Reciprocity On The Hardwood: 
Passing Patterns Among NBA Players

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Abstract

The conventional view of passing in basketball is that patterns of ball distribution are determined by assigned player roles, set plays, and situational opportunity. We sought to investigate whether patterns of reciprocity might also help explain who passes to whom in professional basketball games. Using data from logs of every NBA game of the 2008-9 season, we estimated a series of conditional logistic regression models to study the impact of different factors on the probability that a given player would assist another player in scoring a basket. Our analysis yielded evidence for a direct reciprocity effect in which players who had "received" assists in the past tended to subsequently repay the favor. Further, this tendency was time-dependent, with the probability of repayment highest right after receiving an assist and declining as game time passed. We found no evidence for either generalized reciprocity - a tendency to "pay forward" assists - or indirect reciprocity - a tendency to reward players who had sent others many assists. Findings support the larger view that general behavioral principles observed broadly across social settings can be useful for explaining behavior in sports.

1 Introduction

Reciprocity refers to various patterns by which individuals exchange favors, support, goods, or other valued resources. Past research has identified various forms of reciprocity, including direct (1), indirect (2), and generalized (3). Social scientists have theorized that these forms of reciprocity create patterns of social interaction and provide fundamental building blocks for social institutions (4,
Reciprocity dynamics recur commonly and have been observed in settings as diverse as business negotiations, the production of open-source software, marital partner exchange in indigenous societies, and spontaneous truces among soldiers at war. Among nonhuman animals, reciprocity dynamics have been observed in various species, for example direct reciprocity in stickleback fish, indirect reciprocity among male song sparrows, and generalized reciprocity in rats. Perhaps in part because reciprocity is observed across diverse species, evolutionary theorists have advanced models of how direct, indirect, and generalized reciprocity could each have emerged as a result of evolutionary processes.

Here we advance the study of social exchange in human populations, investigating whether these previously identified forms of reciprocity are present in a unique setting: professional basketball games. Specifically, we investigate whether patterns of passing in basketball games obey the same patterns of reciprocity found with other resource sharing. One might reasonably wonder whether reciprocity plays any role in this domain, as passing in professional basketball games is heavily structured as a result of carefully planned strategy and an explicit division of labor on the court prescribing who passes to whom. Nonetheless, given the fundamental nature of reciprocity, it is possible that these dynamics provide structures to passing behavior, producing hidden patterns that would not be immediately observable without systematic analysis. Below we present each form of reciprocity, identifying the form of resource exchange it describes, and highlighting the social psychological mechanisms thought to drive it.

Direct reciprocity involves an actor A repaying to B benefits received from him/her in the past. This pattern of reciprocal resource sharing is depicted in Figure 1a. A variety of social psychological mechanisms have been invoked for explaining direct reciprocity. Social norms may lead individuals to engage in direct reciprocity because they wish to behave in appropriate ways, fear reputation loss, or wish to avoid social sanctions. The expectation of future interaction with another individual may also stimulate direct reciprocity as a way to build and sustain a mutually beneficial, productive relationship. Finally, the emotional experience of gratitude, felt upon receipt of a favor or gift, can also compel individuals to reciprocate good turns.

Indirect reciprocity occurs when a benefactor, is rewarded by third parties for behaving generously towards someone, i.e., when B is repaid for giving to A by some third party, C. This pattern is depicted in Figure 1b. The prospect of indirect reciprocity encourages individuals to behave in generous ways in their social relations, as their prosocial behavior may come to be known and rewarded by other group members. Researchers have argued that generous acts lead individuals to be seen as sincerely motivated to benefit others, a motivation that is widely respected by others, leading other group members to preferentially accord status and allocate resources to their more generous counterparts.

Generalized reciprocity involves A repaying benefits received from B to some third party, C. This pattern is portrayed in Figure 1c. In popular vernacular, generalized reciprocity is often referred to as “paying it forward,” a pattern of resource sharing in which generosity is essentially contagious, with individuals who receive generosity being more likely to behave generously in future interactions. Theorists have argued that the psychology underlying generalized reciprocity may overlap with that underlying direct reciprocity. Individuals who benefit from an individual’s generosity experience gratitude, and that emotion motivates them to subsequently behave more generously towards third parties.

**Empirical Overview**

Passing in basketball can be viewed as a form of resource sharing and thus might reasonably be subject to the same causal forces shaping exchange in other settings. Thus, in the present study we
investigate whether these three fundamental forms of reciprocity identified by past research help explain patterns of passing in professional basketball games. Unfortunately, total passing data is unavailable for NBA basketball games, and so we focus solely on assists for which we know, 1) who has “given” and who has “received” the assist, and 2) the exact game time of the event. These data allow us to test the following hypotheses:

Direct reciprocity hypothesis: When a player, A, has received an assist from another player, B, in the past he will be more likely to subsequently give an assist to B.

Indirect reciprocity hypothesis: When a player, B, has given to another player, A, he will be more likely to subsequently receive an assist from a third player, C.

Generalized reciprocity hypothesis: When a player, A, has received an assist from another player, B, he will be more likely to subsequently give an assist to a third player, C.

2 Data and Methods

In order to test our hypotheses, we analyzed data on all assists that occurred in the 2008-09 NBA season. We constructed a dataset in which each assist was represented by a set of four player dyads. The dyads included the player who gave the assist, paired with each of the four other players on the floor at the time. A dyad was coded as “1” if an assist occurred between the two players and “0” otherwise. In what follows, we refer to the player giving the assist as “player A” and the potential recipients as “player B.”

We analyzed the data using conditional logistic regression models. Conditional logistic regression models are appropriate for predicting the choice among a set of alternatives as a function of different attributes of the choice set (20). In this case, we were interested in predicting which player on the floor would be the recipient of a given assist and analyzing whether the choice of a particular player was influenced by reciprocity considerations.

Formally, the model is specified as:

$$\Pr(y_i = m|z_i) = \frac{\exp(z_{im}g)}{\sum_{j=1}^{J} \exp(z_{ij}g)}$$

Coefficients estimated from this model refer to the effect of a unit change in the independent variable on the log odds that player A will choose a particular player B, rather than other potential recipients, C, as the recipient of an assist.

Independent Variables

Test of Direct Reciprocity

The key independent variable in this analysis was a binary variable coded “1” if player A had received an assist from player B and had yet to repay that assist, and coded “0” otherwise. We experimented with different versions of this variable (e.g., a count of the number of assists owed) but ultimately decided to use the binary variable because our data was distributed such that most dyads had either 0 or 1 assist owed. Because the desire to reciprocate attenuates over time (21), we also interacted the main reciprocity variable with the (logged) number of minutes that player A and player B have been on the floor together since player B last gave A an assist. In cases where player B has never assisted player A, we counted the number of minutes that the two have been on the floor.
together until the current point in the game. We predicted a negative interaction between our indicator of a reciprocation opportunity and this time variable, consistent with the idea that the desire to repay a favor tends to be strongest shortly after receiving something and weakens over time.

Test of Indirect Reciprocity

Indirect reciprocity corresponds to the desire to help someone who has exhibited helping behavior toward others in the past. In this context, if a focal player were motivated in part by indirect reciprocity, he would be more likely to assist a player who had frequently assisted others, even if that player had not assisted the focal player. Accordingly, we measured drivers of indirect reciprocity with a count of how many assists player B had given to others, not including A. We also interacted this with the (logged) number of minutes player A and player B had been on the floor together since player B last assisted a player other than A. If player B had never assisted anyone or had never assisted anyone other than player A, we included the total amount of time A and B had been on the floor together.

Test of Generalized Reciprocity

Generalized reciprocity represents the idea that a person may be motivated to give to others if he or she has received in the past, even if he does not give back directly to those who have given to him. To test for generalized reciprocity, we counted how many assists A had received from everyone on the floor, excluding B. Similar to our time-based interaction terms for direct and indirect reciprocity, we included a variable to measure the time that A and B had been on the court together since A last received an assist from anyone besides B.

Control Variables

We controlled for a variety of factors that might cause a player to be chosen as the recipient of an assist more frequently than others. In order to capture the fact that a player’s position is a major driver of the role he plays on the team with respect to assisting behavior, we included indicators for B’s position (dummies for center, power forward, small forward and point guard). We also controlled for player B’s field goal percentage (shots made per attempt), assists per game, shots attempted per game, and points per game for the 2008-9 season. We also included the average number of minutes played per game (logged) by player B. To capture the idea that players who are perceived as having a hot hand might tend to receive more assists, we also controlled for both the number of shots player B had attempted and made in the current game, both measured per minute played. We also controlled for the number of minutes player A and player B have been on the court together in the current game.

We controlled for player A’s position, average minutes played per game (logged), and average assists per game for the 2008-9 season. Because player A’s characteristics do not vary within a possession, it is necessary to include the previous variables by interacting them with the number of minutes A and B have overlapped on the court so far in the current game. Finally, we accounted for possible differences in teams’ strategies with respect to assists by including team indicator variables, again interacted with the number of minutes A and B have overlapped on the floor until the current point in the game. Table 1 presents descriptive statistics for the variables used in the analysis.

3 Results

Table 2 presents the estimated coefficients from conditional logistic regression models predicting the likelihood of a particular player getting an assist. Model 2a includes control variables. Most control variables operate as expected. Not surprisingly, a player is much more likely to be
selected as the recipient of an assist if his field goal percentage is high ($b=1.547$, $p<.001$). Moreover, the more shots a player has attempted, on average, the more likely he is to receive an assist ($b=0.051$, $p<.001$).

In model 2b, we tested for direct reciprocity by including the indicator of whether player A owes an assist to player B. This variable is not significant. However, the results of model 2c provide evidence of a direct reciprocity effect once we account for the fact that the desire to reciprocate is likely to vary over time. Model 2c includes the interaction of owing an assist and the time since B last assisted A. Conditional on giving an assist to anyone, a player is 15% ($=\exp (0.138)-1$) more likely to choose a player to whom he owes an assist. However, the negative interaction term indicates that this effect diminishes over time, consistent with theory.

Models 2d and 2e test for indirect reciprocity. In model 2d, we added a variable that captures the total number of assists player B has given to others besides A. Model 2e includes the interaction of this variable with the (logged) number of minutes since player B last assisted someone beside B. Neither variables had a significant effect on player A’s choice of whom to assist.

Models 2f and 2g test for generalized reciprocity by including the number of assists player A has received from anyone besides player B. We interacted this variable with the time player A and B have been on the court together since A last received an assist from someone other than B. Neither of these was significant.

4 Conclusion

Overall, the results of our analyses suggest that reciprocity is responsible for some passing behavior among NBA players, albeit in a limited fashion. We found strong evidence of direct reciprocity as a factor in the choice of whom a player chose to assist. Individuals were more likely to assist another player who had assisted them in the past. Further, this effect was strongest soon after the original assist. The effect of having received an assist on the likelihood of reciprocation was greatest immediately after an assist was received and diminished as time passed from the receipt of the benefit, consistent with reciprocity dynamics in other settings.

Indirect and generalized reciprocity, on the other hand, did not seem to influence assist behavior. The lack of evidence for indirect reciprocity is perhaps not surprising. Assisting others may be seen as an expected behavior, especially among those players responsible for setting up the team’s offense, guards who are responsible for the greatest number of assists. Given these expectations, giving assist may not be seen as a strong indicator that one is generous and deserves to be rewarded by third parties. Still, given the robustness of past research on indirect reciprocity, the prospect that more generous basketball players are subsequently rewarded by their teammates – even those they did not directly benefit – deserves further attention. The lack of evidence for generalized reciprocity may be a product of the subtlety of this effect. While past research has documented tendencies for people to “pay forward” favors received, these effects are likely much smaller than corresponding direct reciprocity effects. However, our finding that direct reciprocity motivates assist behavior suggests social factors emerge even in a setting where individual performance is highly salient and rewarded, player roles are clearly defined, and within-game strategy and coaching prescribes much passing behavior.

5 Acknowledgements

The authors wish to thank Wayne Winston and Mark Madsen for their input, and Jeremy Oldfather for his assistance with the manuscript.
6 References

7  Figures

Figure 1

A. Direct Reciprocity

Time 1

B

A

Time 2

A

B
B. Indirect reciprocity

Two agents interact over time:

- At Time 1, B and A interact.
- At Time 2, A and C interact.
- At the next Time 2, C and B interact.
C. Generalized Reciprocity

Figure 3

Time 1: B → A
Time 2: A → C
7 Tables

Table 1
Summary Statistics for Variables Used in Analysis of Assist Behavior

<table>
<thead>
<tr>
<th>Player B Characteristics</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
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<td>Minutes on Court in Current Game with Player A</td>
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<td>7.82</td>
<td>0.02</td>
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<td>4.29</td>
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</table>

Direct Reciprocity Drivers

| Player A Owes an Assist to B                                  | 0.12   | 0.32      | 0.00  | 1.00  |
| Log Minutes On Court Together Since B Last Assisted A         | 1.75   | 1.07      | -4.09 | 3.76  |

Indirect Reciprocity Drivers

| Number of Assists from B to Players Besides A                  | 0.99   | 1.48      | 0     | 18.00 |
| Log Minutes On Court Together Since B Last Assisted A         | 1.34   | 1.08      | -4.09 | 3.75  |
| Gave an Assist From Anyone Besides A                           |        |          | -4.09 | 3.75  |

Generalized Reciprocity Drivers

| Number of Assists A Has Received From Anyone Besides B         | 1.00   | 1.31      | 0     | 13.00 |
| Log Minutes on Court Together Since A Last Assisted B          | 1.33   | 1.07      | -4.09 | 3.70  |
| Received an Assist from Anyone Besides B                       |        |          | -4.09 | 3.70  |

N=170,756 Player A-Player B Dyads

*Characteristics of Player A are not reported because these are entered into the model as interaction terms with the number of minutes A and B have been on the court together.
Table 2
Estimated Coefficients from Conditional Logistic Regression Models Predicting the Recipient of An Assist

<table>
<thead>
<tr>
<th></th>
<th>Model 2a</th>
<th>Model 2b</th>
<th>Model 2c</th>
<th>Model 2d</th>
<th>Model 2e</th>
<th>Model 2f</th>
<th>Model 2h</th>
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<tr>
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<td>(3) Number of Assists from B to Players Besides A</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
B Last Assisted A

(3) X (4)  
(0.009)  
-0.005  
(0.004)

(5) Number of Assists A Has Received
From Anyone Besides B

(0.012)  
-0.014  
(0.004)

(6) Log Minutes on Court Together Since
A Last Received an Assist from Anyone
Besides B

(0.012)  
0.039**

(5) X (6)  
(0.004)

Wald Chi-Squared

1,742**
1,742**
1,770**
1,742**
1,748**
1,744**
1,762**

N=170,756 Player A-Player B Dyads  
* p<.05  ** p<.01 (two-sided tests)  
Robust Standard Errors Clustered on Assists  
*All models include controls for team and Player A factors, as described in Data & Methods section.  
Results are not reported for brevity.