Illusory Correlation

Ashley L. Watts, Sarah Francis Smith, and Scott O. Lilienfeld
Emory University, U.S.A.

Many individuals hold strong, often unyielding, convictions about the association between occurrences that have been shown to be statistically unrelated, such as the full moon and strange behavior, or joint pain and rainy weather. Indeed, these and many other venerable legends are held by the masses in the face of clear contrary evidence (Redelmeier & Tversky, 1996).

Why do many of us perceive statistical associations between certain events when these associations are objectively absent? The answer is of substantial importance to clinical psychology and allied fields. Clinical psychologists dub this phenomenon *illusory correlation* (Chapman & Chapman, 1967, 1969). More specifically, an illusory correlation is

> the report by observers of a correlation between two classes of events, which, in reality, (a) are not correlated, or (b) are correlated to a lesser extent than reported, or (c) are correlated in the opposite direction from that which is reported. (Chapman, 1967, p. 151)

Psychological research demonstrates that humans tend to be poor at estimating the statistical relations among events; this faulty statistical barometer can predispose us to illusory correlations (Dawes, 1989).

Illusory Correlation and Clinical Assessment

Although illusory correlation is a domain-general phenomenon, Chapman (1967) believed that it bears especially important implications for clinical settings, such as biases (systematic errors) in clinical judgment. In a classic study, Chapman and Chapman (1967) first demonstrated the existence of illusory correlation in the domain of psychological assessment. They asked clinical psychologists to list the characteristics ("signs") of various Draw-a-Person (DAP; Machover, 1949) protocols that are associated with specific psychiatric symptoms and personality traits. The DAP is a widely used projective technique that asks participants to draw three people—a man, a woman, and themselves—which purportedly allows clinicians to infer a wide range of normal and abnormal personality traits. Chapman and Chapman found that clinicians exhibited strong agreement on certain pairings of DAP signs and certain symptoms or personality traits. For example, 91% of clinicians reported that atypical eyes on the DAP tend to be a valid indicator of suspiciousness, and 82% of clinicians agreed that a large or emphasized head is a valid indicator of intelligence. Chapman and Chapman observed that these associations reflect potent associative linkages between certain drawing signs and certain indicators of psychological disturbance. For example, as clinical psychologist Paul Meehl (1920–2003) noted, paranoid people are often characterized by wide-open eyes. Yet these intuitive relations, which mirror those found in DAP manuals, had been disconfirmed in many previous studies.

In the second part of the study, the Chapmans presented students with DAP protocols along with pairs of symptom statements, and asked them to inspect the pictures and statements carefully. For example, a drawing presented to a participant was attached to two symptom statements, such as "The man who drew this is either (a) suspicious of other people or (b) worried about how manly he is." The pairs of symptom statements were drawn from the six symptoms that the clinicians had listed as DAP correlates; the pairs of statements were randomly assigned to each drawing so that each

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symptom statement appeared only once with each of the drawings. After viewing all of the drawings, the researchers asked participants which characteristics of the drawings were associated with which psychological characteristics. Remarkably, these results mirrored the relations perceived by clinical psychologists (e.g., broad shoulders and manliness, atypical eyes and suspiciousness). That is, the undergraduate participants had "recaptured" the identical illusory associates perceived by clinicians.

In a follow-up study, Chapman and Chapman (1969) replicated their findings using a different projective task, the perennially popular Rorschach Inkblot Test (Rorschach, 1927). They sought to identify illusory correlations between Rorschach responses and homosexuality, which at the time was a diagnostic category in *DSM-II* (American Psychiatric Association, 1968). As predicted, an overwhelming majority of clinicians reported that a number of specific Rorschach responses were associated with homosexuality (e.g., responses referring to the anus, feminine clothing, genitals, or sexual ambiguity). As in the Chapman and Chapman (1967) study, the researchers asked undergraduates to render judgments after viewing Rorschach protocols paired with personality statements; the personality statements were rigged so that there was no statistical relation between the card and the statement. Despite the absence of any statistical association between the Rorschach cards and the symptom statements, undergraduates, like clinicians, reported that the aforementioned signs (e.g., anus, feminine clothing, etc.) were indicators of homosexuality, despite the fact that the actual correlations between the signs and homosexuality in the stimulus materials were zero.

Dowling and Graham (1976) extended work on illusory correlation to more objective assessment techniques, namely, the widely used Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1943). Despite the fact that the MMPI's clinical scale labels were replaced with numbers (e.g., Psychopathic deviate with 4), it seems likely that strong semantic associations persist between some scale labels and test responses (e.g., Depression and "feels blue or sad"). The authors hypothesized that many clinicians continued to use the original labels, which may lead to illusory correlation when judges are asked to infer relations between MMPI scales and psychiatric symptoms.

Dowling and Graham tested this hypothesis in a twofold manner. First, they compiled a pool of items in which an MMPI scale name was paired with two of 10 behavioral statements (e.g., often complains about his health, sleeps whenever possible, and keeps his clothes neat). Each statement possessed some semantic association with at least one of the MMPI scales, but not necessarily the scale with which it was paired. To ensure that there was no actual relation between the MMPI scale and the behavioral statements, the researchers chose statements that were not statistically associated with any clinical scale more than another. Each subject received a brief introduction to the MMPI, including the names of the 10 scales; nevertheless, they received no descriptions of these scales. Next, one group of graduate students, who had completed a course on the MMPI, and one group of undergraduate students each studied the pool of items. Later, they indicated with which MMPI scale each of the 10 behavioral statements was most associated.

Despite the fact that the behavioral statements were no more likely to co-occur with a specific MMPI scale over any other, undergraduates reported that certain behavioral statements co-occurred with certain MMPI scales six out of 10 times. Interestingly, graduate students reported a significant co-occurrence for nine out of 10 statements, suggesting even higher levels of illusory correlation. Dowling and Graham's findings demonstrate that illusory correlation is not limited to projective techniques, and suggest that the tendency to perceive relations between uncorrelated phenomena does not necessarily decrease with clinical experience. More broadly, findings concerning illusory correlation have been

replicated using different assessment tasks and different groups of participants (see Starr & Katkin, 1969, for similar findings regarding the Rotter Incomplete Sentences Blank task; and King & Koehler, 2000, for findings regarding graphology, or handwriting analysis).

Illusory Correlation and Erroneous Cultural Beliefs

The implications of illusory correlation extend well beyond psychological assessment. Indeed, many widespread cultural beliefs reflect illusory correlations. For example, numerous superstitions, such as linkages between the number 13 and negative outcomes, are illusory correlations. Another striking illusory correlation is the "lunar lunacy effect" or "Transylvania effect": the purported relation between the full moon and mental illness, violence, and odd behavior (Lilienfeld & Arkowitz, 2009). One survey (Rotton & Kelly, 1985a) revealed that 49.4% of college students believe that there is a statistical association between the full moon and strange occurrences (e.g., violent crimes and psychiatric hospital admissions). Yet data consistently suggest that this belief is unwarranted. Rotton and Kelly (1985b) conducted a meta-analysis of 37 studies examining the relation between the full moon and a plethora of undesirable behaviors (e.g., homicides, suicides, and disturbances in psychiatric settings) and found no evidence that people behave any more aberrantly during one phase of the moon than another (see also Kelly, Rotton, & Culver, 1996).

All too present in popular culture, and even among clinical psychologists, is the misconception that mentally ill individuals are at markedly heightened risk for violence. A large national survey conducted in 2006 revealed that 60% of Americans believed that individuals with schizophrenia are likely to engage in violent behavior; 32% believed that individuals with major depression are likely to do so. These beliefs rarely reflect reality. Although meta-analyses reveal a weak to modest relation between severe mental illness and violence (Douglas, Guy, & Hart, 2009), mentally ill individuals account for a negligible portion of violent crimes committed (Quinsey, Harris, Rice, & Cormier, 2006). Furthermore, the link between mental illness and violence is moderated by abuse of drugs and alcohol (Fazel, Gulati, Linsell, Geddes, & Grann, 2009). Fazel and colleagues (2009) found that the relation between psychosis and risk was due largely or entirely to co-occurring substance use disorders. The increased risk for violence in psychotic individuals was not significantly different from the risk for violence in individuals with substance use disorders alone. Although the reasons for these findings are unknown, certain illicit substances may trigger violent behavior by impairing judgment or decreasing inhibitions. Additionally, among individuals with severe mental illness, substance abuse may exacerbate psychiatric symptoms (e.g., paranoia and hostility). On balance, although some noteworthy examples (e.g., James Holmes, the 2012 Aurora, Colorado movie theater shooter) fit our conception of violent, mentally ill perpetrators, many or most of us substantially overestimate the risk of violence among the mentally ill.

More broadly, many racial stereotypes reflect illusory correlation. One kind of stereotype involves the belief that a certain behavior (e.g., violence, laziness, or arrogance) is more specific to one ethnic or cultural group than another, even when this association does not reflect reality. In such cases, observers perceive a statistical association between ethnic or cultural group membership and specific behaviors when this association is largely or entirely nonexistent.

Illusory correlation may also predispose to mistaken inferences concerning the causes of psychopathology. Take the widely publicized and highly contentious notion that vaccines increase the risk for autism or other neurodevelopmental disorders (Wakefield et al., 1998). Survey data suggest that 24% of individuals believe that vaccines cause autism (Florida Institute of Technology, 2008). This hypothesis originated with a now-discredited research

study published in 1998 by British pediatrician Andrew Wakefield and his colleagues, which described eight children whose symptoms of autism emerged within a month of receiving the measles–mumps–rubella (MMR) vaccine. From these observations, Wakefield and his coauthors hypothesized that the MMR vaccine adversely affected neurodevelopment and in turn boosted the risk of autism.

Although Wakefield's observations have not withstood scientific scrutiny, it remains popular largely because it makes intuitive sense. Indeed, illusory correlation may be partially to blame. Because children typically receive the MMR vaccine between the ages of 1 and 2—around the same time the first symptoms of autism typically become apparent—an association between the two events seems plausible. Nevertheless, there is no compelling evidence for a link between autism and vaccinations. A comprehensive review by the Institute of Medicine in 2004 found no relation between vaccines and autism (see Plotkin, Gerber, & Offit, 2009, and Orenstein, Paulson, Brady, Cooper, & Seib, 2013, for more recent negative evidence). Moreover, there is no evidence that stronger doses of vaccines are associated with higher autism rates than are weaker doses (Hviid, Stellfeld, Wohlfahrt, & Melbye, 2003).

Illusory Correlation and Information Processing

Illusory correlation may also influence how we process emotionally laden stimuli. Tomarken, Mineka, and Cook (1989) were interested in the notion that human fears and phobias are associated with a bias in how we process information, one that confirms and promotes the maintenance of the fear. Inspired by the work of the Chapmans, Tomarken et al. examined whether fear induces cognitive biases in the judgment of covariation (association) between stimuli using an illusory correlation paradigm. In one experiment, they presented female undergraduates, selected for either high or low levels of snake or spider fears, with a set of slides containing fear-relevant (images of snakes or spiders, depending on the condition) and fear-neutral slides (images of mushrooms and flowers). The slides were paired with one of three outcomes: a tone, a shock, or nothing. At the end of the slide presentation, Tomarken et al. asked participants to rate the percentage of trials for which each category of slides was paired with each outcome (e.g., the percentage of trials for which they believed a snake image was paired with a shock). As in the Chapmans' studies, there was no correlation between any category of slide and any type of outcome.

Tomarken and colleagues (1989) found that high-fear subjects overestimated the association between fear-relevant stimuli and aversive outcomes (e.g., shock) despite the fact that the associations between all stimuli and outcomes were equal. Moreover, high-fear subjects' estimates of the relation between fear-relevant stimuli and negative outcomes (e.g., shock) were significantly greater than their estimates of the relation between fear-relevant slides and nonaversive outcomes (e.g., tone or nothing). Additionally, high-fear subjects' estimates of the relation between fear-relevant stimuli and shock were significantly higher than those of low-fear subjects. The findings of the Tomarken et al. study, which have since been replicated (see Mineka & Sutton, 1992, for a review), indicate that even though fear-related stimuli did not differentially predict the occurrence of negative outcomes, they were perceived as if they did. As a consequence, illusory correlation may maintain or even enhance fear.

Cognitive Mechanisms

Illusory correlation is a statistical mirage to which virtually all of us are prone. To understand why we are susceptible to this cognitive bias, we can think of many events in our everyday lives in terms of a table of four probabilities. Using what we term the Great Four-fold Table of Life, one can graphically display the relations between any two events and nonevents (Lilienfeld et al., 2013). Borrowing from the aforementioned lunar lunacy example, for instance, we can depict the four

possible probabilities between the full moon and crime:

The upper left-hand cell of the table (A) consists of cases in which both a full moon and a crime occurred. The upper right-hand cell (B) consists of cases in which a full moon, but no crime, occurred. The lower left-hand cell (C) consists of cases in which there is no full moon, but a crime occurred. Finally, the lower right-hand cell (D) consists of cases in which no full moon and no crime occurred. Research has shown that we generally overattend to the upper left-hand (A) cell (Gilovich, 1991), leading us to experience an illusory correlation. Because instances when both a full moon and a crime occur tend to be memorable and confirm our expectations, we attend to and recall them more often. This phenomenon is called the "fallacy of positive instances," which refers to the tendency for individuals to attend to events that fit their hypotheses ("hits") and ignore events that do not ("misses"). Fueling illusory correlation is the fact that our minds usually have a difficult time remembering nonevents, those instances when events *do not* occur. This uneven attention to the four cells of the table contributes to the formation of illusory correlations.

Our undue attention to the upper left-hand cell of the Great Four-fold Table of Life may stem from confirmation bias. Confirmation bias is the tendency of people to favor information that confirms their hypotheses and ignore or underweight evidence that disconfirms their hypotheses. By leading individuals to seek out evidence that supports their beliefs, confirmation bias probably contributes to the fallacy of positive instances and hence illusory correlation.

Returning to the issue of stereotype formation, one potential explanation for the emergence of prejudicial beliefs is the fallacy of positive instances: We may be more likely to remember an undesirable behavior when it is committed by members of a certain group of people than by others (Feldman, Camburn, & Gatti, 1986). Once we form an initial belief regarding a specific group of people, confirmation bias may predispose us to seek out supporting evidence. Furthermore, Hamilton (1976) showed that stereotyping of minority groups may result in overestimating the number of times that the associated behavior occurred. That is, minority group members may be falsely remembered to have committed more undesirable behaviors than is objectively warranted.

To correctly ascertain the relation between two events, four sources of evidence must be considered: the number of times both events occurred (cell A), the number of times each event occurred in the absence of the other (cells B and C), and the number of times each event did not occur (cell D). When an individual fails to consider all four possibilities, an illusory correlation may emerge. Research shows that individuals misperceive contingencies because they are using only a portion of the available information (Smedslund, 1963). Specifically, people tend to estimate the association between two events largely using information gathered from cell A, or the number of instances in which both events occurred (Arkes & Harkness, 1980; Nisbett & Ross, 1980). Information from all four cells of the table is critical

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		Did a crime occur?	
		Yes	No
Did a full moon occur?	Yes	(A) Full moon + crime	(B) Full moon + no crime
	No	(C) No full moon + crime	(D) No full moon + no crime

to ascertaining whether two events are statistically related; by neglecting to avail ourselves of information from Cells C and D, we are ignoring the base rates, or probabilities, of both events (Arkes & Harkness, 1983).

Traditionally, scientists have viewed illusory correlation as an error in cognition, but some researchers have argued that our ability to recognize patterns in nature is at times adaptive—even when such patterns are nonexistent (Fiedler, 2000). For example, superstitions are generally regarded as mistakes in cognition arising from incorrect cause-and-effect inferences (Wheen, 2004). Nevertheless, Shermer (2000) argued that superstitions are the adaptive outcomes of "patternicity," the tendency to detect meaningful patterns in meaningless noise (Tinbergen, 1963). Shermer noted that humans are faced with two types of errors when estimating statistical associations: type I errors (false positives) and type II errors (false negatives). As long as the cost of type II errors is sufficiently high, natural selection will favor strategies that result in type I errors because they tend to be less dangerous than type II errors ("better safe than sorry"). For example, all things being equal, it is more prudent to assume that a brown, cylindrical object thrashing about in the forest is a poisonous snake than a fallen tree branch being blown by the wind. Using evolutionary modeling, Foster and Kokko (2009) developed a framework to examine under what conditions natural selection would prefer type I errors over type II errors. Their model posits that natural selection favors strategies that lead to incorrect assumptions as long as the occasional correct assumption carries a large fitness benefit (i.e., an increased chance of transmitting the organism's genes to subsequent generations). Overall, they concluded that behaviors that are superstitious are virtually inevitable features of adaptive behavior.

Debiasing Techniques

Efforts to attenuate illusory correlation are in their infancy. Researchers have attempted to reduce certain cognitive biases, such as hindsight bias, by educating participants regarding a given bias and telling them not to be influenced by it when making decisions (Fischoff, 1977; Wood, 1978). This technique has been largely ineffective, probably because individuals often have little awareness of blind spots in their decision making. Nevertheless, we are unaware of similar psychoeducational research on illusory correlation. As an alternative, some researchers have attempted to reduce the existence and/or magnitude of illusory correlation by presenting participants with a brief tutorial on Bayesian statistics. The overestimation of the relation between two events often occurs because the base rates of the two events are underutilized (Kahneman & Tversky, 1973; Nisbett & Borgida, 1975). Arkes (1981) suggested that accuracy in estimation would improve if individuals attended more to the prior odds by pitting the prior odds and the likelihood ratio against each other. By doing so, an individual cannot ignore the base rates of the two events, which allows the individual to process information from all four cells of the table. Nevertheless, this technique has not yet been put to an experimental test. Relatedly, Matute, Yarritu, and Vadillo (2011) found that illusory correlations can be reduced if individuals understand the conditions in which they tend to err in misperceiving the relation between events. Nevertheless, further work to minimize the likelihood and extent of illusory correlation is clearly necessary.

In sum, illusory correlation is a phenomenon that gives rise to a host of erroneous beliefs in clinical psychology, including the validity of largely unsupported assessment techniques and spurious causes of psychopathology. One important area for further work will be to find means of debiasing individuals, including mental health professionals, to diminish their risk of this important cognitive error.

SEE ALSO: Errors/Biases in Clinical Decision Making; Meehl, Paul E. (1920–2003); Minnesota Multiphasic Personality Inventory (MMPI) Instruments; Psychometric Validity; Rorschach Inkblot Test

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