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ARTICLES

THE ROLE OF THE DICE IN BOARD GAMES HISTORY

Alex de Voogt, Nathan Epstein & Rachel Sherman-Presser

Abstract: *When looking at variations in games, the board and the playing pieces provide evidence, but so do the number of dice that are part of play. It is shown that the number of dice being used not only affects the game but that the definition of the values for each throw have significant and game-altering implications. All variations under scrutiny in this study do not appear as radically different games physically or perceptually. It illustrates a situation in which significant changes in strategy and playing length due to changes in randomizing instruments did not necessitate changes in the overall board or the number of playing pieces. In other words, players in history may have experimented with randomizing devices and may have used varying sets of them without any visible repercussion on the remainder of the board game implements.*

In the history of board games it is shown that games may have varying board sizes and number of playing pieces while at the same time different games may be played on the same board, even using the same playing implements (Finkel, 2004, p. 54) Schädler (1998). Such variation that is found with board games complicates our understanding of their development in history. The attestation of a game board is not sufficient to rule out a set of different games being played on that same board, while variations of board design do not necessarily point at different playing communities (Finkel, 2004, p. 54). In order to understand the historical development of board games it is necessary to document what set of rules, boards and playing instruments were present at a particular point in time. Changes in observable variations can then be traced over time and across geographical regions to map the historical development and distribution of board games de Voogt, A.J., A.-E. Dunn-Vaturi & J.W. Eerkens (2013), (Murray, 1952, p. 133). This is an ongoing effort in archaeology but even descriptions of contemporary board games allow us to understand what variations are common within a players' community.

In the following study, we analyze a set of games, which have minor variations in board size and number of playing pieces as well as known variations

of randomizing implements, in this case cowries and cubic dice. The role of randomizing devices in the history and distribution of board games is not yet informed by a better understanding on how such implements affect a game. For this we looked at both the implications for strategy and playing time, the latter expressed as the average number of moves necessary to complete (part of) a game.

While the results of this study do not seem to facilitate conclusions when different types and numbers of dice are attested, they do confirm that players are not bound by these implements and that dice variation should be considered common rather than an unusual phenomenon that requires historical explanation.

Game selection

We have used five games: (American) Parcheesi, (British) Ludo and three versions of (Indian) Pachisi and used the descriptions provided by Parlett (1999). All five games fall under the class of race-games, “in which teams of equal size race one another along a given track, and the first player to complete the course with his team wins” (Murray, 1952, p. 4). Each variation has a different set of randomizing implements. The size of the board is slightly different for the American, British and Indian variation. The three Indian games have the same board and number of playing pieces. It was not our intention to be complete and other board sizes and randomizers may be prevalent but not part of our analysis.

Dice probability distributions

The expected value and variance of spaces moved per turn are derived as follows: Given a rolling schedule (if the term schedule is ambiguous, we refer to the example on (Parlett, 1999, p. 44)), let R be the set of rolls which allow for another turn. Additionally, for any roll, let $p(i)$ be the probability of rolling a value i , and $m(i)$ be the number of moves associated with a roll of value i . Then, the expected number of moves in a given turn is given by

$$\begin{aligned} E(M) &= \sum_{i \in R^c} p(i)m(i) + \sum_{j \in R} p(j) (m(j) + E(M)) \\ &= \frac{\sum_{k \in R \cup R^c} p(k)m(k)}{1 - \sum_{j \in R} p(j)} \end{aligned}$$

We note that

$$E(M^2) = \sum_{i \in R^c} p(i)m(i)^2 + \sum_{j \in R} p(j)(m(j) + E(M))^2$$

and that the variance of M is given by $E(M^2) - E(M)^2$.

It should be noted that the restriction on repeat doubles is neglected in this analysis to ensure computational tractability. Because such scenarios are highly uncommon, the effect on qualitative results is not of great significance.

Pachisi

For 5, 6 and 7 cowries the expected movement per turn is ca. 3.5, 4.28 and 12.06, and with variance 22.11, 25.84 and 215.57, respectively.

Three different movement schedules ultimately suggest game play that differs widely according to the number of cowrie shells used (Finkel, 2004, p. 53). While the probability distribution of different movement lengths does not change drastically between five and six cowries, the distribution for seven cowries has a higher expected value and — more significantly — a substantially higher variance.

How does this distribution affect game play? The higher variance of the seven cowrie distribution implies that there is higher risk in each turn. Alternatively stated, the outcome of each individual turn is less predictable. This makes short term tactical considerations of each individual turn more complex and characteristically different (in the higher variance case, players can expect comparatively more extreme turns — very high or very low total number of spaces — than turns closer to the average movement).

The size of the board (80 spaces to traverse from beginning to end) affects the longer term predictability of movements. If we assume that a turn is dedicated to moving a single piece, then the expected number of turns required to move a piece from beginning to end would be (approximately) 22.86, 18.69, or 6.63 for 5, 6, or 7 cowrie shells respectively. Because the variance of spaces each turn is higher, it is to be expected that the variance of the cycle completion time is higher with 7 cowries. We thus conclude that the number of moves to complete a cycle is less predictable in the case of seven cowries (though typically faster than with five or six cowries).

Parcheesi

Parcheesi is played with two cubic dice but has a board with fewer spaces than the one mentioned above. The expected movement per turn is 8.4 spaces and the board is 68 spaces. If we assume that a turn is dedicated to moving a single piece, we may conclude that, on average, it will take 8.1 turns to advance a piece from start to finish. This would make Parcheesi quicker than the 5 and 6 cowrie shell versions of Pachisi, but slower than the 7 cowrie version.

For a single dice throw, the roll roughly obeys a discrete distribution that roughly approximates the normal distribution. This greatly influences short term tactical decisions. For a particular throw, a player may appropriately make tactical considerations assuming that the throw is likely to be near the mean (7) and not near the extreme values (2 and 12).

Ludo

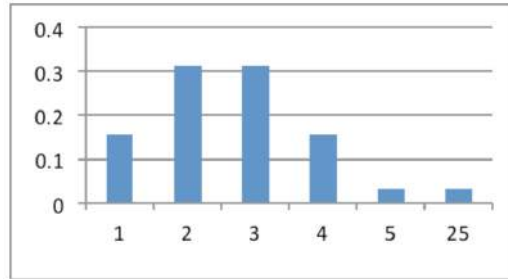
Ludo has a smaller board than Parcheesi and only uses one cubic die. The expected movement per turn in Ludo is 4.2 spaces. The expected movement per throw is 3.5 spaces. Given a board length of 51 spaces, the expected number of turns required to complete a cycle for a piece is 12.14 turns. Thus, the game will generally move more slowly than Parcheesi or the 7-cowrie Pachisi but faster than the 5-cowrie and 6-cowrie Pachisi.

The use of a single die impacts tactical considerations greatly. Unlike with multiple dice, the distribution of a single throw is not an approximation of a normal distribution. A single die has a discretized uniform distribution; it is not appropriate to make tactical decisions on the basis that values closer to the mean are more likely, i.e., all values, one through six, are equally likely.

The following graphs plot the probability distribution function for a single throw for a particular dice system. The horizontal axis gives the number of spaces moved and the vertical axis gives the probability of that outcome.

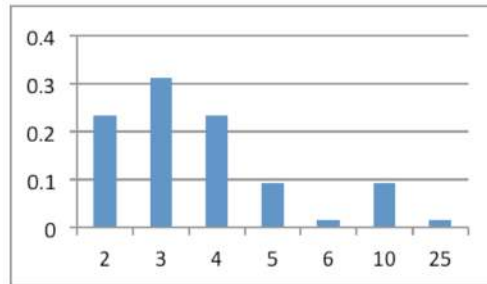
1. 5-Cowries: Pachisi

The throw description was taken from Parlett (1999). A set of five cowries gives six possibilities and in Pachisi they are given the value one through five with a special throw that gives 25.



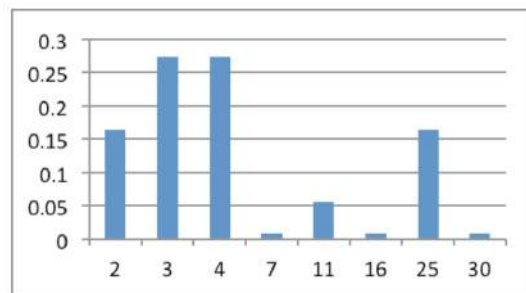
2. 6-Cowries: Pachisi

Six cowries provide seven possibilities that have the values two through six with two special throws that make 10 and 25.



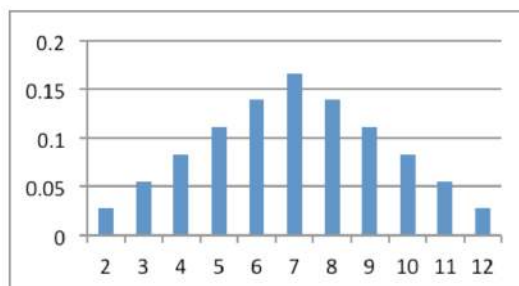
3. 7-Cowries: Pachisi

Seven cowries have eight possibilities and in the rules of Pachisi described by Parlett, the values range from 2 to 30.



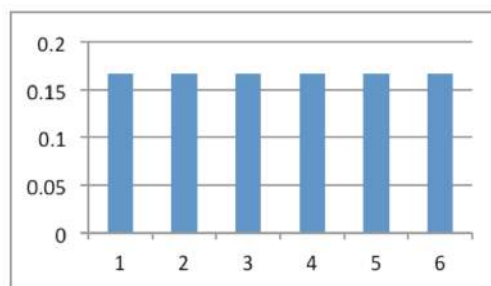
4. 2-Cubic Dice: Parcheesi

American Parcheesi is played with two cubic dice with the numbers one through six on each die. It makes 7 the most likely throw and both 2 and 12 the least likely throws during a game.



5. 1-Cubic Die: Ludo

The originally British game of Ludo has only one die. The probability of each throw is identical and does not assist in strategizing during the game.



Conclusion

Each of the variations had different randomizing implements. The differences between the variations are not obvious. A change from one to two cubic dice has many implications but a change from two to three cubic dice would be much less significant in terms of strategic possibilities, for instance. This also proved to be the case with the number of cowries used in Indian Pachisi. The value that is awarded to each throw is particularly influential and causes the significant difference between 5 and 6 cowries on the one hand and 7 cowries on the other.

It is concluded that variation of randomizing implements is significant for strategy and game length but has not had a visible influence on the game board and/or gaming pieces. In other words, this variation may exist independently and thus adds another layer to our understanding of board game variation over time.

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Board Games Studies was first published in 1998, an initiative inspired by the colloquia on board games held at Leiden University, the Netherlands, in 1995 and 1997. Five institutions affiliated themselves with the journal: the Institut für Spielforschung und Spielpädagogik in Salzburg, the International Institute for Asian Studies in Leiden, the Russian Chess Museum in Moscow, the British Museum in London, and the Department of Computer Science at the University of Maastricht. The journal, which was published by CNWS Publications in Leiden on a yearly basis, was partially funded through the assistance of patrons and boasted a modern layout, trilingual summaries and color plates. The broad ambition of this journal required a continuous commitment from the editors, who reviewed contributions in German, French and English, provided translations of summaries for each article and, in several cases, collaborated extensively with authors to develop manuscripts that were to the academic standards of the publication. The journal had a trial run of three years, after which the format, content and review process was evaluated. The authors of the articles integrated wide-ranging literature necessary for a comprehensive understanding of particular games. Contributions from different disciplines — including psychology, computer science, philology, classical archaeology and history — allowed for a better historical and systematic understanding of board games to emerge. Starting in 2000, a section with a translation of primary sources was added. Book reviews and research notes further complemented the multi-faceted contents. Its first ambition, to serve as a platform for the publication of board games research, was met quickly, while gradually the journal gained prominence among researchers by publishing seminal historical overviews. The colloquia continued from 1995 onwards, moving from a biennial to a yearly schedule. The host institution was expanded beyond Leiden to universities and museums throughout Europe as well as Jerusalem, Philadelphia and, in 2013, the Azores. The colloquia continue to gather an enthusiastic group of scholars, players and collectors. Despite the institutional affiliations and a group of patrons, the production of the journal became financially and logistically problematic with CNWS no longer able to serve as a publisher. Reluctantly, the paper version of the journal was discontinued after volume 7 was published in 2004. The possibility of an online version of the journal had been explored with the online publication of the first issues, a decision that greatly assisted the dissemination of knowledge accumulated in those early volumes. The next step, an online journal that operates again as a platform for recent board games research, was not far away but required the skills and enthusiasm of previous and new editors to materialize. In these last fifteen years, the study of board games has gained momentum and this journal will not only showcase new results but, most of all, will encourage and publicize the work of the dedicated researchers in this field.

Alex de Voogt



To the authors

Board Game Studies is an academic journal for historical and systematic research on board games. Its object is to provide a forum for board games research from all academic disciplines in order to further our understanding of the development and distribution of board games within an interdisciplinary academic context. Articles are accepted in English, French, and German and will be refereed by at least two editors under the final responsibility of the Editorial Board. Please send your contributions in any editable format (Word, L^AT_EX, rtf, ...) with a matching PDF file. Please send all the illustrations in separate files.

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