of Management, The University of Texas at Austin, Austin, TX 78712, USA. ²Department of Management and Organizations, Northwestern University, Evanston, IL 60208, USA.

*To whom correspondence should be addressed. E-mail: jennifer.whitson@mcombs.utexas.edu

duce a sense of control (26–28). Consistent with this paradigm, participants in the lack-of-control condition received random performance feedback that was not contingent on their responses. Baseline participants identified concepts without feedback. We measured the individuals' need to perceive patterns using the Personal Need for Structure Scale, which assesses the need to "structure the world into a simplified, more manageable form" (29).

Participants lacking control in the concept identification task [Personal Need for Structure Scale mean (M) = 44.9, SD = 6.3] showed an increase in their personal need for structure as compared with those in the baseline condition [M = 38.2, SD = 10.7; Student's t test, $t(27) = 2.11$, $P = 0.045$]. Having established that a lack of control increases the need to see structure and patterns, we next tested whether it increases the perception of illusory patterns.

Experiment 2 manipulated lack of control using the same concept-identification task from the previous experiment and then measured visual pattern perception with a modified version of the snowy pictures task (30). Twelve of the 24 pictures were from the original task and contained a grainy embedded image that was difficult but possible to perceive. The other 12 pictures were manipulated using software to eliminate any traces of the embedded image. Participants were asked to identify whether there was an image or not and, if so, what it was.

In the 12 pictures in which an image did exist, almost all participants perceived an image [overall M = 11.4, SD = 1.1; $t(34) = 0.57$, $P = 0.57$]. However, in pictures that lacked an image, participants in the lack-of-control condition (M = 5.16, SD = 3.5) saw marginally more images than did participants in the baseline condition [M = 3.47, SD = 2.0; $t(34) = 1.76$, $P = 0.09$]. Participants who lacked control were more likely to perceive images where none existed.

In the third experiment, we manipulated lack of control by having participants vividly recall an experience in which they lacked or had full control over a situation. They next responded to three scenarios that tapped into superstitious beliefs; each scenario described an outcome that was preceded by a potentially unrelated behavior (such as knocking on wood before an important meeting and then getting one's idea approved). The participants were asked whether they thought the behavior was related to the outcome and how worried they were about performing that behavior in the future. Those who recalled an experience in which they lacked control (M = 4.92, SD = 2.5) perceived a greater connection between the two events than did those who recalled having control [M = 3.5, SD = 1.8; $t(39) = 2.03$, $P = 0.05$] and were more worried about performing similar behaviors in the future [M = 5.95, SD = 2.6 versus M = 4.12, SD = 2.3; $t(39) = 2.42$, $P = 0.02$]. This experiment establishes that the mere recollection of an experience involving a lack of control increases superstitious perceptions.

To demonstrate that threat, independent of lacking control, is not the driving force behind illusory pattern perception, we conducted a fourth

experiment in which all participants recalled a situation "in which something threatening happened," but we manipulated whether they had or lacked control in the situation. Our dependent measures were visual pattern perception and an additional type of pattern perception, conspiracy perceptions. Because the altered snowy pictures in the second experiment may have contained trace images of the original image, we measured illusory pattern perception by creating 10 pictures that each contained a random scattering of black dots on a white background, resembling noise on a television set. We also measured conspiracy perceptions to rule out the possibility that the above findings are simply the result of increased heuristic processing: The perception of conspiracies is not a simplifying process but a complex integration of data that is cognitively effortful. In each of our conspiracy scenarios, the situation was ambiguous as to whether there was a coordinated effort among a set of individuals to produce an outcome; participants were asked how connected they thought the individuals' behavior was to the outcome.

Even though all participants recalled a threatening situation, our manipulation of control still had the predicted effects. Lacking control (M = 2.92, SD = 2.5) led participants to see more images in the visual static than did those in the control condition [M = 0.92, SD = 2.0; $t(23) = 2.18$, $P = 0.04$]. In addition, participants who lacked control (M = 4.42, SD = 1.1) perceived a significantly greater likelihood of conspiracy than did control participants [M = 3.50, SD = 1.0; $t(23) = 2.19$, $P = 0.04$]. Two raters that were blind to the conditions and hypotheses coded the situations the participants recalled (31), and we found no differences between conditions in the level of threat expressed [$t(23) = 1.1$, $P = 0.30$]. Lack of control, and not threat alone, appears to produce illusory pattern perception.

We next tested the relationship between lack of control and illusory pattern perception in a financial domain, the stock market, by using a standard illusory correlation paradigm, which assesses whether two uncorrelated sets of information are perceived as related (that is, whether a pattern is seen that does not exist). We manipulated control by describing the stock market environment as either volatile or stable. In the volatile condition, participants read that the stock market was volatile and uncertain and were given a headline that said, "Rough Seas Ahead for Investors." In the stable condition, participants read that the stock market was stable and predictable and were given a headline that said, "Smooth Sailing Ahead for Investors."

Participants then read 24 statements about the financial performance of two companies. Each statement contained either positive or negative performance information. The ratio of positive to negative statements was constant across the companies, but the amount of information seen about each company was different: company A had 16 positive and 8 negative statements, whereas company B had 8 positive and 4 negative statements. Participants were then given a choice to invest in either company A or B and were asked

to report the number of negative statements that they remembered referring to companies A and B.

The presentation of the financial performance statements was designed to be consistent with the typical illusory correlation paradigm. Using this paradigm, researchers typically find that participants perceive a correlation between the infrequent behaviors and the group with less information, overestimating the number of times the two rare events occurred together, even though the information they are given distributes the positive and negative behaviors in equal proportion between the two groups. Because people typically over-associate the infrequent information with the infrequent group (that is, they perceive a correlation), we predicted that market volatility would increase the association between negative information and company B.

Market volatility affected investment decisions: Only 25% chose to invest in company B during a volatile market as compared with 58% during a stable market [χ^2 test, $\chi^2(1) = 4.94$, $P = 0.03$]. The volatile market condition also led to a stronger association between the negative information and company B: Participants overestimated the frequency of negative statements about company B in the volatile market (M = 5.0, SD = 1.5) but accurately perceived the amount of negative statements in the stable market [M = 3.9, SD = 1.7; $t(42) = 2.40$, $P = 0.02$]. The degree that participants overestimated the frequency of negative statements about company B mediated the effect of market volatility on investment decisions: when market volatility and frequency of negative statements simultaneously predicted investment decisions, market volatility was no longer a significant predictor ($P = .169$), but frequency of negative statements did predict investment decision ($P = .009$; Sobel test, $z = 1.78$, $P = 0.07$). These analyses demonstrate that participants formed illusory correlations: participants overestimated the infrequent type of information (negative) with the infrequently presented group (company B), and this illusory connection between negative statements and company B drove their investment decisions.

If the perception of illusory patterns is a compensatory mechanism induced by the distressing experience of lacking control, then an intervention that ameliorates this aversive state should break the link between lacking control and illusory pattern perception. Numerous studies have shown that letting individuals contemplate and affirm their important values is an effective method for reducing a variety of psychologically aversive states, including learned helplessness, dissonance, attributional biases, and persistent rumination (32–34). Because (i) self-affirmation reduces reactivity to threats and eliminates compensatory responses and (ii) lacking control is such a psychologically aversive and distressing state, we predicted that self-affirmation would reduce the tendency for individuals who lack control to perceive illusory patterns.

To test whether self-affirmations would reduce illusory pattern perception, we used the recall task from experiment 3 to manipulate lack of control and measured illusory pattern perception by using experiment 2's snowy pictures task and

conspiracy scenarios similar to those used in experiment 4 (35). The experiment had three conditions: lack of control without self-affirmation, lack of control against self-affirmation, and baseline (no recall task). After completing the recall task but before reading and responding to the snowy pictures and the conspiracy scenarios, participants completed a standard self-affirmation procedure (34). They were asked to complete a scale focused on a value they had indicated at the beginning of the experiment to be either most important (self-affirmation) or least important (no self-affirmation) to them.

To analyze the data, we conducted contrast tests that compared the lack of control/no self-affirmation condition with the self-affirmation and baseline conditions. Similar to effects found in Experiment 2 on the snowy pictures task, participants who lacked control and received no opportunity for self-affirmation ($M = 5.44$, $SD = 3.6$) saw more patterns when none existed than did those in the self-affirmation condition ($M = 3.24$, $SD = 2.6$) and the baseline condition [$M = 3.47$, $SD = 3.3$; $t(47) = 2.21$, $P = 0.03$]. Additionally, participants who lacked control without self-affirmation ($M = 4.76$, $SD = 0.87$) perceived a significantly greater likelihood of conspiracy than did those in the self-affirmation ($M = 4.18$, $SD = 0.83$) and baseline conditions [$M = 4.20$, $SD = 1.10$; $t(47) = 2.08$, $P = 0.04$] (36). Lacking control without an opportunity to self-affirm led participants to see images that did not exist and to perceive conspiracies. However, participants who experienced a lack of control but then had the opportunity to self-affirm resembled participants in the baseline condition. This experiment shows that a lack of control creates a need to perceive patterns in one's environment, even when the patterns perceived are illusory.

These six experiments demonstrate that lacking control motivates pattern perception: Experiencing a loss of control led participants to desire more structure and to perceive illusory patterns. The need to be and feel in control is so strong that individuals will produce a pattern from noise to return the world to a predictable state.

We acknowledge that the studies did not involve large sample sizes, but given the large effects required to achieve significance, combined with the consistent pattern across the studies, we feel our hypothesis has been effectively supported.

The focus of the current research was on illusory pattern perception. Because nearly all participants correctly identified an image in the snowy pictures when one was present, we were not able to address whether a lack of control also increases accuracy in detecting real patterns, ones that do in fact exist. If so, a lack of control would seem to increase positive identifications, both false and accurate. Future research should employ tasks with greater variance in participants' ability to detect actual patterns to test this idea more systematically. It should also explore whether increased pattern perception exists not just in

the identification of more patterns but also in shorter latencies to perceive them.

Illusory pattern perception may not be entirely maladaptive. If pattern perception helps an individual regain a sense of control, the very act of perceiving a pattern, even an illusory one, may be enough to soothe this aversive state, decreasing depression and learned helplessness, creating confidence, and increasing agency. Although it is certainly preferable to accurately perceive one's environment, illusory pattern perception itself may be at times adaptive by allowing an individual to psychologically engage with rather than withdraw from their environment.

The current research offers insights into how illusory pattern perception driven by a lack of control may be overcome. When individuals were made to feel psychologically secure after lacking control, they were less prone to the perception of illusory patterns. Indeed, the beneficial effects of this sense of security are tapped into by psychotherapy, which attempts to give clients a sense of control over their lives to reduce the obsessive-compulsive tendencies or sinister attributions engendered by seeing too much meaning and intentions in others' innocuous behaviors. Collectively, the six experiments highlight the importance of having versus lacking control and hold promise for preventing futile pursuits born of the perception of illusory patterns.

References and Notes

- H. H. Kelley, *Attribution in Social Interaction* (General Learning Press, Morristown, NJ, 1971).
- R. White, *Psychol. Rev.* **66**, 297 (1959).
- R. deCharms, *Personal Causation* (Academic Press, New York, 1969).
- D. C. Glass, J. E. Singer, *Am. Sci.* **60**, 457 (1972).
- D. C. Klein, E. Fencil-Morse, M. E. P. Seligman, *J. Pers. Soc. Psychol.* **33**, 508 (1976).
- S. Cohen, *Behavior, Health, and Environmental Stress* (Plenum Press, New York, 1986).
- D. C. Glass, J. E. Singer, H. S. Leonard, D. Krantz, S. Cohen, H. Cummings, *J. Pers.* **41**, 577 (1973).
- A. Luck, S. Pearson, G. Maddern, P. Hewett, *Lancet* **354**, 2032 (1999).
- P. J. Whalen, *Curr. Dir. Psychol. Sci.* **7**, 177 (1998).
- J. W. Brehm, *A Theory of Psychological Reactance* (Academic Press, New York, 1966).
- T. A. Pyszczynski, J. Greenberg, *J. Pers. Soc. Psychol.* **40**, 31 (1981).
- R. Hastie, *J. Pers. Soc. Psychol.* **46**, 44 (1984).
- E. G. Clary, A. Tesser, *Pers. Soc. Psychol. Bull.* **9**, 609 (1983).
- S. Kanazawa, *Pers. Soc. Psychol. Bull.* **18**, 659 (1992).
- B. Weiner, *Psychol. Bull.* **97**, 74 (1985).
- T. S. Pittman, N. L. Pittman, *J. Pers. Soc. Psychol.* **39**, 377 (1980).
- J. S. Bruner, C. C. Goodman, *J. Abnorm. Soc. Psychol.* **42**, 33 (1947).
- R. Levine, I. Chein, G. Murphy, *J. Psychol.* **13**, 283 (1942).
- J. M. Burger, L. T. Hemans, *J. Pers.* **56**, 531 (1988).
- D. Pipes, *Conspiracy: How the Paranoid Style Flourishes and Where It Comes From* (Free Press, New York, 1997).
- B. Malinowski, R. Redfield, *Magic, Science and Religion, and Other Essays* (Beacon Press, Boston, 1948).
- P. Simonov, M. Frolov, V. Evtushenko, E. Sviridov, *Aviat. Space Environ. Med.* **48**, 856 (1977).
- G. Gmelch, *Trans Action* **9**, 39 (1971).
- R. M. Kramer, *Motiv. Emot.* **18**, 199 (1994).
- S. M. Sales, *J. Pers. Soc. Psychol.* **28**, 44 (1973).
- N. L. Pittman, T. S. Pittman, *J. Pers. Soc. Psychol.* **37**, 39 (1979).
- A pretest experiment found that this manipulation did not affect self-esteem {lacking control condition ($M = 5.33$, $SD = 1.4$) versus the baseline condition ($M = 5.15$, $SD = 0.90$; $t(26) = 0.38$, $P = 0.70$ }.
- Materials and methods are available as supporting material on Science Online.
- S. L. Neuberg, J. T. Newsom, *J. Pers. Soc. Psychol.* **65**, 113 (1993).
- R. B. Ekstrom, J. W. French, H. H. Harman, D. Dermen, *Manual for Kit of Factor-Referenced Cognitive Tests* (Educational Testing Service, Princeton, NJ, 1976).
- The two raters independently coded each situation for "How much did the person experience or feel threat in the situation?" using a 7-point scale with anchors 1 (very little) and 7 (very much). Because inter-rater reliability was acceptable ($\alpha = .71$), we averaged the coders' ratings.
- C. M. Steele, T. J. Liu, *J. Pers. Soc. Psychol.* **45**, 5 (1983).
- T. J. Liu, C. M. Steele, *J. Pers. Soc. Psychol.* **51**, 531 (1986).
- S. L. Koole, K. Smeets, A. van Knippenberg, A. Dijksterhuis, *J. Pers. Soc. Psychol.* **77**, 111 (1999).
- Because the conspiracy and superstition scenarios used in the previous experiments were written from a first-person perspective, it may be that illusory pattern perception in social domains only occurs when the self is affected by or implicated in the pattern. To test this possible boundary condition, we altered the conspiracy scenarios used in experiment 6 to be from a third-person perspective (other-focused) and manipulated the lack of control by using the recall task from experiments 3 and 6. We submitted conspiratorial perceptions to a 2 (control: control, lacking control) by 2 (scenario focus: self, other) analysis of variance (ANOVA). The analyses revealed a main effect of lacking control ($F_{1,82} = 9.96$, $P = 0.002$) and no interaction between scenario focus and lacking control ($F_{1,82} = 0.001$, $P = 0.98$). Separate analyses showed that the effect of lacking control significantly increased the perception of conspiracies in both the other-focused scenarios [$M_{\text{lack of control}} = 4.76$, $SD = 0.76$; $M_{\text{control}} = 4.18$, $SD = 0.78$; $t(43) = 2.49$, $P = 0.02$] and the self-focused scenarios [$M_{\text{lack of control}} = 4.87$, $SD = 0.85$; $M_{\text{control}} = 4.30$, $SD = 0.95$; $t(39) = 2.01$, $P = 0.05$], demonstrating that illusory pattern perception increased regardless of whether the self was affected by the possible conspiracy.
- Focused contrasts are the preferred analysis with three levels of a single experimental factor when researchers have a hypothesis that one condition will be different from the other two conditions (37). For the interested reader, we report the omnibus ANOVA testing the overall variance among the conditions: for snowy pictures, $F_{1,47} = 2.49$, $P = .09$; for conspiracy, $F_{1,47} = 2.17$, $P = .13$.
- R. Rosenthal, R. L. Rosnow, *Essentials of Behavioral Research: Methods and Data Analysis* (McGraw-Hill, New York, 3rd ed., 2008).
- This work benefited from the generous financial support of the Dean's office of the Kellogg School of Management. We thank C. Appleton, K. Dover-Taylor, L. Howland, and A. Marfia for research help. The research was based in part on the doctoral dissertation submitted by J.W. to Northwestern University and has benefited from the comments of the committee members W. Gardner, V. Medvec, and K. Murnighan. We also thank L. Egan, Z. Kiniias, G. Ku, K. Liljenquist, L. Nordgren, N. Sivanathan, C. Wang, and C. Zhong for their helpful comments.

Supporting Online Material

www.sciencemag.org/cgi/content/full/322/5898/115/DC1
Materials and Methods
References

30 April 2008; Accepted 10 September 2008
10.1126/science.1159845



www.sciencemag.org/cgi/content/full/322/5898/115/DC1

Supporting Online Material for

Lacking Control Increases Illusory Pattern Perception

Jennifer A. Whitson* and Adam D. Galinsky

*To whom correspondence should be addressed. E-mail: jennifer.whitson@mcombs.utexas.edu

Published 3 October 2008, *Science* **322**, 115 (2008)
DOI: 10.1126/science.1159845

This PDF file includes:

Materials and Methods
References

Supporting Online Materials

Materials and Methods

Study 1: Direct Manipulation of Control and Increasing the Need for Structure

Participants and Design

Participants were 29 undergraduates who participated for a payment of \$10. The experiment consisted of two between-participants conditions: baseline and lack of control.

Procedure

Upon their arrival, participants were told that they would be completing several tasks.

Control manipulation. Subjects were told they would be completing a 'concept identification' task, which was created by Pittman and Pittman (*SI*), and given the following instructions:

This is a concept identification task. The computer will select a concept, and through the feedback the computer provides, it is your job to determine what this concept is.

You will be presented with pairs of symbols. In each pair of symbols, one correctly represents the concept the computer has selected, and one incorrectly represents the concept. It is your job to decide which side of the screen displays the correct symbol.

Each time you select a symbol, the computer will tell you if you are correct or incorrect, and present you with another pair. You will be exposed to ten pairs in total. You should learn the correct answer from the computer's feedback and choose correctly as often as possible.

First, you will participate in a practice trial with ten pairs of symbols (just like the real trials). This is to give you a chance to get used to the task.

After the practice trial (with ten pairs of figures), participants completed another four trials (each with ten pairs of figures).

In the *lack of control condition*, participants received computer feedback. However, the feedback was random and non-contingent to their responses – 50% of the time the computer told them their response had been correct, and 50% of the time that their response had been incorrect. There was no concept to identify, and thus participants were unable to correctly intuit an answer.

In the *baseline condition*, participants were told that, in order to get a 'base rate' of responses, they would answer without receiving computer feedback, making their best guess as to what concept the computer had selected. We told them their performance did not matter, and that we simply wanted their instinctive responses.

Dependent variables. Participants completed the Personal Need for Structure Scale, which measures the need to “structure the world into a simplified, more manageable form” (S2). This measure was used to test whether lacking control increases the desire for structure, which relates to pattern perception in its search for simplified structures in the environment.

After completing the tasks, participants were paid and debriefed.

Study 2: Direct Manipulation of Control and Seeing Images in Snowy Pictures

Method

Participants and Design

Participants were 36 (25 women and 11 men) undergraduates who participated for a payment of \$10. The experiment consisted of two between-participants conditions: baseline and lack of control.

Procedure

Upon their arrival, participants were told that they would be completing several unrelated tasks. The first task participants completed comprised the manipulation of control. Participants completed the same concept identification task used in Experiment 1 and then responded to a Snowy Pictures task.

Control manipulation. Participants completed the control deprivation task used in Experiment 1 to manipulate lack of control.

Visual pattern perception. Participants next completed a modified form of the Snowy Pictures Task (S3). The task is drawn from the aptitude literature, and was originally used to test perception. It consists of a series of 'snowy' pictures – pictures that are grainy and granulated so that it is difficult to make out an image in them. For the purposes of this experiment, half of the pictures were taken and manipulated using digital media software such that no traces of the original image remained (See Appendix A).

Participants were told the task involved visual perception and that “it is helpful to be able to see objects quickly in spite of their being partially concealed by snow, rain, haze, darkness, or other visual obstructions. After being shown two examples, participants were further told that: “Some pictures in this test may have no object in them. If you believe a picture does not have an object in it then describe the picture by writing ‘none’. Your score on this test will be the number of pictures that you name correctly. Work as quickly as you can without sacrificing accuracy.”

After completing all of the measures, participants were paid for their participation and debriefed.

Study 3: Recall Manipulation of Control and Forming Superstitions

Method

Participants and Design

Participants were 41 (26 women and 15 men) undergraduates who participated for \$10. The experiment consisted of two between-participants conditions: control and lack of control.

Procedure

Upon their arrival, participants were told that they would be completing several unrelated tasks. The first task participants completed was the recall task that comprised the manipulation - they were asked to write about an autobiographical experience. Half of the participants completed a *lack of control prime*:

Please recall a particular incident in which something happened and you did not have any control over the situation. Please describe the situation in which you felt a complete lack of control – what happened, how you felt, etc.

The other half of the participants completed a *control prime*:

Please recall a particular incident in which something happened and you were in complete control of the situation. Please describe the situation in which you felt in complete control– what happened, how you felt, etc.

Superstition. Participants were next presented with three scenarios. In each scenario an event (or significant non-event, such as an expected promotion not materializing) was preceded by an action that was not necessarily objectively connected to it. For example:

Imagine that you work in the marketing department of a large firm and have an excellent record of getting your marketing ideas accepted in meetings. Before every meeting in which you pitch an idea, you always stomp your feet three times before entering the room. However, today you were running late and forgot to stomp your feet three times. At the meeting your ideas were completely ignored. How much do you feel not stomping your feet is connected to your ideas not being accepted?

They were asked how connected they felt one event was to the other from 1 (impossible) to 11 (certain). They were also asked how worried they were about performing or not performing the action that 'led' to the event in the future, from 1 (definitely not worried) to 11 (definitely

worried). After completing all of the dependent measures, participants were paid for their participation and debriefed.

Study 4: Does Threat (in the Absence of Lack of Control) Increase Illusory Pattern Perception

Method

Participants and Design

Participants were 25 (19 women, 6 men) undergraduates who participated for \$10.

The experiment consisted of two between-participants conditions: control and lack of control.

Procedure

Upon their arrival, participants were told that they would be completing several unrelated tasks. In the first task, participants were again asked to write about an autobiographical experience. In both conditions, participants were asked to recall an experience that was threatening. Half of the participants wrote about situation in which they had control and the other half wrote about an experience in which they lacked control. Participants in the *lack of control condition* saw the following instructions:

Please recall a particular incident in which something threatening happened to you and you did not have any control over the situation. Please describe the situation in which you were threatened and felt a lack of control over the situation – what happened, how you felt, etc.

Participants in the *control condition* saw the following instructions:

Please recall a particular incident in which something threatening happened to you and you were in complete control of the situation. Please describe the situation in which you were threatened but you felt complete control over the situation – what happened, how you felt, etc.

Pattern Perception. Participants' tendency to perceive patterns were examined at two levels, one social and one non-social.

Noise. To explore whether participants would see visual patterns, participants were given a packet in which each page had one picture of randomly generated noise. The pictures were of unstructured white noise, essentially a tightly-packed scattering of black dots on a white background that resembled static on an empty channel of a television set. After each picture, participants were asked if they saw an object in the picture and were given the option to answer 'yes' or 'no.' Participants viewed a total of ten pictures. Since each picture was of random static, in which no image existed, any identification from a participant that they had seen an object in the picture is evidence of illusory pattern perception.

Conspiracy. Participants were next presented with two scenarios. In each scenario, it was possible to interpret the behavior of the people around the protagonist as innocent or as conspiratorial and as having caused the protagonist's positive or negative outcome, but the facts of the situation made it ambiguous whether there was a conspiracy affecting the outcome.

In the first scenario, the protagonist experiences a bad event and is asked to what extent the event may be due to the actions of people mentioned earlier in the scenario:

Imagine that you are one of the top administrators in your organization. You are in charge of running a number of aspects of the organization, including tracking the hours of all employees and their email and internet usage. You will soon be up for promotion. The day before your scheduled meeting with your superiors, you notice that the number of emails between your boss and the coworker sitting next to you jumps precipitously.

When you meet with your boss, you are told you're not getting the promotion.

To what extent do you think your coworker may be connected to you not getting the promotion?

In the second scenario, the protagonist experiences a good event and is asked to what extent that event may be due to the actions of people mentioned earlier in the scenario:

Imagine that you buy stock in one of the three construction companies that service your area. One day, your spouse, who runs the local bed and breakfast, notes that the families of all three company owners have checked into the B&B recently. Later, the prices all three companies offer for their services have risen drastically.

Because of the higher prices, all three companies post very high profits, and you make a lot of money off of the stock you own.

To what extent do you think the visits to the bed and breakfast may be connected to the earnings you made off your stocks?

Participants rated to what extent the actions of the other people in the scenario were connected to the outcomes the protagonist experienced, from 1 (not at all) to 7 (a great deal).

After completing the dependent measures, participants were paid for their participation and debriefed.

Study 5: Lacking Control and the Perceiving Patterns in the Stock Market

Method

Participants and Design

Participants were 44 undergraduates who participated in the experiment for \$10. The experiment involved two between-participants conditions: current market conditions were described as either volatile or stable.

Stimulus Materials

Stimulus sentences were created by taking authentic comments about real companies from the Value Line Investment Survey online – information people actually read before making decisions about which stocks to buy and sell. We pre-tested statements for how positive and negative they were regarding the performance of a hypothetical company. A statement was

chosen as positive if its average rating (on a 5-point scale where 1= bad and 5 = good) was above 4, and chosen as negative if its average rating was below 2. From this list, 24 positive and 12 negative statements were chosen for use in the study.

Procedure

Participants were told that the study investigated “how people process and retain information that is presented to them visually, as well as how that information is used during the decision-making process.” They were then given information about the current stock market prior to reading the information about the companies.

In the *volatile market condition* they were told,

You are considering investing money in the stock market and right now it is very volatile. Even analysts admit that it's hard to predict which stocks will do well and which will do poorly. Fortune magazine recently had a headline that says, “Rough Seas Ahead for Investors.” The Wall Street Journal used a similar but different metaphor – “Investing is like walking through a minefield.” You recognize the volatility of the current market. You feel it's important to get into the stock market.

In the *stable market condition* they were told,

You are considering investing money in the stock market and right now it is very stable. Even analysts admit that it's easy to predict which stocks will do well and which will do poorly. Fortune magazine recently had a headline that says, “Smooth Sailing Ahead for Investors.” The Wall Street Journal used a similar but different metaphor – “Investing is like walking through a field of flowers.” You recognize the stability of the current market. You feel it's important to get into the stock market.

Stock Market Stimuli. All information about the companies was presented on the computer. Participants were told, “In the following exercise you will see a series of slides, each slide showing a single sentence describing events concerning a company's stock performance”

and were shown two example sentences. They were then told, “The companies in the following sentences will not be identified by their actual names. Each company described will be referred to as Company A or Company B. In collecting descriptions of each company's stock market behavior, we drew a random sample from a number of different business portfolios, investment journals, and magazines.” They were told to read the behaviors carefully because they would be tested later for their comprehension and memory of the statements.

Each statement appeared on the screen for 8 seconds and participants saw 36 total statements. There were 16 positive and 8 negative statements about Company A and 8 positive and 4 negative statements about Company B. Thus, the ratio of desirable to undesirable behaviors for each group was 2:1. The statements were presented in a fixed, random order.

Dependent Measures. There were two dependent measures. The first measure assessed investment intentions. Participants were asked “If you could purchase only one company's stock, would you purchase Company A or Company B's stock?” The second measure concerned the frequency that negative statements were attributed to Companies A and B and participants were asked to estimate the frequency of the negative statements about each of the companies. After completing all of the dependent measures, participants were paid for their participation and debriefed.

Study 6: Self Affirmation and Breaking the Lacking Control → Pattern Perception Link

Method

Participants and Design

Participants were 50 undergraduate students (31 women, 18 men, and one individual who elected not to share their demographic information) paid \$10 for their participation. The

experiment involved 3 between-participants conditions (lack of control without self-affirmation, lack of control with self-affirmation, baseline).

Procedure

Participants were brought into the lab and told they would complete a number of different tasks. As in Koole, Smeets, van Knippenberg, & Dijksterhuis (S4), participants in the lack of control conditions first ranked the personal importance of a set of six global values taken from the Allport-Vernon-Lindzey Values scale (S5).

Manipulation of control. Participants in the *lack of control conditions* then completed the recall task introduced in Experiment 3, in which they were asked to recall and write about an incident in their life in which they lacked control. Participants in the *baseline condition* did not complete the control prime or the self-affirmation manipulation.

Affirmation manipulation. Participants in the lack of control conditions were randomly assigned to either an affirmation or no affirmation condition. In the *affirmation condition*, participants were asked to complete a 10-item Allport-Vernon Lindzey subscale on the value they had indicated had the *most* importance to them. By confirming their most strongly held value, participants had an opportunity for self-affirmation. In the *no-affirmation condition*, participants were asked to complete a 10-item Allport-Vernon Lindzey subscale on the value they had indicated had the *least* importance to them. By contemplating their opinions on a belief they did not strongly hold, participants did not have an opportunity for self-affirmation (S4).

Visual pattern perception. Participants completed the modified version of the Snowy Pictures Task (S3) as used in Experiment 2.

Conspiratorial thinking measures. Participants were next presented with three conspiracy scenarios (the two scenarios from Experiment 3 and one additional scenario). After each

conspiracy scenario participants were asked to what extent they thought the two events they saw were connected, from 1 (not at all) to 7 (a great deal).

The visual pattern perception and scenario tasks were counterbalanced. After completing the dependent measures, participants were paid for their participation and debriefed.

Footnote 27: Direct Manipulation of Control and Self-Esteem

Method

Participants and Design

Participants were 28 (15 women and 13 men) undergraduates who participated for a payment of \$10. The experiment consisted of two between-participants conditions, baseline and lack of control.

Procedure

The first task participants completed comprised the manipulation of control and was the concept identification task used in Experiments 1 and 2.

After completing the manipulation of control, participants were asked to what extent they agreed with the statement, "I have high self esteem," from 1 (definitely agree) to 7 (definitely disagree), This single-item measure has been shown to be reliably correlated with a larger 10-item measure of self-esteem (*S6*).

Footnote 34: Recall Manipulation of Control and Self- and Other- focused Conspiracies

Method

Participants and Design

Participants were 41 individuals (19 women and 22 men) who completed an on-line survey. The experiment was a 2 (prime: lack of control, control) x 2 (scenario focus: self, other) between participants design.

Procedure

Manipulation of control. Participants first completed the recall task introduced in Experiment 3, in which they were asked to recall and write about an incident in their life in which they possessed or lacked control.

Conspiratorial thinking measures. Participants were next presented with the same three conspiracy scenarios used in Experiment 6. For half of the participants, these scenarios were altered to be in the third person rather than the first person as in the previous experiments. For example, the first scenario presented in the methods of Study 4 was altered to read:

Imagine that a friend is one of the top administrators in their organization. They are in charge of running a number of aspects of the organization, including tracking the hours of all employees and their email and internet usage. They will soon be up for promotion. The day before their scheduled meeting with your superiors, they notice that the number of emails between their boss and the coworker sitting next to them jumps precipitously.

When they meet with their boss, they are told they're not getting the promotion.

After each conspiracy scenario participants were asked to what extent they thought the two events they saw were connected, from 1 (not at all) to 7 (a great deal).

After completing the dependent measures, participants were paid for their participation and debriefed.

Appendix A. The modified Snowy Pictures Task. 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 media software so that no traces of the original picture remain.

PART 1

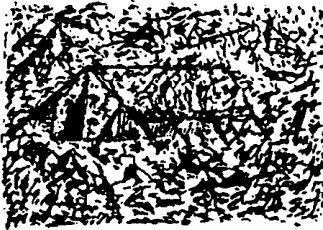
Write one or two words to describe each picture.



1. _____

2. _____

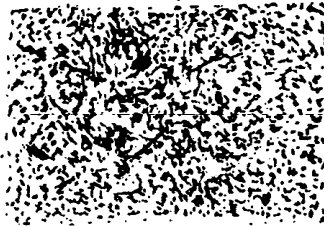
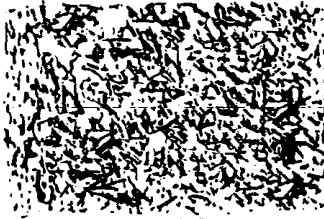
3. _____



4. _____

5. _____

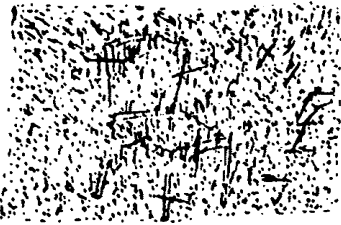
6. _____



7. _____

8. _____

9. _____



10. _____

11. _____

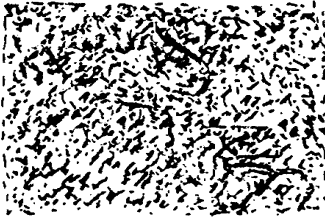
12. _____

PART 2

Write one or two words to describe each picture.



13. _____



14. _____



15. _____



16. _____



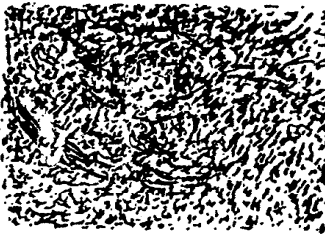
17. _____



18. _____



19. _____



20. _____



21. _____



22. _____



23. _____



24. _____

DO NOT GO BACK TO PART 1

References

- S1. N. L. Pittman, T. S. Pittman, *J. Pers. Soc. Psychol.* **37**, 39 (1979).
- S2. S. L. Neuberg, J. T. Newsom, *J. Pers. Soc. Psychol.* **65**, 113 (1993).
- S3. R. B. Ekstrom, J. W. French, H. H. Harman, D. Dermen, *Manual for kit of factor-referenced cognitive tests*. (Educational Testing Service, Princeton, NJ, 1976).
- S4. S. L. Koole, K. Smeets, A. van Knippenberg, A. Dijksterhuis, *J. Pers. Soc. Psychol.* **77**, 111 (1999).
- S5. G. W. Allport, P. E. Vernon, G. Lindzey, *Study of values: a scale for measuring the dominant interests in personality*. (Houghton Mifflin, Boston, ed. 3rd, 1960).
- S6. R. W. Robins, H. M. Hendin, K. H. Trzesniewski, *Pers. Soc. Psychol. Bull.* **27**, 151 (2001).