

Psychology and Aging

Beliefs About the “Hot Hand” in Basketball Across the Adult Life Span

Alan D. Castel, Aimee Drolet Rossi, and Shannon McGillivray

Online First Publication, January 30, 2012. doi: 10.1037/a0026991

CITATION

Castel, A. D., Drolet Rossi, A., & McGillivray, S. (2012, January 30). Beliefs About the “Hot Hand” in Basketball Across the Adult Life Span. *Psychology and Aging*. Advance online publication. doi: 10.1037/a0026991

BRIEF REPORT

Beliefs About the “Hot Hand” in Basketball Across the Adult Life Span

Alan D. Castel, Aimee Drolet Rossi, and Shannon McGillivray
University of California, Los Angeles

Many people believe in streaks. In basketball, belief in the “hot hand” occurs when people think a player is more likely to make a shot if they have made previous shots. However, research has shown that players’ successive shots are independent events. To determine how age would impact belief in the hot hand, we examined this effect across the adult life span. Older adults were more likely to believe in the hot hand, relative to younger and middle-aged adults, suggesting that older adults use heuristics and potentially adaptive processing based on highly accessible information to predict future events.

Keywords: aging, hot hand, judgment, decision making, heuristics

Many people believe in streaks, and they sometimes bet on them. In basketball, belief in the “hot hand” occurs when a person thinks a player is more likely to make a shot if that player has made the previous couple of shots. Anecdotally, many fans, and even coaches, profess belief in the hot hand. For example, Phil Jackson, one of the most successful coaches in the history of the National Basketball Association (NBA), once said of Kobe Bryant, in Game 5 of the 2010 NBA Finals: “He’s the kind of guy (where) you ride the hot hand, that’s for sure, we were waiting for him to do that He went out there and found a rhythm.”

Despite the prevalence of hot hand endorsements, Gilovich, Vallone, and Tversky (1985) analyzed basketball players’ successive shots and showed that they are independent events, and thus belief in the hot hand can be interpreted as fallacious and an example of decision bias. Alternatively, one could argue that a belief that events often occur in streaks is in fact adaptive under certain circumstances (e.g., Burns, 2004; Scheibehenne, Wilke, & Todd, 2011). One important question that has yet to be investigated is whether the belief in the hot hand is more or less prevalent in certain age groups, and more specifically, are older adults especially likely to believe in the hot hand?

There is evidence to suggest that older adults may show a similar belief in the hot hand relative to younger adults. Some

research has shown that older adults’ decision-making behavior is similar to that of young adults (Kovalchik, Camerer, Grether, Plott, & Allman, 2005). Although cognitive functioning declines with age, older adults have greater wisdom that can compensate for decreased functioning and improve their judgment (e.g., Tentori, Osherson, Hasher, & May, 2001; Worthy, Gorlick, Pacheco, Schnyer, & Maddox, 2011). Further, if given the opportunity to do so in various memory, judgment, and decision-making tasks, older adults can behave adaptively and adopt different strategies that compensate for changes in their cognitive functioning (Castel, 2008; Mata, Schooler, & Rieskamp, 2007; Mata, Wilke, & Czienskowski, 2009; McGillivray, Friedman, & Castel, 2011). For instance, although older adults often review less information and take longer to process information compared to young adults, they are capable of using more complex, less heuristic-based decision-making strategies when the environment requires their use (Mata et al., 2007; Pachur, Mata, & Schooler, 2009), when they are properly motivated to do so, or when there is sufficient time to carry out more analytical processing (Kim, Goldstein, Hasher, & Zacks, 2005; Peters, 2010).

The theoretical perspective that the use of heuristics is enhanced with age would predict greater endorsement of the hot hand in older adults. A number of studies (e.g., Mata et al., 2007; Peters, Hess, Västfjäll & Auman, 2007; Thornton & Dumke, 2005) have shown that use of heuristics versus more analytical processes increases with age and that increased reliance on heuristics has been linked to increased decision bias. Thus, a view that belief in the hot hand is a manifestation of decision bias implies that the belief will increase with age. However, under certain conditions, the increased use of heuristics with age can also be considered adaptive (e.g., Gigerenzer & Todd, 1999). According to this more adaptive view, life experience with streaks (i.e., experience with “clumpy” events or locations of resources in the environment, e.g., Scheibehenne et al., 2011; Wilke & Barrett, 2009) can lead to general expectations about the distribution of events even in those environments in which these statistics may not apply (e.g., a sequence of shots in basketball). Thus, it may be that life experi-

Alan D. Castel and Shannon McGillivray, Department of Psychology, University of California, Los Angeles; Aimee Drolet Rossi, Anderson School of Management, University of California, Los Angeles.

We thank Bruce Burns for providing the materials used in this study, as well as helpful comments during various stages of this work. We also thank Danny Oppenheimer, Keith Holyoak, Bob Bjork, and Craig Fox for useful insights regarding the interpretation of the findings, as well as two anonymous reviewers.

Correspondence concerning this article should be addressed to Alan D. Castel, Department of Psychology, University of California, Los Angeles, 1285 Franz Hall, Box 951563, Los Angeles, CA 90095. E-mail: castel@ucla.edu

ence can enhance certain access to information that is deemed relevant, even when the application of this knowledge may not always be accurate for a specific situation.

While age differences were not examined in the initial Gilovich et al. (1985) study, they found the hot hand effect even among people who had a high degree of interest in and experience with basketball (dedicated fans and collegiate and NBA players), implying that life experience or expertise may actually enhance belief in the hot hand. In addition, if the belief in the hot hand is a product of life experience, namely that things in the world often occur in streaks, then older adults may more likely to endorse such beliefs because they experienced more of these events (having simply lived longer than younger adults). Thus, both views—the enhanced use of heuristics and biases with age and the adaptive use of heuristics with age—predict increased endorsement on hot hand beliefs in older adults, relative to younger adults. However, they do so for different reasons. Specifically, the heuristics and biases view suggests that to the extent that hot hand belief is a cognitive shortcut (heuristic) and depends on cognitive resources, its use could increase with age, whereas the adaptive view suggests that to the extent that the hot hand belief is a product of experience with clumpy environments, its use could increase with age. In addition, the earlier-mentioned comment from Phil Jackson (made at age 65), who is one of the most successful coaches in NBA history with 11 championships, suggests that some experienced older adults do in fact endorse the hot hand and that this may be adaptive under critical circumstances such as choosing who should shoot the ball in a high-stakes basketball game.

To examine belief in the hot hand across the life span, we tested a large sample of people ($N = 455$) who varied in age and degree of interest in basketball. Participants were first told: In college and professional basketball games no player makes 100% of their attempted shots at the basket. Overall, around about half the time their shots miss when they attempt to score by shooting the ball at the basket. They were then asked two critical questions: (1) Does a basketball player have a better chance of making a shot after having just made the last two or three shots than after having missed the last two or three shots? and (2) Is it important to pass the ball to someone who has just made several shots in a row? We were particularly interested in whether older adults relative to younger adults would be more, less, or equally likely to believe in the hot hand phenomenon (based on the previously outlined hypotheses), as this might illustrate how lifetime experience contributes to the use of heuristics in the context of judgment and decision making. In addition, insight regarding how older adults view streak-like behavior casts important light on what cognitive processes are utilized or impaired in old age and how aging may also lead to adaptive functioning.

Method

The sample ($N = 455$) ranged in age from 22 to 90 years old ($M_{\text{age}} = 46.96$, $SD = 18.03$), was 51.75% women, and reported ethnicity was as follows: 73.03% Caucasian, 23.68% Asian, 2.19% Latino, and 0.88% African American. The participants were recruited from the Midwest and West Coast and consisted of university students and local library patrons. All older participants reported having at least graduated from high school. With few exceptions, the older adult participants completed their surveys at

noon or earlier in the day. We excluded any participant who reported having any major illness or medical condition that might affect intellectual functioning.

Participants completed a short questionnaire in which they first read, “In college and professional basketball games no player makes 100% of their attempted shots at the basket. Overall, around about half the time their shots miss when they attempt to score by shooting the ball at the basket.” This section was present so as to clearly establish that most players only make about half of their attempted shots in games, based on normative data. Participants were asked “Does a college/professional basketball player have a better chance of making a shot after having just made his or her last two or three shots than he or she does after having missed his or her last two or three shots?” Participants were also asked, “In college/professional basketball, is it important to pass the ball to someone who has just made several (two, three, or four) shots in a row?” Participants then rated their level of interest in basketball on a 6-point scale, with 1 = *low interest*, 6 = *high interest* (for a similar procedure, see Burns, 2004).

Results

The main results are presented in Figure 1, in terms of the proportion of people responding “yes” to the first question, the chance of making the next shot (or chance), and the second, pass the ball to this person (or pass), as a function of age. In general, older adults were more likely to believe in the hot hand, relative to younger adults. To examine the effects of age, we included gender and ethnicity as covariates and tested both a linear and quadratic (curvilinear; age-squared) function. For the chance question, there was a significant effect of age ($\chi^2_{\text{linear}} = 11.56$, $p < .0007$, and $\chi^2_{\text{quadratic}} = 12.70$, $p < .0004$). For the pass question, there was also a significant effect of age ($\chi^2_{\text{linear}} = 7.98$, $p < .0047$, and $\chi^2_{\text{quadratic}} = 9.03$, $p < .0027$). The correlation between the chance and pass judgments was .41 ($p < .0001$).

We asked participants to report their interest in basketball ($M = 2.81$, $SD = 1.58$). There was a significant negative correlation between age and interest ($r = -.26$, $p < .0001$). However, after controlling for gender and ethnicity, there was no significant effect of age on interest ($t = -1.41$, $p = .158$). When interest was included as a covariate in the previous analyses, the effect of age on the chance question was significant ($\chi^2 = 13.17$, $p < .0003$), and there was a significant effect of interest ($\chi^2 = 8.08$, $p = .0045$). Similarly, the effect of age on the pass question was significant ($\chi^2 = 10.69$, $p < .0011$), and there was a significant effect of interest ($\chi^2 = 24.70$, $p < .0001$).

General Discussion

Older adults were more likely than younger adults to endorse the hot hand and believe that a player with a hot hand should shoot the ball. In fact, adults age 70 and over were almost twice as likely to believe in the hot hand as adults age 40–49. These results are consistent with the observation that older adults tend to rely on heuristic-based processing, as opposed to more analytical or deliberative operations (e.g., Peters et al., 2007). Older adults may also have more exposure and experience with “streak-like” phenomena, and the availability of these events in memory (e.g.,

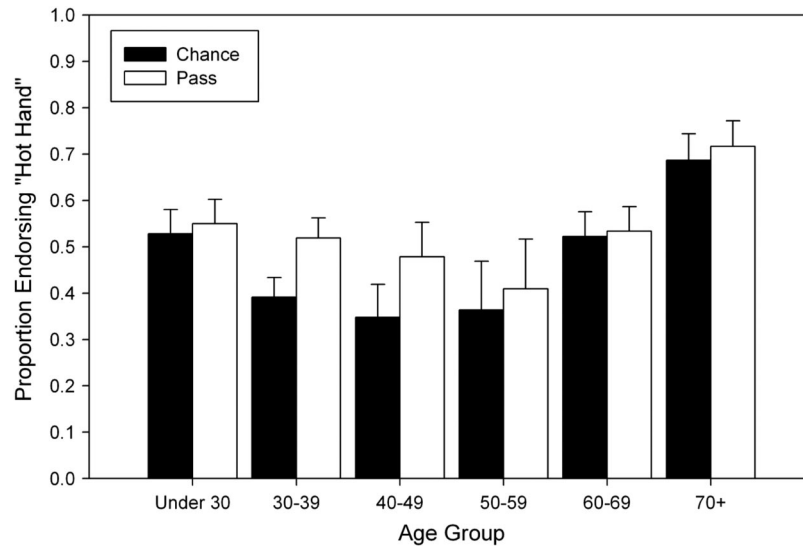


Figure 1. The mean proportion of participants who responded *yes* to the chance and pass questions, as a function of age. Error bars represent standard errors of the means.

Tversky & Kahneman, 1974) may then lead to a greater belief in the hot hand.

Older adults are also more likely to remember positive information (Mather & Carstensen, 2005) and are more sensitive to gains and less sensitive to losses than younger adults (Samanez-Larkin et al., 2007). In the present task, memory for streaks may be considered positive when framed in the context of successful performance, potentially guiding older adults' subsequent judgments. Consistent with this notion, Gilovich et al. (1985) suggested that belief in the hot hand may result from memory biases, in that streaks are more memorable. The results from the present study suggest this may be exist, especially in the case of older adults, who may rely on availability regarding memory for past streaks and may use this information in an adaptive manner, given lack of any other information to make judgments regarding future events. In addition, older adults may be more likely to interpret that a player who has made several shots has a better chance of scoring, based on recent performance, and assuming all other things being equal, it is thus advantageous to pass the ball to this potentially high-performing player.

Older adults typically show impairments in many complex laboratory-based reasoning tasks (Salthouse, 2011), as well as complex decision-making tasks that involve time limits and numerical comparisons (Peters, 2010). However, there are various instances where older adults display effective judgment, reasoning, and decision making (McGillivray, Friedman, & Castel, 2011; Salthouse, 2011; Worthy et al., 2011). The present findings suggest a complex relationship between age-related impairments in reasoning, decision making, and the use of statistical learning and laws of independence. Older adults in the present sample, as well as the highly experienced fans and players tested by Gilovich et al. (1985), strongly believe in the hot hand, which may represent the greater reliance on experience-based heuristics, coupled with less emphasis placed on why events may or may not be independent.

Interestingly, recent research suggests that belief in the hot hand (and specifically, endorsing the question about passing the ball to

a player who has made several shots in a row) may be adaptive (e.g., Gigerenzer & Todd, 1999; Scheibehenne et al., 2011), as it could essentially lead to more scoring, if streaks are predictive of a player's shooting percentage (see also Burns, 2004). The adaptiveness of this belief may stem from experience, such that older adults have lived longer and experienced or witnessed more streak-like behavior and thus use this knowledge to guide judgments about potentially unpredictable events in the future. The observation that, in addition to Phil Jackson, many older adults in the present sample recommend passing the ball to someone who is on a hot streak supports this view.

In the present study, we assessed belief regarding the hot hand using a questionnaire that explicitly stated that about half the time college and professional players' shots miss when they attempt to score by shooting the ball at the basket during a game and then presented information about some streak regarding shooting. It may be the case that older adults adopt the view that if someone has made several shots in the past, he or she is in fact a good shooter, and in the absence of any additional information, this inference guides judgments regarding this specific player's ability to score. This could lead to both adaptive choices based on the availability of recent information, as well as also possibly biasing specific judgments relative to arbitrary base rate information. However, future research is needed to examine this issue in terms of how aging may influence the use base rate information and also relief from base-rate neglect.

We qualify our results in that they were obtained using a cross-sectional design and cannot directly speak to how beliefs in the hot hand necessarily *change* with age, at the individual level. However, the present results do indicate strong age-related *differences* between age groups and include data from people across the life span, as opposed to simply extreme age groups. This comprehensive representation of age-groups also allows for the important examination of both linear and curvilinear relationships between age and beliefs about the hot hand. The pattern of results hints that middle-age adults may be slightly less likely to endorse beliefs in

the hot hand, relative to young and older adults (see Figure 1). A quadratic function fits the data slightly better than does a linear function, consistent with other work on decision making and cognitive function across the life span (see Agarwal, Driscoll, Gabaix, & Laibson, 2009; Castel et al., 2011). It is important to note that neither of the earlier-mentioned theoretical perspectives—the enhanced use of heuristics with age, nor the adaptive view regarding endorsing the hot hand, would necessarily predict an inverted U-shaped function, and this pattern suggests that middle-aged adults may rely on more analytical processing without strong biases based on life experience. Interestingly, however, it was the middle-age group that showed some marked differences between the belief in the hot hand and the option of passing the ball to someone who has made several shots in a row. The cognitive processes that lead to age-related differences in the belief about the hot hand may range from the use of statistical knowledge regarding independence of events to the reliance on more general heuristics that are more accessible for older adults. There may also be strong contextual aspects regarding belief in the hot hand, such that older adults may *not* be more likely than younger adults to believe that a coin flip that results in three heads in a row will then be more likely to yield a heads on the fourth flip, but in the context of basketball, older adults rely on more general heuristics that may, or may not, be adaptive depending on the situation.

It would also be important to examine further how expertise (and not simply interest) may interact with age and influence beliefs in the hot hand and if these beliefs generalize to other domains or are influenced by the length of the streak in question (e.g., Carlson & Shu, 2008) or the past record of the player. It would also be of interest to see if people change their position based on having to provide justification for their responses (e.g., Kim et al., 2005) or when having to actually bet on the presence of absence of a streak, which may prove important in terms of learning more about the underlying mechanisms that give rise to beliefs in the hot hand, as well as for more practical reasons such as when making decisions that involve evaluating the independence of events. Thus, future research is needed to determine if the effects obtained in the present study are directly the result of age and the use of adaptive processing as opposed to thinking that involves base rates about basketball statistics (e.g., Hall, Ariss, & Todorov, 2007), given that prior research has shown that cognitive ability is not related to the use of base rate information (e.g., Stanovich & West, 2008). It may be that older adults simply believe that streaks are often present in nature and that this also applies to basketball. In general, research on how statistical reasoning varies across the life span would be very valuable, for example, to practitioners in fields such as medicine and marketing. At the individual level, age-related differences in the belief that the presence of a certain illness or the need to pay a specific bill may have a high probability of recurring may prove to be adaptive under situations in which events are not independent or random in nature and require the analyses of recent occurrences.

In summary, the present study examined belief in the hot hand in a large sample of adults, to determine whether older adults are more likely to endorse the hot hand relative to younger adults. Overall, there was a strong effect of age, suggesting that older adults rely on heuristics that could arise from life experience and that there could be an adaptive aspect to expecting events to occur in streaks, although future research is needed to determine the

precise mechanisms that lead to greater endorsement of the hot hand in older adults.

References

- Agarwal, S., Driscoll, J. C., Gabaix, X., & Laibson, D. (2009). The age of reason: Financial decisions over the life-cycle and implications for regulation. *Brookings Papers on Economic Activity, Fall*, 51–117. doi: 10.1353/eca.0.0067
- Burns, B. D. (2004). Heuristics as beliefs and as behaviors: The adaptiveness of the “hot hand.” *Cognitive Psychology*, 48, 295–331. doi:10.1016/j.cogpsych.2003.07.003
- Carlson, K. A., & Shu, S. B. (2007). The rule of three: How the third event signals the emergence of a streak. *Organizational Behavior and Human Decision Processes*, 104, 113–121. doi:10.1016/j.obhdp.2007.03.004
- Castel, A. D. (2008). The adaptive and strategic use of memory by older adults: Evaluative processing and value-directed remembering. In A. S. Benjamin & B. H. Ross (Eds.), *The psychology of learning and motivation* (Vol. 48, pp. 225–270). London, UK: Academic Press.
- Castel, A. D., Humphreys, K. L., Lee, S. S., Galván, A., Balota, D. A., & McCabe, D. P. (2011). The development of memory efficiency and value-directed remembering across the lifespan: A cross-sectional study of memory and selectivity. *Developmental Psychology*, 47, 1553–1564.
- Gigerenzer, G., & Todd, P. M. (1999). Fast and frugal heuristics: The adaptive tool box. In G. Gigerenzer, P. Todd, & the ABC Research Group (Eds.), *Simple heuristics that make us smart* (pp. 3–34). New York, NY: Oxford University Press.
- Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology*, 17, 295–314. doi:10.1016/0010-0285(85)90010-6
- Hall, C. C., Ariss, L., & Todorov, A. (2007). The illusion of knowledge: When more information reduces accuracy and increases confidence. *Organizational Behavior and Human Decision Processes*, 103, 277–290. doi:10.1016/j.obhdp.2007.01.003
- Kim, S., Goldstein, D., Hasher, L., & Zacks, R. T. (2005). Framing effects in younger and older adults. *Journal of Gerontology: Psychological Sciences*, 60B, P215–P218. doi:10.1093/geronb/60.4.P215
- Kovalchik, S., Camerer, C. F., Grether, D. M., Plott, C. R., & Allman, J. M. (2005). Aging and decision making: A comparison between neurologically healthy elderly and young individuals. *Journal of Economic Behavior & Organization*, 58, 79–94. doi:10.1016/j.jebo.2003.12.001
- Mata, R., Schooler, L. J., & Rieskamp, J. (2007). The aging decision maker: Cognitive aging and the adaptive selection of decision strategies. *Psychology and Aging*, 22, 796–810. doi:10.1037/0882-7974.22.4.796
- Mata, R., Wilke, A., & Czienskowski, U. (2009). Cognitive aging and adaptive foraging behavior. *Journal of Gerontology: Psychological Sciences*, 64B, 474–481. doi:10.1093/geronb/gbp035
- Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences*, 9, 496–502.
- McGillivray, S., Friedman, M. C., & Castel, A. D. (in press). Impact of aging on thinking. In K. Holyoak & R. Morrison (Eds.), *The Oxford handbook of thinking and reasoning*. New York, NY: Oxford University Press.
- Pachur, T., Mata, R., & Schooler, L. J. (2009). Cognitive aging and the adaptive use of recognition in decision making. *Psychology and Aging*, 24, 901–915. doi:10.1037/a0017211
- Peters, E. (2010). Aging-related changes in decision making. In A. Drolet, N. Schwarz, & C. Yoon (Eds.), *The aging consumer: Perspectives from psychology and economics* (pp. 75–101). New York, NY: Psychology Press.
- Peters, E., Hess, T. M., Västfjäll, D., & Auman, C. (2007). Adult age differences in dual information processes: Implications for the role of affective and deliberative processes in older adults’ decision making.

- Perspectives on Psychological Science*, 2, 1–23. doi:10.1111/j.1745-6916.2007.00025.x
- Salthouse, T. A. (2011). Consequences of age-related cognitive declines. *Annual Review of Psychology*, 63, 5.1–5.26.
- Samanez-Larkin, G. R., Gibbs, S. E., Khanna, K., Nielsen, L., Carstensen, L. L., & Knutson, B. (2007). Anticipation of monetary gain but not loss in healthy older adults. *Nature Neuroscience*, 10, 787–791. doi:10.1038/nn1894
- Scheibehenne, B., Wilke, A., & Todd, P. M. (2011). Expectations of clumpy resources influence predictions of sequential events. *Evolution and Human Behavior*, 32, 326–333. doi:10.1016/j.evolhumbehav.2010.11.003
- Stanovich, K. E., & West, R. F. (2008). On the relative independence of thinking biases and cognitive ability. *Journal of Personality and Social Psychology*, 94, 672–695. doi:10.1037/0022-3514.94.4.672
- Tentori, K., Osherson, D., Hasher, L., & May, C. (2001). Wisdom and aging: Irrational preferences in college students but not older adults. *Cognition*, 81, B87–B96. doi:10.1016/S0010-0277(01)00137-8
- Thornton, W. J. L., & Dumke, H. A. (2005). Age differences in everyday problem-solving and decision-making effectiveness: A meta-analytic review. *Psychology and Aging*, 20, 85–99. doi:10.1037/0882-7974.20.1.85
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124–1131. doi:10.1126/science.185.4157.1124
- Wilke, A., & Barrett, H. C. (2009). The hot hand phenomenon as a cognitive adaptation to clumped resources. *Evolution and Human Behavior*, 30, 161–169. doi:10.1016/j.evolhumbehav.2008.11.004
- Worthy, D. A., Gorlick, M. A., Pacheco, J. L., Schnyer, D. M., & Maddox, W. T. (2011). With age comes wisdom: Decision making in younger and older adults. *Psychological Science*, 22, 1375–1380. doi:10.1177/0956797611420301

Received August 5, 2011

Revision received December 5, 2011

Accepted December 6, 2011 ■