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Lacking Control Increases Illusory Pattern Perception

Jennifer A. Whitson[1]* and Adam D. Galinsky[2]

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, suggesting 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-

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

*To whom correspondence should be addressed. E-mail: jennifer.whitson@mccombs.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.

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36. 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, $F_{1,47} = 2.17$, $P = .13$.
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