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SMARTER FOOTBALL

Game Theory Says Pete Carroll's Call at Goal Line Is Defensible

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It's the biggest moment in your N.F.L. coaching career: 26 seconds remain in the Super Bowl, your team is 4 points behind, you have the ball just one yard short of the end zone, it's second down, and your team has arguably the N.F.L.'s best running back. What's your call? Run or pass?

Here's what I would do: Call a game theorist, someone who specializes in the branch of economics that analyzes strategic interactions. Game theory is

the tool used to understand how global superpowers respond to each other, how large companies compete with each other and how grandmasters play chess. It also describes the strategic tussle between Bill Belichick, the coach of the New England Patriots, and Pete Carroll, the coach of the Seattle Seahawks, who each found themselves facing difficult decisions in the final seconds of Sunday's Super Bowl.

The key insight of game theory for an N.F.L. coach is that when you think about what choice you should make, you need to also consider the response from the opposing coach, understanding that he is also thinking strategically. This line of thinking suggests that you should not necessarily call a run play, even if you're blessed with a great running back. Likewise, it's not clear that you should definitely pass. Rather, your choice should be somewhat random — a choice that game theorists call a "mixed strategy."

The logic is that if you always choose to run in this situation, then you make the opposing coach's job too easy, as he will set a defensive formation aimed at stopping your running back. Forget guarding the receivers, Belichick would respond by piling players between Marshawn Lynch and the end zone. As great as Lynch is, even he would find it difficult to run over a stacked defense that was waiting for him. Likewise, if the Seahawks would always decide to pass in this situation, there would be little need for the Patriots to guard against the run, and so their defense could double-team the eligible receivers.

Instead, you need to keep your opponents guessing, and the only way to do this is to be unpredictable. The only way to be unpredictable is to be a little bit random.

To see why, realize that Carroll and Belichick were essentially playing the football equivalent of Rock-Paper-Scissors. If Carroll will definitely play scissors, Belichick will respond with rock. The only way to make Belichick's job hard is for Carroll to make it impossible for him to guess what he will play next. And the only way to do that is for his strategy to appear random. After the game, Carroll suggested as much: "We went to three receivers, they sent in their goal-line people. We had plenty of downs and timeouts. We really didn't

want to run against their goal-line group right there."

The analogy between Rock-Paper-Scissors and football is close, but not perfect. In Rock-Paper-Scissors each weapon is both as destructive and as vulnerable as the other — they each beat one opponent, and are beaten by another — and this symmetry means that the best strategy is to play each alternative with the same probability. In the football context, your running back may be a better weapon than your quarterback, and so an optimal strategy does not dictate that you use them both with the same probability. Rather, you choose the probabilities in an optimal mixed strategy so that the payoff from a running play will be the same as that from a pass. This means that even with a great running back, an optimal strategy sometimes involves passing. Otherwise, your star running back, always facing a run defense, may end up less effective than a less great passer.

Whenever I have taught economics students the idea of playing a mixed strategy, they respond incredulously, because it defies common sense to make the biggest decision of your football coaching life randomly. It may defy common sense, but it makes good strategic sense.

Perhaps you are like my students, and your advice is that maybe Carroll should follow a mixed strategy most of the time, but not in the dying seconds of the Super Bowl. But realize that if this were an optimal choice, Belichick would probably figure it out, and he would instruct his players to guard against the run. When most of the defenders focus only on stopping one running back, they usually succeed.

Or perhaps you believe that Lynch's statistics show that he is so successful at bulldozing through opponents that he would succeed even against a defense set up only to stop the run. I disagree. A key reason that Lynch has been so successful is that his coach has been playing a mixed strategy all season. Lynch has accumulated impressive numbers in part because opposing defenses have had to be concerned about Russell Wilson's passing. And so Lynch's history of success when playing as part of a mixed strategy says nothing about how successful he would be if his opponents knew for sure his coach would call a running play.

Game theory points to the possibility that Carroll's decisive call was actually the result of following the best possible strategy, and that this is a strategy that involves an element of randomness in play-calling. This leads to the intriguing possibility that if that fateful final play were to be run in a dozen parallel universes, with each coach continuing to play the same mixed strategy, the actual plays called would differ, as would their outcomes.

And so the same teams pursuing the same strategies under the same circumstances might have yielded a different Super Bowl champion.

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