
COMMENT

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Hot Hand Belief and Hot Hand Behavior: A Comment on Koehler and Conley

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In our comment on Koehler and Conley's (2003) findings on the "hot hand" belief, we want to emphasize the different conclusions that can be drawn from their results by applying the concept of ecological rationality. The choice of environmental contexts and structures imposes constraints on possible interpretations of the results obtained. Differentiating between the cognitive and behavioral levels of the phenomenon seems analytically useful, particularly if practical recommendations to professionals are to be made. The implications of Koehler and Conley's data, new evidence, and the relationship between the perceived streaks of players and their base rates are discussed with the aim of developing empirically founded recommendations to professionals in sports, especially in real game situations.

Key Words: basketball, streaks, base rate, adaptiveness, ecological rationality

Koehler and Conley (2003) have provided new evidence in the ongoing study of the detection of dependency in performance streaks. Research on the "hot hand" belief, the belief that "an athlete's performance temporarily increases beyond his or her base rate following a string of successes" (p. 253), has prompted many studies whose findings are being generalized from the original sport studied, basketball (Gilovich, Vallone, & Tversky, 1985), to other sports such as baseball, volleyball, and horseshoe pitching. Furthermore, the results are being used to examine questions in other academic fields such as economics (Hendricks, Jayendu, & Zeckhauser, 1993) and cognitive science. Here we focus on two broad questions: Does success breed success and failure breed failure? What are the consequences of a behavior that is influenced by the mistakenly perceived dependence of future success on past streaks?

By comparing expected and actual runs, Koehler and Conley (2003) detected no unusual streaks of success and no sequential dependency in the shooting performance of 23 participants in the NBA long-distance shootout contests (1994–1997) except for two players, Anderson and Scott. The claim of sequential dependency as an interpretation of the belief has been studied extensively, and there seems to be agreement that consecutive successful shots (hits) are often not posi-

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tively associated. However, there is less agreement on the interpretation of the belief that performance would vary considerably and that base rates were not constant (nonstationarity claim). The runs test used by Koehler and Conley is a statistical method that, judged by effect sizes, is sensitive to sequential dependency but less sensitive in detecting nonstationarity (Wardrop, 1999). However, converging evidence seems to indicate nonstationarity as the potential better explanation of the hot-hand belief in sports (Hales, 1999; Raab, 2002). The situational context is an important factor that should be considered in any account of the hot-hand phenomenon. Koehler and Conley's choice of the special context for their study of the phenomenon, i.e., the NBA 3-point shootout, exposes the advantage of a less-rich environment in which sequence effects cannot be as easily masked as in real game situations.

However, the conclusions Koehler and Conley (2003) draw from the analyzed data are possible but not exclusive interpretations. In this comment we present an alternative perspective that looks less to the rationality of beliefs and more to the adaptiveness of behaviors and has empirical support in research projects not mentioned in Koehler and Conley's article. They conclude, "These data suggest that coaches, managers, and athletes should resist the temptation to predict future performance based on recent short-term runs of uncharacteristically strong performance. Instead, an athlete's base rate for success in similar competitive circumstances is probably a better indicator of future success" (p. 257).

The interesting point considered here is the implication for the transition of belief into behavior. One might mistakenly understand Koehler and Conley to mean that it is not beneficial to use the hot-hand belief in general. But, for the most part it is not the professionals in basketball who want to predict behavior, but the scientists who study them. The professionals' goal is to win games. Several studies (Burns, *in press*; Gilovich et al., 1985; Raab, 2002) suggest that professionals believe that a "hot" player should be given the ball more often, and this belief is even stronger for persons with higher expertise. Burns (*in press*) provides a possible explanation for the persistence of this belief among professionals. He proposes that the belief developed as a post hoc explanation by players of a behavior they had experienced as successful, and not as a one-to-one representation of relationships in environments.

Ecological Rationality of Hot Hand Behavior

Burns (*in press*), for example, argues that an irrational belief such as the hot hand phenomenon leads to adaptive decisions and behaviors if those decisions and behaviors attain goals. One such goal is to win games. This perspective takes account of the notion of ecological rationality, that the belief or cognitive processes are not bad or good per se, but their effects on behavior depend on the environment in which they are used. Accordingly, beliefs can be of a heuristic value and thus ecologically rational to the degree that they are adapted to the structure of environments in which they are employed (Raab & Gigerenzer, *in press*). Seen from this perspective, the behavior that is influenced by the hot-hand belief is not necessarily nonadaptive. Rather, if the behavior corresponds positively to the goals of the acting individuals, then it is ecologically valid and adaptive, regardless of whether it is based on a normatively false or irrational belief.

We want to emphasize that the question of whether the belief is false cannot

be answered without considering the criteria and environmental context by which evolved beliefs and behaviors should be judged. It must still be determined in which situations this correspondence between behavior and goals can be found. In pursuing these questions, distinguishing between the cognitive level of the phenomenon (the hot-hand belief) and the behavioral level (favoring a hot player; Burns, in press) is useful in enabling us to judge the value of the belief. Since Koehler and Conley focused only on one of the two cognitive level criteria, i.e., the dependency of hits and not nonstationarity, any conclusions drawn from their results about behavior lack empirical evidence, and theoretical clarifications on the nature of the hot-hand phenomenon are limited.

Assuming that players' base rates are valid cues for decisions in real game situations is plausible by definition. However, if we consider a player's ball allocation behavior in basketball, several situations can arise in which the base rate is not known, due to new players joining the team or frequent player changes in NBA or pick-up games. Further, even if base rates are known and are reasonable performance predictors, their processing may be impaired due to the cognitive load on and distributed attention of coaches or players. The usefulness will be also limited in games in which the difference between players' base rates is barely noticeable. In an earlier article, Koehler (1996) argued there is a degree to which base rates were used that depends mainly on the particular task structure and representation.

According to the common lack of perfect information, the relationship between base rates and streaks of hits perceived as unusual might be advantageous if the latter enhanced the use of the former, thereby increasing a team's or a player's performance. Generally it can be concluded that perceived hotness focuses attention on the base rate or its changes in contexts where on the behavioral level its use is not optimal. Burns (in press) presented evidence that in contexts where base rates are not known, they can be inferred from the streaks in a player's performance. Koehler and Conley's study of commentators' outbursts showed that elevated performance is correctly perceived. If one assumes there is variance in a player's performance, then a present predictor or a "true likelihood of success" (Burns, in press) is necessary and has to be inferred from a player's short-term runs of hits and misses.

Practical Recommendations

Research on the "hot hand" seems particularly fruitful to us when well-founded recommendations to coaches and players can enable decisions that raise their teams' chances of winning a game. In a simulation, Burns (in press) proved that a team's performance was higher if the hot-hand assumption influenced allocation in the game versus if only base rates were used. In other words, the probability of winning a game was higher if the ball was allocated to the "hot" player more often than according to players' base rates. Raab, Gula, and Gigerenzer (2003) show that for volleyball players this strategy will be used adaptively in environments wherein belief in the hot hand results in allocating the ball to players with high base rates, and nonadaptively in environments in which, because of performance streaks, the ball is passed to the player with less chance of success.

Still, the most important recommendation to coaches or players that can be drawn from the studies is that if they perceive a player as hot, and it is the player with the higher base rate, they will increase the team's chance of winning if they

pass the ball to the “hot” player more often than they would based only on his or her base rate. Thus we believe neither hot-hand-as-fallacy (or myth) nor hot-hand-as-adaptation are appropriate descriptions of the belief, but rather hot-hand-as-information, which, like many other cues (e.g., base rates, coaches’ instructions, strength and weakness of opponent’s defense, trained tactics), will enable players allocating the ball to win games or to lose them.

According to Koehler and Conley (2003), “Future research might focus more on implications of false belief in the hot hand rather than on pinpointing where hotness exists” (p. 257). These two directions of research are not mutually exclusive. Instead, the theoretical positions outlined above make another assumption plausible, which can be formulated as follows: Future research may wish to focus more on the implications of a normatively irrational belief for behavior by detecting environments in which behaviors influenced by the belief are adaptive, beneficial, and ecologically rational according to the goals that individuals want to attain, or where and when these behaviors are nonadaptive and costly. The identification of environmental features that enable this distinction is crucial to the derivation of useful recommendations to sports and other professionals. This is especially the case when performance streaks are used as information and the decision-maker is confronted with the uncertain choice between different behavioral alternatives, such as the decisions of coaches, scouts, managers, fans, and athletes regarding which player should go in or be taken out of a game, who should be put under contract, who might be a good bet in the next NBA long-distance shootout, or which player to pass the next ball to.

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