Keep the Innovation Rolling

A Modern Board Game Review of Dice Usages and their Mechanisms

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INTRODUCTION: TOWARD A CULTURE OF DICE GAMES

Dice games are as old as human civilization itself.[1] Looking back at the history of games, we see that older dice appear in many shapes and forms—some of them do not resemble in any way those of today. These proto dice can result from carving bones while mixing seashells and sticks deliver similar experiences. Other dice derivatives appear as artificial and geometric-shaped objects.[2] Despite their different shapes, these objects (as game components) are a type of technology players can engage with, activating the game mechanics to generate a random outcome. The results are manifold but most often establish a controlled random effect (in the case of a D6 die, it varies from 1 to 6). Usually, this corresponds with an additional time effect: Results do not appear instantly; it takes some seconds at least, ensuring that players engage in a state of suspenseful anticipation. This phenomenon might seem magical, a distortion of time and space to those who watch dice rolling. The way how players lose track of time and focus on moving dice hints at a clear relationship to the concept of the magic circle developed by Huizinga.[3]

1 Dales, George F.: "Of Dice and Men," in: *Journal of the American Oriental Society* 88/1 (1968), pp. 14-23.

2 Schwartz, David G.: *Roll the Bones: The History of Gambling*, New York, NY: Gotham Books 2006.

3 Huizinga, Johan. *Homo Ludens*, New York, NY: Routledge 2014.

Dice continue to fascinate humans also in other ways: "Rolling dice" expressions are used as a metaphor in popular culture, even as old as references like those attributed by Plutarch to Julius Caesar—"*The die has been cast*"—invoke powerful statements, showing that dice are not only something to interact with to generate a random outcome but that they also transport a feeling of fate. We find them almost anywhere in today's popular culture. The tabletop role-playing game DUNGEONS AND DRAGONS (D&D, 1974), for example, appears in TV shows like THE BIG BANG THEORY, COMMUNITY, and STRANGER THINGS which thus provide new dissemination channels for classic dice games, making them famous, and contributing to the relative triumph of geek culture. The effect of digital technology and the post-digital movement[4] is also important. These reactions result from the overwhelming and ever-present digital technologies in our lives and the rediscovered value of handmade things and objects.[5] Some players want to disconnect from digital and connect to material and social experiences, where they feel more in control.

This feeling of control may be attributed to narrative games like D&D, in which dice can be used in different formats to decide conflict and other game state changes. But the internationalization of Eurogames and the impact of a game like CATAN (1995) also shows that rolling D6 dice can generate strategic gameplay without being overcomplex. It became one of our days' most popular board games, played by casual players, families, and even hobby gamers. CATAN championships attract many participants, and newspapers like *The Guardian* have sections for board games,[6] while other media state that playing these new board games is a trend in top tech and finance elite communities.[7]

These observations raise many questions, one of which is: Are dice being used the same way as in historical and older games? After all, many modern tabletop games are challenging and transforming dice usage. No longer do dice need to be rolled for a tabletop game to function, as many alternatives to classic roll and move

4 Cramer, Florian: "What Is 'Post-Digital'?" in: Berry, David/Dieter, Michael (eds.): *Postdigital Aesthetics*, London: Palgrave Macmillan, pp. 12-26.

5 Sax, David: *The Revenge of Analog: Real Things and Why They Matter*, New York, NY: Public Affairs 2016.

6 http://www.theguardian.com/lifeandstyle/board-games

7 Tam, Ui-Wing: "An Old-School Board Game Goes Viral Among Silicon Valley's Techie Crowd," *The Wall Street Journal*, 2009, https://www.wsj.com/articles/SB126092289275692825; Ellwood, Mark: "Wall Street's Latest Secretive Trend? Board Game Nights," *Bloomberg*, 2018, https://www.bloomberg.com/news/articles/2018-04-26/wall-street-s-latest-trend-in-networking-board-game-nights

mechanisms that have been developed in the last decades show. If mass-market games like MONOPOLY (1935) are still popular and being played today, the renaissance of modern board games might change some paradigms.[8] In a time of dominance of video games, dice games invoke traditional social associations that combine game design innovations. This interplay of playful materialities, mechanisms, and metaphors results in new ways of engaging players. Without player involvement, physical games would simply not work—machines can roll dice, but humans desire to roll them for playable experiences. To address these complex relationships, we need to approach dice materiality, game design traits, human motivations, the history, and the social effects of contemporary dice usages in modern board games to understand them. Identifying this change in the paradigm of dice usage helps to understand the evolution of tabletop games in the last decades and what drives players to play analog games with dice. In this chapter, we intend to find out what has changed.

This contribution addresses how dice are used in modern tabletop games, exploring ongoing innovations. It aims to cover the way dice relate to game mechanisms and innovative gameplay while keeping the materiality of handling dice. We propose a method to find different dice games and classify their aesthetics and the way they are combined with innovative game mechanisms. As we will see, making subtle changes may change player experiences, like allowing players to reroll and pick which dice to use. Other changes have a more radical effect, like changing the composition, assemblage, materials, and the ability to craft dice during gameplay. To achieve these objectives, we propose a framework to classify dice usage in contemporary tabletop and board games, considering the material, mechanical, and metaphors for dice usage. Our framework proposal results from analyzing available data from the hobbyist gaming community that deals with modern board games, where game design innovations are expected to occur.

Designing dice innovation is a permanently ongoing process. New games are constantly trying to use dice in innovative ways. Some depart from the traditional mechanisms of rolling to get controlled random outcomes. Other games go beyond this, using dice for many different mechanical and narrative purposes, profiting from the fascination of handling chunky, colorful, and customized dice. Effectively, we argue that dice usage in games will never be obsolete. Introducing dice components can be something that drives players to play a tabletop game, while the associated game mechanisms make the defining, crucial

8 Donovan, Tristan: *It's All a Game: The History of Board Games from Monopoly to Settlers of Catan*, New York, NY: Thomas Dunne Books 2017.

difference in the playing experience. This assumption meets the efforts of game designers who are continuously exploring dice potentials to deliver engaging new experiences, mixing the traditional rolling with new game mechanisms that change gameplay. Arguably, mechanisms' innovation might be what kept dice popularity in hobby games.

THE MATERIAL FASCINATION OF DICE

While for a holistic dice analysis, a mere focus on materiality would surely not be sufficient, looking at the physical dice dimensions can be an effective first step to explaining the dice's appeal in modern board games. The aesthetic, sensual experience of the players is a key factor here. Understanding how players deal, interact, and use dice can provide answers to the questions of why we enjoy handling dice—whether it is the sense of touch, the dynamic of rolling, the sound, or the uncertainty of the result that changes game states. Or, to look at the question from the other end: Would just rolling dice without meaningful and innovative mechanisms be enough to engage players?

Although game components may not determine game effectiveness, their quality helps enhance the experience of playing a tabletop game.[9] These effects are so important that some gamers invest considerable amounts of money tweaking their games with additional detailed components. Similarly, board games with a higher quality component can collect hundreds of thousands of dollars on KICKSTARTER.[10] Extreme cases like FROSTHAVEN (2022) surpass the twelve million dollars of funding from backers. The material aspect, the sense of touch, and the aesthetics play an important role. Together with additional aspects like the gameplay experience, the mechanisms, and narratives, this may explain the overall appeal.

Dice are simple from a material perspective—at least our contemporary standard dice, usually D6 dice, that are present in traditional, historic, mass-market, and even casino games. They are also part of pop culture: The iconography of dice is everywhere, evoking associations of 'randomness,' 'gambling,' or simply games. One paradigmatic example of these associated meanings can be found in western board games from the 19th-century. Most of these Victorian games were about

9 Rogerson, Melissa J./Gibbs, Martin/Smith, Wally: "'I Love All the Bits': The Materiality of Boardgames," in: *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 2016, pp. 3956-3969.

10 Werning, Stefan. "Conceptualizing Game Distribution: Kickstarter and the Board Game 'Renaissance,'" in: *La Valle Dell'Eden* 31 (2018), pp. 65-82.

teaching morality. The creators of these games avoided using dice because they represented gambling, considered a severe vice at that time.[11] But these 19th-century games, not so different from the historical GAME OF THE GOOSE (16th century), used other randomization systems like spinners, like those seen in Milton Bradley's GAME OF LIFE versions.[12] These examples show that employing dice in the design of games could be avoided—at least in theory—but their effects continued to fascinate and fuel game dynamics.

Standard dice are designed to be rolled, and this motion is a way to determine a result. It is a physical process that depends on the materiality of the dice and the rolling surface. It is supposed to be a mechanical activity, a dynamic. Players feel a sense of control until the releasing moment; the fate in their hands, slipping through their fingers. The touch and the mechanical effect reinforce this metaphor. Dice roll during a variable time. When dice are rolling, players enter a trance-like state of anticipation, where time seems to stop because players do not know precisely when dice will halt and reveal the outcome. In this sense, dice can be understood as a door into the magic circle.[13] This uncertainty fascinates us humans, and it is a specific trait of games.[14]

But can rolling enormous quantities of dice also become tedious, transforming a game into a chore? It can be excessive when players spend more time rolling dice than using them to affect the game state and generate meaningful play. During WARHAMMER 40K (1987) battles, players might need to use dozens of dice simultaneously, but this process helps build the conflict experience and keep track of the narrative and tension.[15] Xu et al.[16] found that these chores can be fun and that introducing digital tools to remove dice can negatively impact the gameplay experience. When approaching hybrid games, using digital technology to reduce the

11 Crump, Justine: *The Perils of Play: Eighteenth-Century Ideas about Gambling*, Cambridge: Centre for History and Economics 2004.

12 T. Donovan: *It's All a Game;* Wardle, Heather: *Games Without Frontiers? Socio-Historical Perspectives at the Gaming/Gambling Intersection*, Cham: Palgrave Macmillan 2021.

13 J. Huizinga: *Homo Ludens*.

14 Costikyan, Greg: *Uncertainty in Games*, Cambridge, MA: The MIT Press 2013.

15 Carter, Marcus/Harrop, Mitchell/Gibbs, Martin: "The Roll of the Dice in Warhammer 40,000," in: *ToDigra* 1/3, 2014, http://todigra.org/index.php/todigra/article/view/20

16 Xu, Yan et al.: "Chores Are Fun: Understanding Social Play in Board Games for Digital Tabletop Game Design," *DiGRA*, 2011, http://www.digra.org/digital-library/publications/chores-are-fun-understanding-social-play-in-board-games-for-digital-tabletop-game-design/

complexity, bookkeeping, and introducing a virtual game master can be positive, but replacing dice roll is not.[17] Hobby gamers tend to dislike using digital apps and tools in their games,[18] regardless of the success of some tabletop games like MANSION OF MADNESS, 2ND ED (2016). In this case, the App did not remove the dice from the game.

Another possible reason for the success of dice is the sense of permanence. Unlike digital games, analog games have a physical, enduring manifestation in the real world, opposing a fear of obsolescence.[19] Dice will always be there and do not require updates or another type of energy beyond human hands. And even if players lose some dice, replacements are easy to make.

From the findings collected above, a quite simple fact emerges: Players like the handling and rolling the experiences dice provide. People are drawn to roll dice when they interact with them.

However, dice demand a multilevel analysis, seeing them from multiple lenses, from game design to cultural studies. In what follows, we will analyze dice, focusing on the game material and how they relate to game mechanisms. First, we will propose a method to find modern board games and then explore their previously stated dimensions.

FINDING INFORMATION ABOUT DICE GAMES

It might be surprising, but compared to other analog games like card games, literature about dice games is scarce.[20] The existing literature about dice, however, can be misleading: While the history of dice games in academic and scientific

17 Oliveira, Ana Patrícia et al.: "Towards a New Hybrid Game Model: Designing Tangible Experiences," in: *IEEE 8th International Conference on Serious Games and Applications for Health* (SeGAH), 2020.

18 Ibid.; Kosa, Mehmet/Spronck, Pieter: "What Tabletop Players Think about Augmented Tabletop Games: A Content Analysis," in: *Proceedings of the 13th International Conference on the Foundations of Digital Games*, 2018, pp. 1-8.

19 Rogerson, Melissa J./Sparrow, Lucy A./Gibbs, Martin R.: "More Than a Gimmick—Digital Tools for Boardgame Play," *Proceedings of the ACM on Human-Computer Interaction* 5 (2021), pp. 1-23.

20 D. Schwartz: *Roll the Bones*; G. Dales: "Of Dice and Men;" Parlett, David: *The Oxford History of Board Games*, Oxford: Oxford UP 1999.

databases may diverge to mathematics,[21] research about game material and mechanical uses are even more difficult to find. Reiner Knizia's DICE GAMES PROPERLY EXPLAINED[22] is one of the most relevant books about historic dice games. But surprisingly, the book is mainly descriptive. Knizia, being one of the most prolific and successful contemporary game designers,[23] writes little about designing dice games in the book. It also does not approach recent dice games, particularly leaving out how materiality and new mechanisms are implemented.

Looking for such information about analog games leads almost necessarily to the BOARD GAME GEEK (BGG) website:[24] BGG gathers information about the hobby tabletop movement, collecting available information about analog games and the emergent associated culture since 2000.[25] BGG supported several academic and scientific publications as an information source and case studies to understand games and support new analog game-based projects.[26] BGG is a crowdsourcing online interactive database based on a Bayesian review system to control the evaluation bias. Games that have a low number of votes from users will not achieve higher classifications. Besides the overall evaluation, players can vote to define the game characteristics like player count, the duration, recommended age, and game complexity (1 to 5).

21 Voogt, Alex de/Epstein, Nathan/Sherman-Presser, Rachel: "The Role of the Dice in Board Games History," in: *Board Game Studies Journal* 9 (2015), pp. 1-7; Bennett, Deborah J.: *Randomness*, Cambridge: Harvard University Press 2009.

22 Knizia, Reiner: *Dice Games Properly Explained*, London: Blue Terrier Press 2010.

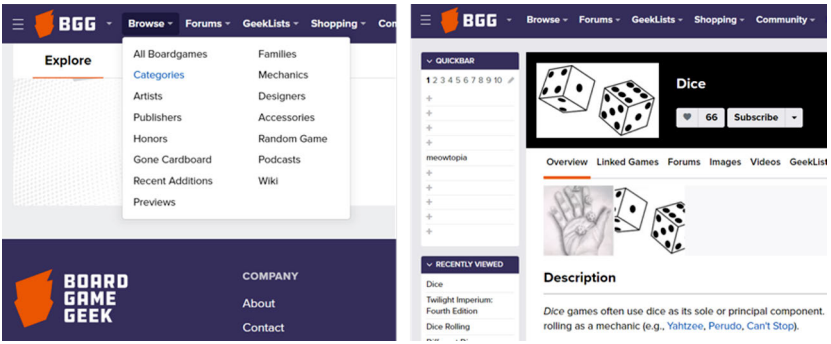
23 Knizia, Reiner: "Knizia Games," 2022, https://www.knizia.de/

24 www.boardgamegeek.com

25 Konieczny, Piotr: "Golden Age of Tabletop Gaming: Creation of the Social Capital and Rise of Third Spaces for Tabletop Gaming in the 21ˢ Century," in: *Polish Sociological Review*, No. 2 (2019), pp. 199-215; Woods, Steward: *Eurogames: The Design, Culture and Play of Modern European Board Games*, Jefferson, NC: McFarland 2012.

26 Sousa, Micael: "Defining the Mechanisms for Engagement Design Protocol Towards the Development of Analogue and Hybrid Serious Games: Learning from FlavourGame," in *Joint International Conference on Serious Games*, 2021, pp. 31-46; Kritz, Joshua/Mangeli, Eduardo/Xexéo, Geraldo: "Building an Ontology of Boardgame Mechanics Based on the BoardGame Geek Database and the MDA Framework," in: *XVI Brazilian Symposium on Computer Games and Digital Entertainment*, 2017, pp. 182-91; Mesentier Silva, Fernando de et al.: "AI as Evaluator: Search Driven Playtesting of Modern Board Games," in: *AAAI Workshops,* 2017.

Figure 1: Browsing BGG to find Categories and Game Mechanisms



Source: Screenshot by Micael Sousa

On the BGG website, it is possible to browse and search for specific keywords. Surprisingly, BGG only defines three direct dice type mechanisms: Dice Rolling (DR), Die Icon Resolution (DI), and Different Dice Movement (DDM). However, the database is by no way a perfect tool for collecting an exhaustive amount of information about dice games. While the homepage does classify games by families, there is not a clearly defined family for games with dice components. Instead, dice appear as a category (Dice Category), which might be confusing. This gap and misleading information hamper the search for games with dice and how dice are used alternatively, beyond roll and move mechanisms of most mass-market games.[27] Nevertheless, a closer look at BGG makes one aspect of modern popular board games stand out clearly: dice rolling and moving is the most common game mechanism at BGG.[28]

FINDING INNOVATIVE DICE USAGES IN GAMES

Experimenting with BGG as a knowledge database allows for further methodological approaches: One way to find information is to search for the highest-ranked games at BGG and analyze each game entry, finding if each game uses dice or not

27 Sousa, Micael/Bernardo Edgar: "Back in the Game: Modern Board Games," in: Zagalo, Nelson (eds.), *Videogame Sciences and Arts*, Cham: Springer 2019, pp. 72-85.

28 Samarasinghe, Dilini et al.: "A Data Driven Review of Board Game Design and Interactions of Their Mechanics," *IEEE Access*, 2021, pp. 114051-114069.

and how the game mechanisms are implemented. Adopting this selection method reveals games that are well known and enjoyed by many players. We can say that top-ranked BGG games are engaging because they are those that hobbyist players play or recognize the most, despite these ranks being prone to marketing effects.

The games related to the dice game category were considered first, followed by the games related to three types of dice mechanisms (see below). After obtaining these four lists (BGG top 10 ranked games in each list), it was necessary to cross the obtained data in a spreadsheet. Other complementary information was gathered by informal social interviewing. Discussing with expert hobby players allowed us to identify other paradigmatic dice games to analyze. The treated data show the publication year of each game and how the dice are used, defining a typology proposal for dice games. The result data will be presented further in this chapter.

Because BGG information was not perfectly adapted to the purposes of this chapter, we analyzed the four lists proposing new categories and classifications. This process demanded understanding the gameplay of every game and how the dice are used. We used the Grounded Theory to generate clusters until patterns emerged.[29] This method allowed to deal with qualitative information in an interactive approach, evaluating data as it was collected. Each time a game was being analyzed, we filled a spreadsheet with notes about the game characteristics and dice usage. These steps were done for every list of related games to the categories and mechanisms (four in total). Each time a game was analyzed, all the previously collected data were reanalyzed and reclassified. Categories emerged as the analysis progressed (the categories are explained in the next sections). We collected the raw data from the ten higher-ranked BGG games on the following lists:

- Dice Category
- Mechanisms: Dice Rolling
- Mechanisms: Dice Icon
- Mechanisms: Different Dice Movement

From the previous lists, a new summarized list emerged with 37 games. From the 40 obtained games, three games appeared simultaneously in the different lists.

29 Charmaz, Kathy: *Constructing Grounded Theory*, Los Angeles: SAGE 2014; Farkas, Timea et al.: "A Grounded Analysis of Player-Described Board Game Immersion," in: *CHI PLAY 2020—Proceedings of the Annual Symposium on Computer-Human Interaction in Play*, 2020, pp. 427-437.

The Top-Ranked Games Related to Dice at BGG

Table 1: The general characteristics of BGG selected dice games

		Abbreviation	Description
Type	Abstract	A	No defined metaphor for mechanics
	Eurogame	E	Theme but focus on mechanics
	Thematic	T	Focus on theme/narrative
	Wargame	W	Focus on simulation
BGG Source	Dice Rolling	DR	Mechanism at BGG
	Dice Icon	DI	Mechanism at BGG
	Different Dice Movement	DDM	Mechanism at BGG
	Dice category	DC	Category at BGG
Dice Usage description	Roll dice to determine conflict outcomes	RDcoutcomes	Used in combat or other types of conflicts and threshold comparison
	Roll dice to define available actions	RDactions	Determine what players are allowed to do. Related to restrictions.
	Roll dice to change game state	RDgamestate	Define and change the game state and affect players' decisions or narrative progress.

Selecting the list of ten ranked BGG games for every list related to dice "Category" and the mechanisms of "Dice Rolling" (DR), "Dice Icon" (DI), and "Different Dice Movement" (DDM) provided considerable data. The merged table from the four lists was divided into three tables (2, 3, and 4) filtered by BGG rank. Table 2 refers to the general characteristics of the selected games. It presents the year of publication, the complexity (one being the lowest complexity and five the highest), the type of game according to the hobby designations,[30] the BGG source (list from where the game appeared), and a brief description of how dice are used in each game. To ease the reading of Table 2, which presents the sample of

30 M. Sousa/E. Bernardo: "Back in the Game;" S. Woods: *Eurogames*.

analyzed games, we created a support table (Table 1) to explain the concepts and abbreviations used to define the games.

The previous classification results from the terminology hobby gamers adopt.[31] Even though games like SAGRADA and PAPER APPS: DUNGEON have a defined theme and were considered Eurogames, they could also be defined as abstract games. Eurogames typically have a clear abstract dimension that can lead to this confusion. They try to address the theme through the game mechanisms, which are the core drive for the game. Thematic games were those related to Ameritrash (avoiding some of the negative conations the word may carry), where the theme and narrative are core for the game system. Wargames were those games that simulate credible and detailed contemporary or historical conflicts, battles, and wars.

Table 2: The general characteristics from BGG selected dice 37 games

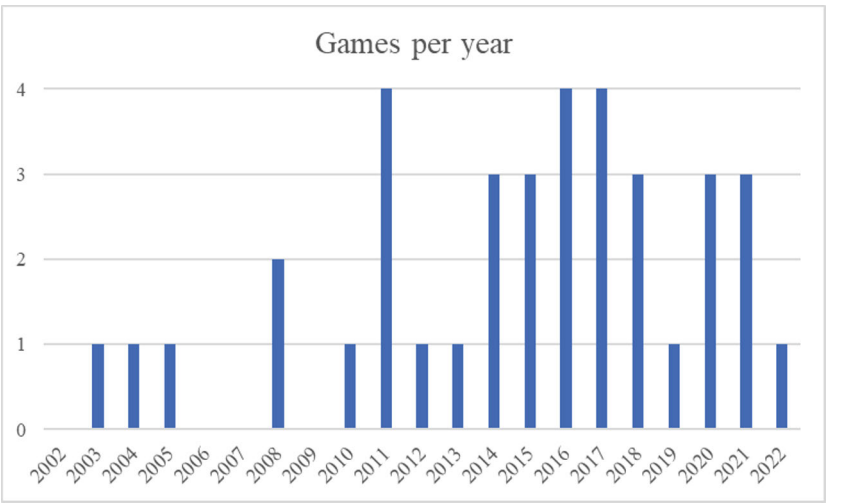
General						Dice usage description
Name	**Rank**	**year**	**Com-plex**	**Type**	**BGG Source**	
TWILIGHT IMPERIUM: FOURTH EDITION	6	2017	4,26	T	DR	RDcoutcomes
STAR WARS: REBELLION	8	2016	3,73	T	DR DI	RDcoutcomes
WAR OF THE RING: SECOND EDITION	11	2011	4,18	T	DR	RDactions.
TWILIGHT STRUGGLE	13	2005	3,60	W	DR	RDcoutcomes
THE CASTLES OF BURGUNDY	16	2011	3,00	E	DC DR	RDactions
NEMESIS	17	2018	3,40	Tc	DR	RDcoutcomes RDdefinestate
A FEAST FOR ODIN	22	2016	3,85	E	DR	RDcoutcomes
WINGSPAN	23	2019	2,44	E	DR	RDactions
ROOT	26	2018	3,73	W	DR	RDcoutcomes
MAGE KNIGHT BOARD GAME	29	2011	4,33	T	DR	RDactions.
TOO MANY BONES	38	2017	3,85	T	DC DI	RDcoutcomes
STAR WARS: IMPERIAL ASSAULT	53	2014	3,30	T	DI	RDcoutcomes

31 Ibid.

ROBINSON CRUSOE: ADVENTURES ON THE CURSED ISLAND	71	2012	3,80	T	DI	RDcoutcomes RDdefinestate
THE VOYAGES OF MARCO POLO	73	2015	3,18	E	DC	RDactions.
TROYES	88	2010	3,46	E	DC	RDactions.
ROLL FOR THE GALAXY	106	2014	2,78	E	DC	RDactions.
CHAMPIONS OF MIDGARD	109	2015	2,59	E	DC	RDactions. RDcoutcomes
STONE AGE	130	2008	2,47	E	DC	RDcoutcomes
THAT'S PRETTY CLEVER!	141	2018	1,89	A	DC	RDactions.
RAJAS OF THE GANGES	147	2017	2,89	E	DC	RDactions.
MEMOIR '44	154	2004	2,27	W	DI	RDcoutcomes
SAGRADA	168	2017	1,93	E	DC	RDcoutcomes
THE MANHATTAN PROJECT: ENERGY EMPIRE	255	2016	3,07	E	DI	RDcoutcomes
KING OF TOKYO	349	2011	1,49	T	DI	RDcoutcomes
1775: REBELLION	418	2013	2,24	W	DI	RDcoutcomes
BLACK ORCHESTRA	432	2016	2,41	T	DI	RDcoutcomes RDactions.
RUNEBOUND (THIRD EDITION)	488	2015	2,70	T	DI	RDactions.
FORMULA D	563	2008	1,97	T	DDM	RDactions.
RALLYMAN: GT	1018	2020	2,22	T	DDM	RDcoutcomes
BRISTOL 1350	3059	2021	1,41	T	DDM	RDactions.
BATTLEBALL	3143	2003	1,51	T	DDM	RDcoutcomes
SPURS: A TALE IN THE OLD WEST	4955	2014	2,56	T	DDM	RDactions. RDcoutcomes
AGE OF DOGFIGHTS: WW1	7803	2020	2,50	W	DDM	RDcoutcomes
MOB: BIG APPLE	8552	2022	2,20	T	DDM	RDactions. RDcoutcomes
ROLL IN ONE	9058	2021	1,75	T	DDM	RDcoutcomes.
PAPER APPS: DUNGEON	13235	2021	1,50	T	DDM	RDcoutcomes
POTATO PIRATES: ENTER THE SPUDNET	13428	2020	2,17	E	DDM	RDcoutcomes

As stated before, games like STAR WARS: REBELLION, CASTLES OF BURGUNDY, and TOO MANY BONES appeared in more than one list. They were considered as "Dice Rolling" games but not in the BGG "Dice Category." Another pattern is the games with "Different Dice Movement" mechanisms appear as the lower BGG ranked games, with lower complexity. Race games like FORMULA D and RALLYMAN: GT appear on the list. Other games related to movement dynamics also may be identified, like BRISTOL 1350 and BATTLEBALL. These games resemble some of the mass-market games where dice rolls define the movement.[32] These lower complexity games can be explained by the demographics and preferences of BGG users. They are hobby gamers that tend to prefer complex games with many mechanisms and thematic experiences.[33]

Figure 2: Games from the sample per publication year.



Source: Graphic by Micael Sousa

The year of publication gives an overview of new board game trends. All the games were published in the last 20 years. Most of the games are less than ten years available on the market. This timeframe means new games are still using dice, and hobby gamers enjoy them (recent games with high BGG rank). It also

32 Ibid.

33 Samarasinghe: "A Data Driven Review of Board Game Design;" M. Sousa/E. Bernardo: "Back in the Game;" Booth, Paul: *Board Games as Media*, New York, NY: Bloomsbury 2021.

shows that the eventual prejudice that games with dice are very random and not fit for heavy and hobby gamers is questionable. These perceptions are common among some hobbyist players, mainly Eurogamers and those that prefer highly strategic games with low random effects that can impact their choices.[34]

Table 2 gives a brief description of the dice usage in each game. This option was a way to avoid some of the abstractions that mechanism descriptions induce. It provides complementary information for Tables 3 and 4, with "Y," meaning the game has this trait.

Table 3: The aesthetics from BGG selected dice games

Name	Dice aesthetics								
	D							Colors	Images
	4	6	8	10	12	20	30		
TWILIGHT IMPERIUM: FOURTH EDITION				Y				N	N
STAR WARS: REBELLION		Y						Y	Y
WAR OF THE RING: SECOND EDITION		Y						Y	Y
TWILIGHT STRUGGLE		Y						N	N
THE CASTLES OF BURGUNDY		Y						N	N
NEMESIS		Y		Y				Y	Y
A FEAST FOR ODIN			Y		Y			Y	N
WINGSPAN		Y						Y	Y
ROOT					Y			N	N
MAGE KNIGHT BOARD GAME		Y						Y	Y
TOO MANY BONES		Y						Y	Y
STAR WARS: IMPERIAL ASSAULT		Y						Y	Y
ROBINSON CRUSOE: ADVENTURES ON THE CURSED ISLAND		Y						Y	Y
THE VOYAGES OF MARCO POLO		Y						Y	N
TROYES		Y						Y	N
ROLL FOR THE GALAXY		Y						Y	Y
CHAMPIONS OF MIDGARD		Y						Y	Y
STONE AGE		Y						N	N
THAT'S PRETTY CLEVER!		Y						Y	N

34 S. Woods: *Eurogames*; Wilson, Devin. "The Eurogame as Heterotopia," *Analog Game Studies* 2, No. 7 (2015), https://analoggamestudies.org/2015/11/the-eurogame-as-heterotopia/

RAJAS OF THE GANGES		Y						Y	N
MEMOIR '44		Y						Y	Y
SAGRADA		Y						Y	N
THE MANHATTAN PROJECT: ENERGY EMPIRE		Y						Y	Y
KING OF TOKYO		Y						Y	Y
1775: REBELLION		Y						Y	Y
BLACK ORCHESTRA		Y						Y	Y
RUNEBOUND (THIRD EDITION)		Y						Y	Y
FORMULA D	Y	Y	Y	Y	Y	Y	Y	Y	N
RALLYMAN: GT		Y						Y	N
BRISTOL 1350		Y						Y	N
BATTLEBALL	Y	Y		Y	Y	Y		Y	N
SPURS: A TALE IN THE OLD WEST		Y						Y	Y
AGE OF DOGFIGHTS: WW1		Y						Y	Y
MOB: BIG APPLE		Y						Y	N
ROLL IN ONE	Y	Y	Y	Y	Y	Y		Y	Y
PAPER APPS: DUNGEON		Y						N	N
POTATO PIRATES: ENTER THE SPUDNET			Y					Y	N

Table 3 presents the aesthetics of the dice, the format, colors, and images they have. D6 dice (six faces) are the most common. They have been used for centuries, showing pips in their faces from one to six. Although most games use D6 (33 Games, 89,2%), other types appear as follows:

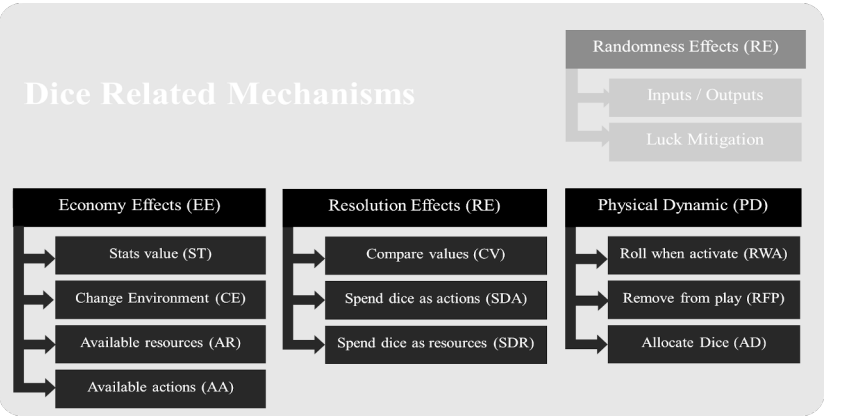
- D4 (3 games, 8,11%)
- D8 (4 games, 10,51%)
- D10 (5 games. 13,51%)
- D12 (5 games. 13,51%)
- D20 (3 games, 8,11%)
- D30 (1 game, 2,71%)

The shape of the dice is associated with geometric solids and face shapes. As the number of geometric shapes increases, practicability may be jeopardized. The D100 type of dice is unstable: it rolls inadvertently and even after the first stop. Depending on the size, reading the results is not easy. These shapes might be a limitation that led designers to innovate in a new direction.

In games like FORMULA D and A FEAST FOR ODIN, players use different dice in each move, representing distinct opportunities and probabilistic outcomes. The dice format is a way to model a range of results, the variability of an uncertain action like speeding, hunting, or hitting something. Dice of different forms are

usual among narrative hobby games,[35] but they are also present in contemporary board and card games. Besides the dice format and colors, the information dice faces show is relevant. Games may use customized dice with common shapes (i.e., D6) but express modified values and images in the faces. This design option allows higher configuration and addresses specific themes. We see these types of dice in games like WINGSPAN, where the dice show bird food available to be transformed into food tokens. These tokens allow playing bird cards. Adding to the dice aesthetics, WINGSPAN also features an original cardboard dice tower shaped like a birdhouse and feeder. This construction helps the game theme and functionality. It increases the dice rolling as a metaphor for bird food.

Figure 3: Scheme of dice related mechanisms obtained from Tables 1, 2, and 3



Source: Graphic by Micael Sousa

Table 4 specifies how even the traditional dice rolling to generate results is implemented differently in those modern board games that hobbyist players enjoy according to BGG ranks. These innovations are expressed not just by the dice aesthetics but by the way they are combined with game mechanisms. In order to make these relations evident, we propose the following "Dice Related Mechanisms" (Figure 3) obtained from the samples (Grounded Theory application). Luck Input/Output (Luck In/Out); Direct Luck Mitigation (DLM) relate to Randomness Effects (RE). Economy Effects (EE), Resolution Effects (RE), and Physical Dynamics (PD) are new proposals to classify the dice according to the way they are

35 Arnaudo, Marco: *Storytelling in the Modern Board Game: Narrative Trends from the Late 1960s to Today*, Jefferson, NC: McFarland 2018.

combined with game mechanisms. The subtypes of each Dice Related Mechanisms are presented in Figure 3 as additional information to avoid the typical abstraction of game mechanisms.

Table 4: The mechanisms from BGG selected dice games

Name	Dice Related Mechanisms				
	RE		New mechanisms dimensions		
	Luck In /Out	DLM	EE	RE	PD
TWILIGHT IMPERIUM: FOURTH EDITION	Out	Y	ST	CV	RWA
STAR WARS: REBELLION	Out	Y	ST	CV	RWA
WAR OF THE RING: SECOND EDITION	In	Y	AA	SDA	RFP
TWILIGHT STRUGGLE	Out	N	ST	CV	RWA
THE CASTLES OF BURGUNDY	In	Y	AA	SDA	RFP
NEMESIS	Out	Y	CE	CV	RWA
A FEAST FOR ODIN	Out	Y	ST	CV	RWA
WINGSPAN	In	Y	AR	SDR	RFP
ROOT	Out	Y	ST	CV	RWA
MAGE KNIGHT BOARD GAME	In	Y	AR	SDR	RFP
TOO MANY BONES	Out	Y	ST	CV	RFP
STAR WARS: IMPERIAL ASSAULT	Out	Y	ST	SDA	RFP
ROBINSON CRUSOE: ADVENTURES ON THE CURSED ISLAND	Out	Y	CE	CV	RWA
THE VOYAGES OF MARCO POLO	In	Y	AA	SDA	AD
TROYES	In	Y	AA	SDA	RFP
ROLL FOR THE GALAXY	In	Y	AA	SDA	AD
CHAMPIONS OF MIDGARD	In	Y	AR	SDR	RWA
STONE AGE	Out	Y	SV	SDR	RWA
THAT'S PRETTY CLEVER!	In	Y	AA	SDR	RFP
RAJAS OF THE GANGES	In	Y	AA	SDR	RFP
MEMOIR '44	Out	N	CE	CV	RWA

SAGRADA	In	Y	AR	SDA	AD
THE MANHATTAN PROJECT: ENERGY EMPIRE	Out	Y	AR	CV	RWA
KING OF TOKYO	Out	Y	AR	SDA	RWA
1775: REBELLION	Out	N	CE	CV	RWA
BLACK ORCHESTRA	Out	Y	AA	CV	RWA
RUNEBOUND (THIRD EDITION)	Out	Y	AA	SDA	RFP
FORMULA D	Out	N	CE	SDA	RWA
RALLYMAN: GT	Out	Y	CE	CV	RWA
BRISTOL 1350	In	Y	AA	SDA	RFP
BATTLEBALL	Out	N	CE	CV	RWA
SPURS: A TALE IN THE OLD WEST	Out	Y	CE	SDA	RFP
AGE OF DOGFIGHTS: WW1	Out	N	CE	CV	RWA
MOB: BIG APPLE	In	Y	AA	CV	RWA
ROLL IN ONE	Out	N	AA	SDA	RWA
PAPER APPS: DUNGEON	In	N	CE	CV	RWA
POTATO PIRATES: ENTER THE SPUDNET	In	N	AR	SDR	RWA

Table 4 is where we propose a classification for dice mechanisms. It classifies the game dynamics and how the dice are used as mechanisms, as playable interactions, express decision making, and outcomes affected by uncertainty. All the identified games demand dice to be rolled, which intends to generate various levels of randomness for the game system. This uncertainty can be classified as input and output randomness, following the definitions of LUDOLOGY Podcast.[36] Input is when the dice change the game state affecting players' decisions but not defining them in an absolute way. Output is when the results of the dice set the players' choices. From the list, 22 games were considered to have output randomness resulting from dice rolling, but all the games had some direct or indirect ways to mitigate the results (28), while all had some indirect system to mitigate luck. This design is

36 Engelstein, Geoffrey: "GameTek Classic 183—Input Output Randomness," in: *Ludology*, 2018, https://ludology.libsyn.com/gametek-classic-183-input-output-randoness

predictable because hobby gamers usually dislike games with no player agency to affect the outcomes.[37]

The dice-related mechanisms scheme (Figure 3) is a proposal to analyze games that use dice. The dice can affect the game economy, changing the values of the game stats (statistics) or the position of other elements impacting the game environment. These environmental impacts can be visual and material (game components and bits), while the stats tend to be represented by numbers. The dice can also define available resources and actions.

Table 5: Summary of game characteristics from BGG selected dice games

Classifications		**Number of games**	**% of the sample**	
Type	Eurogame (E)	10	27,03%	100%
	Wargame (W)	5	13,51%	
	Thematic (T)	19	51,35%	
	Abstract (A)	3	8,11%	
Economy Effects (EE)	Stats value (ST)	8	21,62%	100%
	Change environment (CE)	10	27,03%	
	Available resources (AR)	7	18,92%	
	Available actions (AA)	12	32,43%	
Resolution Effects (RE)	Spend dice as resources (SDR)	7	18,92%	100,00
	Compare values (CV)	17	45,95%	
	Spend dice as actions (SDA)	13	35,14%	
Physical Dynamic (PD)	Roll when activate (RWA)	22	59,46%	100%
	Remove from play (RFP)	12	32,43%	
	Allocate Dice (AD)	3	8,11%	

The resolution mechanisms are often common in games. It is done simply by rolling and seeing if the results achieved a defined threshold or are bigger or smaller than other values (sometimes other players' dice). These are all considered "compared values." When dice are resources or actions, the resolution mechanism can be just spending the dice to establish the scarcity of the resource or action at stake.

Resolution mechanisms affect the game economy mechanisms and vice-versa. It is the resolution that changes the game state (economy of the game). But dice

37 Booth, Paul: *Game Play: Paratextuality in Contemporary Board Games*, New York, NY: Bloomsbury 2015.

require physical actions to generate meaningful game state changes, affecting the economy as a resolution. The identified physical mechanisms were rolling dice, removing to define what is available, or allocating the dice to a board or similar game component. Removing or allocating dice is a way to track and bookkeep the game economy. It is an auxiliary activity to support the economic mechanisms.

Merging Tables 2, 3, and 4 provides a general overview of the sample. On average, the games had a complexity of 2,77 (considered as medium or medium-high complexity). But the Standard deviation of 0,84 shows that there are low and complex games in the sample. This variation means dice can be used in games of all complexity ranges.

Analyzing the type of games, 51.35% of the games are thematic, and 13,51% are wargames. We can say that dice are common ways to deliver thematic significance to a tabletop game. Dice often define the unpredictability of interactions, conflicts, weather conditions, and the possibility of failure and success when simulating an activity. Even Eurogames (27,03%), which tend to be more deterministic and mechanical centered, use them to introduce thematic representation like in A FEAST FOR ODIN hunting, fishing, and raiding. Other games like CASTLES OF BURGUNDY generate random inputs that increase replayability by changing the available actions and resources players can choose each round.

Complementing the Tables: Other Dice Games Identified by Hobby Gamers

Despite considering the BGG rank system to identify popular dice games, many other innovative dice usages in modern tabletop games were missing. Asking hobby tabletop gamers can complement this information. We attended several game meetings in Leiria (Portugal), including the LEIRIACON national convention. This city is one of the most dynamic Portuguese cities regarding modern tabletop games. There are three publishers, one association (BOARDGAMERS OF LEIRIA), and the biggest national convention in Leiria. Also, the POLYTECHNIC OF LEIRIA offers a videogame course.

Discussing what innovative games with dice these gamers knew helped to find new games to analyze. These interactions with gamers consisted of three meetings of approximately 30 minutes before the local hobbits' local gaming gathering that happens every Friday evening. The same was done at Leiriacon 2022 during the playtest sessions. We asked: "*What were the more innovative dice games and games with dice they knew*?" Through informal conversation, it was possible to collect several game examples:

One of the first examples is "MANSION OF MADNESS, 2ND EDITION" (2016), which appears in the 12th best game with the "Dice Rolling" mechanism. This example is interesting because it uses dice of different shapes, colors, and images while maintaining regular D6. As stated before, the game uses a digital App to guide the narrative. But the App does not replace dice. The game keeps them as part of the experience players enjoy.

Gamers identified at least two other examples of dice usage beyond rolling within the Eurogame type of game: First, designers may mix dice with other typic Eurogame mechanisms like "Worker Placement," a mechanic defined by Engelstein and Shalev.[38] One example of this is TEOTIHUACAN: CITY OF GODS (2018), where dice are never rolled, but their faces reveal the power of the worker they represent, changing whenever they acquire more experience as a deterministic outcome along the circular path in the game board. Another example is CRYSTAL PALACE (2019), where the dice represent workers. Here dice face values are predetermined at the beginning of each round simultaneously in a hidden way by players. Players need to pay the sum of the pips in each dice face, choosing how much they are willing to spend to have weaker or stronger workers for the round. Then, in a turn-based process, each player decides where to allocate dice to resolve in order of power later. These two games exemplify how standard D6 dice can be used alternatively without the effects of rolling and associated random outcomes. These games depart from the familiarity of dice as a game component and use innovative mechanisms.

During the conversations, gamers identified the "Worker Placement with Dice Workers," which we missed during our survey on BGG. But the complementary literature about tabletop game design alerted us to these mechanical options.[39] Exploring this mechanism revealed games like TROYES (2010), GRAND AUSTRIA HOTEL (2015), THE VOYAGES OF MARCO POLO (2015), LORENZO, IL MAGNIFICO (2016), and so many other popular Eurogames. These games appeared in the category of dice games, reinforcing the importance of crossing multiple lists and keywords when analyzing BGG databases. This mechanism has been used in the last ten years in many successful games, reinventing the worker placement mechanisms as a variation of the action point system. Here, players have a determined quantity of action points to do different actions. Players can block other players, and there are loops and cycles of renewal that allow repeating moves and reno-

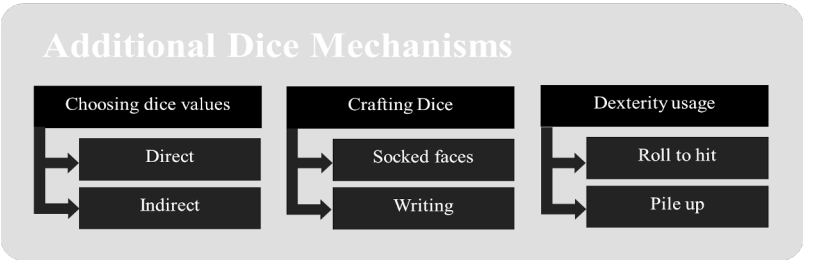
38 Engelstein, Geoffrey/Isaac, Shalev: *Building Blocks of Tabletop Game Design: An Encyclopedia of Mechanisms*, Boca Raton: CRC Press LLC 2019.

39 Ibid.

vating resources. The power and effect of the actions can vary depending on the dice value when the worked placement mechanisms and dice are combined.

The other mechanic beyond rolling is found in dice crafting games. Players use the same dice along with the game, but they can change the faces of their dice. In DICE FORGE (2017), players use a customized device that resembles dice with sockets to change the dice faces. During the game, players customize their dice differently. Players change the actions, resources, and outcomes probability. Alternately, BLANK WHITE DICE (2016) is all about writing tags in the dice faces that give players actions to activate. Each player has a set of dice that allow them to write and erase during the gameplay according to the available tags defined by setup cards. DICE CITY (2015) is also a dice crafting game, but players do not change dice. In this game, players change what the pips represent. It is an alternative way of dice crafting by maintaining standard dice and changing only the auxiliary board and components.

Figure 4: Additional Dice Mechanisms emerged from hobby gamers' suggestions and previously collected data.



Source: Graphic by Micael Sousa

A little older than previous games is DUNGEON FIGHTER (2011), where dice rolling is the core game mechanism, but the space where the dice stops is relevant. This game comes with several customized D6 and a target (in a board format). Players roll the dice, trying to obtain the best dice face over the center of the target. Rolling dice simulates attacks of the different playable characters. It is an additional layer to the physical outcome of the dice rolling. The materiality of the dice can also be explored as a dexterity game. BATACLAN (1997) is older, less known, and simpler than the previous games. It is a dexterity dice game. It uses D6 dice of different sizes and demands players to pile them by pip value, regarding the size.

Based on the collected game information, we propose these new findings as additional dice mechanisms:

- Choosing dice values
- Crafting dice
- Dexterity usage

These additional mechanisms and their generic implementations are presented in Figure 4.

CONCLUSION

As expected, dice are far from obsolescent. Although non-hobby board gamers might feel that dice usage in games is static, new game releases prove otherwise. New tabletop games, board, card, and dice games continue to be invented. These modern board games can be highly successful, providing engaging experiences. Many of these new games depend on the materiality of dice to function, although considering other dimensions helps to understand how game design innovations are happening. Modern tabletop games provide examples of how dice are part of the ongoing design innovations. This novelty results from the new physical implementations, metaphors, and mechanical representation.[40] The aesthetics of dice are relevant, but even standard D6 dice (piped faces) can be innovative through the associated game mechanisms. Successful applications of dice are the result of mixing their material dimensions with mechanisms that build engaging game experiences.

This chapter proposed a method to find how dice appear in recent tabletop and board games. We proposed a framework to classify their uses according to the associated game mechanisms. This proposal aims to tackle the lack of systematic analysis of modern dice game systems. BGG proved to be useful for exploring tabletop dice game dimensions, despite the need to complement and adapt data. Interacting with the hobbyists is recommended, like crossing this informal information with updated literature. It is easy to miss a mechanism or other data at BGG. Talking with hobby gamers to collect data and understand their game experiences helps fill these gaps.

The proposed approach revealed how hobby games deal with the random effects of dice, using them to simulate uncertain results, but combining dice with mechanisms that increase player agency and meaningful decisions. Dice may

40 Sousa, Micael/Oliveira, Ana Patrícia/Zagalo, Nelson: "Mechanics or Mechanisms: Defining Differences in Analog Games to Support Game Design," in: *IEEE Conference on Games*, 2021.

maintain the same shape as centuries ago, but their appearance in contemporary games has changed. Dice are examples of game components that never ceased to adapt to game design trends, proving to be adaptable and supporting new game mechanisms while maintaining the ability to engage players. We argue that game mechanisms are continuously reinventing dice games and enhancing our fascination for these material objects, despite some ground-breaking innovations like dice crafting that affect the particular materiality of dice.

Analog game innovations continue to occur. Even though the COVID-19 pandemic affected the hobby tabletop industry considerably,[41] it is expected that dice games continue to be developed in new, innovative, and exciting ways.

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