Making data playable:
A game co-creation method to promote creative data literacy

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ABSTRACT

This article explores how making data playable, i.e. developing exploratory co-creation techniques that use elements of play and games to interpret small to mid-sized datasets beyond the current focus on visual evidence, can help a) promote creative data literacy in higher education, and b) expand existing definitions of data literacy. The article briefly investigates playful characteristics in existing data practices, and discusses how this perspective compares to existing frameworks that define data literacy. In a second step, we present a Discursive Game Design technique to promote creative data literacy. The article reports on findings from a sample workshop, during which students explored how modifying small, hybrid games based on real-world datasets can alter players' interpretation of the data, but also their perception of how the games operate as epistemic objects within data analysis. Finally, we formulate recommendations on how to adapt the technique to different educational settings.

Keywords: *discursive game design, creative data literacy, playful appropriation, card games, critical making.*

INTRODUCTION

This article explores how making data playable, i.e. creating and re-making hybrid game prototypes based on small to mid-sized datasets, can a) help promote data literacy in higher education, b) afford new insights into data beyond the current focus on visual evidence (Beale et al., 2013; Drucker, 2015; Jessop, 2008), and c) expand existing definitions of data literacy by emphasizing the role of playfulness and creativity (Lieberman, 2014) in contemporary data practices.

In recent years, the widespread application and ongoing refinement of "digital methods" (Gubrium & Harper, 2016; Rogers, 2015) and other humanities-based computational techniques such as Cultural Analytics (Yamaoka et al., 2011) has provided valuable insights into contemporary, increasingly datafied societies by enabling scholars to process large amounts of culturally relevant data. Yet, these techniques may arguably also constrain corresponding notions of data literacy, for example privileging visualization techniques and their suitability for finding patterns and outliers in large datasets, or institutionalizing conceptual bias such as "homophily" (e.g. Chun, 2018), i.e. definitions of social connectedness disproportionately predicated on common interests, activities or ideologies, by relying on a small set of increasingly standardized tools.

Below, the argument at hand will be situated alongside existing definitions of data literacy; harnessing play(fulness) specifically resonates with Catherine D'Ignazio's (2017) concept of "creative data literacy" (p. 6), that is the proposed game co-creation technique aims to create a sense of empowerment, invites learners to question the role of tried-and-tested tools and techniques to make sense of data, and conceptually allows for embracing rather than preemptively resolving a multiplicity of potential interpretations of the same data material.

The role of play(fulness) in exploratory data practices

To contribute to the diversification of data practices, this article first compares the material affordances (Curinga, 2014) of selected speculative, arts-based approaches to analyze their creative engagement (Glăveanu, 2012) with datasets, differences in making data accessible to the senses, as well as their implicit uses of playfulness and forms of scholarly bricolage (Antonijevic & Cahoy, 2018). Play arguably manifests itself already in established forms of data analysis;[1] however, in professional contexts it is often disregarded or marginalized as it is deemed incompatible with the common rhetoric of scientific rigor. For instance, the recombination and juxtaposition of different metrics to infer potential correlations in data analysis affords and requires "cognitive spontaneity" and – depending on the interface – "physical spontaneity", two central tenets of J. Nina Lieberman's oft-cited definition of playfulness (Lieberman, 2014, pp. 23-24).[2] Playfulness is expressed in visualizations by the Cultural Analytics Lab, e.g. the defamiliarizing effect of compressing entire feature films into a single screenshot,[3] or the "z-axis map[s]" described by Arbuckle & Christie (2015, p. 6), which plot the geographic distribution of literary narratives by deforming a 3D model of a corresponding historical city map depending on the frequency of events occurring in particular areas. Play in these examples is rooted in bricolage, i.e. finding unconventional ways to make do with and combine readily available materials and techniques. In comparison, the race to procure more and more comprehensive data corpora to represent national Twitter discourses (Bruns et al., 2014; van Geenen et al., 2016) can be characterized as "competitive" play (Caillois, 2001, p. 14); Caillois defines competition, i.e. symbolic conflict between individuals, groups or simply by challenging oneself, as one of four categories of games, alongside games of chance, mimicry and vertigo. The spirit of competition also applies to some of the aforementioned Cultural Analytics projects like *One*

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[1] A characteristic example, as exemplified below in this section, is the Cultural Analytics Lab, especially its earlier attempts at transcoding the complexities of cultural expression into human-readable charts as in the Selfiecity project (2014-15); see http://lab.culturalanalytics.info/2014/08/selfiecity-investigates-style-of.html. For another example of playfulness in working with textual data, see e.g.
https://junkcharts.typepad.com/junk_charts/2018/04/playfulness-in-data-visualization.html.

[2] Contrary to Lieberman's concise definition of playfulness, a comprehensive definition of play is outside the scope of this article; following Sicart's (2014) synthesis of existing definitions, play is an activity that requires repetition and experimentation, is a mode of appropriation and self-expression, and, most importantly, maintains an unresolved state of ambiguity between order (e.g., accepting the agreed-upon rules) and freedom (e.g., testing their limits).
[3] See http://lab.softwarestudies.com/2009/02/art-of-dominant-color-in-film.html.

Million Manga Pages,[4] which exhibit an escalating logic of continually trying to push one's own technical boundaries. Even more explicitly, competitions on data science web sites like Kaggle harness this aspect of games to promote innovation in data analysis, e.g. to incentivize finding new approaches to wicked problems like categorizing and identifying "toxic" comments online.[5]

Play and data literacy

Most actual data literacy frameworks do not explicitly define data, but operate with an implied definition that refers to data, based on the material modalities of collecting and processing them, as discrete metrics that describe "a world of ontologically self-sufficient entities" (Bergmann, 2016, p. 976). However, Bergmann points out the limitations of this rather positivist definition, which nonetheless is perpetuated by many data-driven tools and practices. Instead, he suggests that (geographic) information might be better defined in terms of "speculative data" (Bergmann, 2016, p. 983); following Donna Haraway's notion of situated knowledges and partial perspectives, this term describes a world "in which spaces are relational, matter is vibrant, and/or knowledge is situated" (Bergmann, 2016, p. 973). Bergmann (2016) concedes that "a key challenge will be to facilitate operations on such stores of data which support deferring semiotic closure" (p. 983), but does not expound on how to tackle that challenge. As will be elaborated below, play and games constitute a very suitable medium to acknowledge and reflect on this situatedness, since they cater to a broad range of different player mentalities (Tuunanen & Hamari, 2012). That is, understanding the other players' approaches and situated knowledges is often vital in both competitive and cooperative play situations, and game rules often provide means of developing and testing hypotheses to that end.

A commonality in many data literacy frameworks is the focus on discrete skillsets, e.g. as part of "21st-century literacy" (Gunter, 2007) curricula, which includes "the ability to synthesize and evaluate data", and being "statistically literate" and "able to think critically about basic descriptive statistics" as well as "to access, assess, manipulate, summarize, and present data" (p. 25). These claims can be difficult to translate into neatly separable practical skills. Yet, existing research suggests that games and play are particularly conducive to developing these types of metacognitive 21st century skills like "creativity […], learning to learn […], conflict management, and a sense of initiative and entrepreneurship" (Romero et al., 2014, p. 149), which particularly apply to working with data beyond following standardized procedures. Other definitions of data literacy focus on specific professional domains like teacher education. For instance, Gummer and Mandinach (2015) aim to inform the "development of instruments to measure data literacy", which requires breaking down the elusive concept into an even more granular list comprising "59 elements of knowledge and skills" (para. 2). These are subdivided into six "components" that form an "inquiry cycle", which teachers iterate upon to "use data effectively and responsibly" in the classroom (p. 3). This cycle closely resembles an expanded feedback loop (Goetz, 2011) and involves identifying/framing a question, selecting, contextualizing and processing data to produce actionable information, and finally acting on that information and evaluating the outcome to restart the cycle. Feedback loops similarly are crucial in any game context; in fact, the influential Mechanics-Dynamics-Aesthetics (MDA) framework for game design and criticism prominently features "feedback systems" (Hunicke et al., 2004, p. 3) to explain how games combine simple mechanics to produce complex aesthetic experiences.

For this article, more recent debates on "creative data literacy" (Bhargava et al., 2016; D'Ignazio, 2017) will constitute the primary reference point. While they do not explicitly mention play(fulness), these definitions have a more holistic focus, i.e. they are independent from a particular area of application or group of learners, and define a data literate individual as being able "to read, work with, analyze, and argue with data as part of a broader process of inquiry into the world" (D'Ignazio, 2017, p. 7). More than other frameworks, creative data literacy acknowledges the inequalities inherent in contemporary data practices, and focuses on learners from non-technical backgrounds. D'Ignazio (2017, p. 8) formulates five "tactics" to teach and work with data: working with community-centered data, writing data biographies, making data messy, building learner-centered tools and favoring creative, community-centered outputs. Co-creating games to promote data literacy directly addresses specifically the last two of

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[4] See http://lab.culturalanalytics.info/2010/11/one-million-manga-pages_14.html.

[5] See e.g. https://www.kaggle.com/c/jigsaw-toxic-comment-classification-challenge.

these tactics. Rather than make tools with the learner in mind, we invite students to co-create the game-as-tool themselves. Thereby, the game prototypes can afford very diverse play experiences as "experimental outputs" (D'Ignazio, 2017, p. 14). Compared to the examples provided, e.g. "physicalizing data via 3D printing" (D'Ignazio, 2017, p. 14) or creating a "data mural" (Bhargava et al., 2016, p. 201), these outputs do not have a visible and/or tangible data object as reference point. Thus the challenge lies in evaluating them to determine their potential benefits for data literacy education.

Fostering co-creation through discursive game design

To explore how play can promote and expand on creative data literacy, we have developed and evaluated a co-creation technique rooted in Discursive Game Design (DGD; Glas et al., in press). Our technique involves transcoding a digital dataset into physical playing cards, playtesting a sample game to critically engage with the data, and then co-creating both the sample game as well as each other's variations to experiment with different perspective on correlations within the chosen dataset as well as potential interpretations. Over the last few years, game-making as a creative humanities practice has gained traction, as evidenced e.g. by Stefano Gualeni's (2016) work on games as "philosophical artifacts" (para. 19), Marcus Schulzke's (2014) view on video games as "executable thought experiments" (p. 251) or "experimental game design" (Waern & Back, 2015, p. 341) as part of a game studies methods curriculum. More recent approaches such as the design of a "critical board game" (Zavala & Odendaal, 2018, para. 1) offer more specific insights into "codifying theory into game mechanics" (para. 5), in this case translating software studies concepts like David Berry's "compactants" (para. 10) into a board game about app publishing. However, all these approaches culminate in the creation of one game as the final deliverable. For instance, the game *Unveiling Interfaces* (2018) referenced by Zavala and Odendaal (2018) addresses the app economy, specifically the dualism of algorithms and interfaces, aiming to promote "algorithmic literacy" (para. 1) rather than critical data literacy. Yet, the authors acknowledge that "the emergence of critical play did not seem to occur naturally [as] players struggled to understand the Event Cards' relation to their choices of Software Tile selection" (Zavala and Odendaal, 2018, para. 18). This is not unexpected, as the impact of educational games

will inevitably and considerably differ depending on the player's approach to learning, familiarity with games as a medium, and previous knowledge of the subject matter, a problem that any one educational game – even using adaptive gameplay and other forms of personalization – cannot properly accommodate.

These product-oriented approaches thus rely on the explanatory power of a prototype (see e.g. Galey and Ruecker, 2010 on the prototype as a form of scholarly argument), but usually do not explicitly reflect on the epistemic nor the socio-technical implications of the prototype-as-object, its influence on how learners obtain and organize knowledge, or on how they operate as a community of practice (see Frank and Walker, 2016, below). Instead, the DGD framework (Glas et al., in press) emphasizes game co-creation rather than making one definitive game as a ready-made tool. It conceptualizes game-making itself as an ongoing critical conversation conducted through the language of procedural rhetoric, i.e. game rules and goals. In that context, each prototype merely constitutes an utterance that can and should be continually referenced, quoted, challenged and rephrased through continuous modification. The approach combines Gerald Voorhees' (2012) notion of "discursive games" (p. 2), which acknowledges that (commercial) games increasingly become part of and intervene in societal discourses, with Bruce and Stephanie Tharp's (2018) "discursive design" framework (p. 25), which emphasizes that design in the service of social change should not be "unobtrusive, intuitive, invisible, and undemanding", but may rather "offer social criticism" by disregarding norms and usability concerns as illustrated for example by the productive irritations in the sample game. In the context of games, co-creation has only been explored with younger learners, e.g. children aged 7-12 (Kangas, 2010), as a means of fostering creativity, imagination and group work. For this article, we adapt it to higher education contexts by combining it with principles of "critical making" (as defined by Matt Ratto, 2011, p. 252) outside of gaming, that is as a "social knowledge creation" (Arbuckle & Christie, 2015, p. 2) process rather than a means to create one game as a "knowledge object" (Kalthoff & Roehl, 2011, p. 456). The focus on social learning via critical making differs from many of the aforementioned data literacy frameworks, which are concerned with increasing the individual learner's skills and competences, but plays an important role in the game co-creation process. A notable exception is the work of Frank and Walker (2016), who emphasize building a "community of practice" (p. 234), following

– albeit not explicitly – the definition of Lave and Wenger (1991), as an essential prerequisite to make data literacy education more sustainable. Critical making as defined by Matt Ratto (2011, p. 252) originally describes techniques that explore "the relationship between [digital] technologies and social life" (p. 252), e.g. by recombining craft materials, electronic components and simple algorithms. In that regard, critical making has a similar purpose, because it aims to enable users to think of consumer electronics – as we hope to achieve with games – not merely as products but as assemblages and material to play with. Yet, in comparison, our material is more hybrid. To create and modify the sample game outlined below, we used freely available digital prototyping tools including nanDECK and Squib,[6] which transcode data from a Google Sheet into printable physical playing cards. nanDECK (see Figure 1) uses a simple markup language similar to HTML to display the content of the columns on playing cards, including conditional formatting and unique fronts and backs via duplex printing. The immediate

modifiability of the card layouts, e.g. using ready-made templates based on familiar games like *Top Trumps* as a basis, enables a bricolage approach, which we aimed to stimulate not only with reference to the card design but the student games' mechanics as well. Our use of playing cards as a data storage device is informed by Nathan Altice's (2014) interpretation of the playing card as "platform" (para. 5) Drawing on Bogost and Montfort's (2009) definition of platform studies, which investigates the material conditions enabling (digital) games as cultural artifacts, Altice (2014) argues that "cards are platforms too [as] their 'hardware' supports particular styles, systems, and subjects of play while stymying others" (para. 5). Accordingly, the material affordances of playing cards, specifically their "planar, uniform, ordinal, spatial, and textural" characteristics (para. 6), enable different types of symbolically manipulating cards such as tapping (one of the primary gameplay innovations popularized by *Magic: The Gathering*), stacking or shuffling.
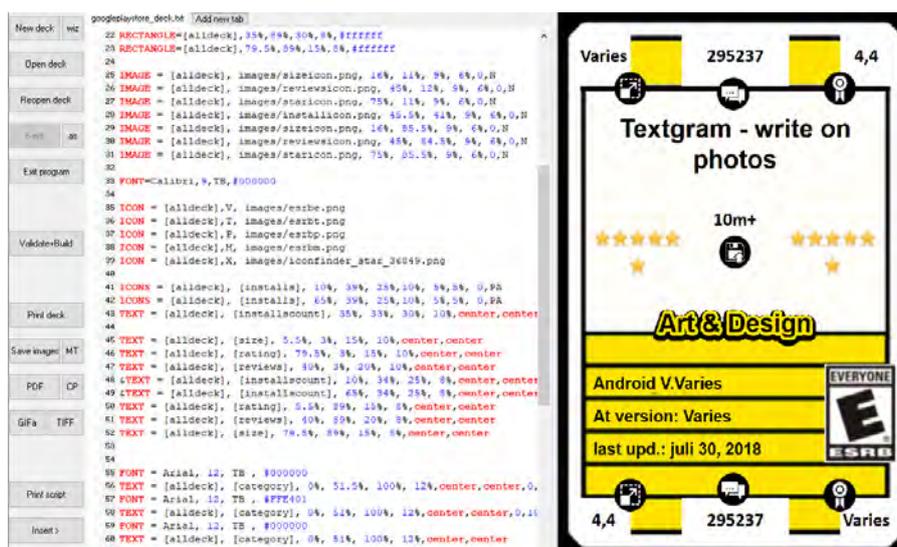

Figure 1. *A screenshot of Nandeck and its simple markup language*

Considering the Architecture Awareness card decks deployed by the U.S. Department of Defense[7] as an example (see Figure 2), we can extend that argument and posit that these symbolic manipulations not only affect the potential gameplay purpose of the cards but also the data they contain. The DoD cards follow the logic of the standard 52-card deck of French playing cards, which indicates ordinality or hierarchy through numerals, and

groups of cards via suits (diamonds, clubs, hearts and spades). This logic is mapped – in this case rather arbitrarily – onto the list of archaeological treasures, yet the categories implied by the layout do not fully align, as some cards display archaeological sites while others contain more generic advice on how to engage with national cultural heritage in Iraq. Apart from the cards storing data, the game rules define the quasi-algorithmic

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[6] See http://www.nand.it/nandeck/ and http://squib.rocks/.

[7] See e.g. https://archive.archaeology.org/0707/trenches/solitaire.html.

symbolic manipulation of these data. Thereby, game co-creation emphasizes how data literacy and algorithmic literacy are intertwined. Bhargava & D'Ignazio (2015) rightly emphasize that "the primary way of exploring [particularly] Big Data is not through visual browsing but rather through complex algorithmic transformation" (p. 3), yet algorithmic literacy "has only sparingly [been] tackled" in earlier work on data literacy (p. 3). Moreover, the authors caution that, due to the "significant technical challenges in working with Big Data", this aspect may be framed primarily as a technical problem rather than acknowledging the corresponding "social processes and ethical questions" (p. 3). With that issue in mind, the level of abstraction that comes from using physical cards as tools to play with data may allow for taking into consideration the role of algorithms (as game rules) in data work without preemptively foregrounding any particular technical implementation.
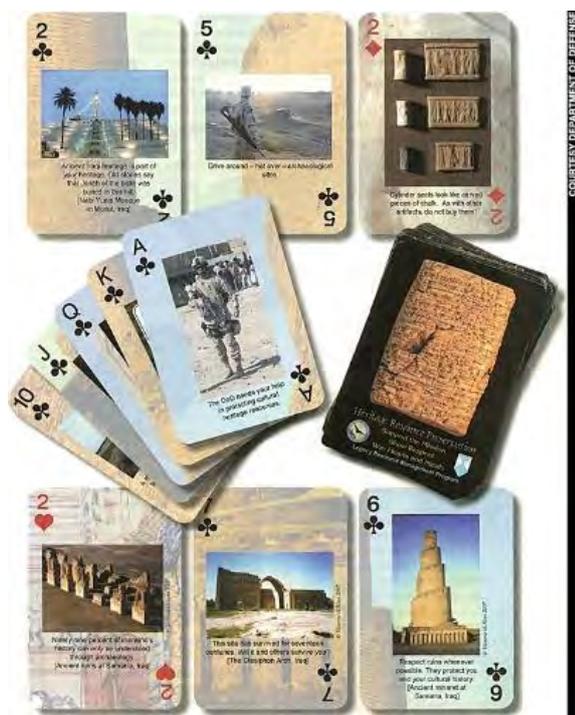

Figure 2. *The Architecture Awareness card deck, distributed by the U.S. Department of Defense*

A sample game

To illustrate how making data playable can work in a humanities-based classroom, a co-creation exercise was designed for and tested with two groups, each comprising about 10-15 advanced graduate students,

with about 70% female participants. These workshops are part of a media studies curriculum, but students' undergraduate experience (ranging from design and journalism to cultural studies and gender studies) and cultural backgrounds (including students from the Netherlands, India, the United States and China) were diverse. Each self-contained workshop comprised six hours, including an initial 45-minute lecture segment, two co-creation rounds, a one-hour lunch break and a

concluding plenary discussion of 30-40 minutes.

Figure 3. *A card from the sample game*

We developed a basic sample game, using a pre-existing dataset comprising metadata on almost 10,000 apps from over 30 different categories on the Google Play Store as material; the dataset was original scraped by Lavanya Gupta and shared via Kaggle.[8] The familiar subject matter – most students have basic knowledge of the political economy of app publishing, but more importantly use apps from the given categories in everyday life – created a shared frame of reference that helped look beyond the data themselves and consider how remaking games as "epistemic objects" (Ewenstein & Whyte, 2009, p. 9) can reframe the players' interpretations. The sample game uses the basic card layout shown in Figure 3, displaying four key metrics on the four main axes, i.e. the number of reviews (vertical), the number of installs (horizontal; both as approximate number and simplified representation, ranging from one to ten stars), install size in megabytes (top-left and

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[8] See https://www.kaggle.com/lava18/google-play-store-apps.

bottom-right) and average review score (top-right and bottom-left). Players initially receive seven cards and take turns, placing one card on the board so that it connects on at least one axis with another card. Cards must be strategically placed as to outperform adjacent cards in the category on the respective axis and to avoid exposing weaknesses. After placing a card, players draw a random new card from the pile. After a predetermined number of rounds (adjusted according to the number of players), the game ends and the player with the most points across all four metrics win the game. During the workshops, students played with physical cards, yet we also developed a digital version using the commercial prototyping and playtesting tool *Tabletop Simulator*[9] (Figure 4).

Figure 4. *Screenshot of the sample game implemented in Tabletop Simulator*

After playtesting, students discussed the game's procedural rhetoric (Treanor et al., 2011) expressed through its core rules. For instance, some commented on how the notion of an increasingly contested app market was symbolized by the limited play space, or how actual app developers would also plan the launch of their apps to outperform competitors in specific aspects while concealing any obvious deficits. Moreover, the participants found the overall focus on metrics to be rather dominant but, despite the inevitable generalization, considered it a reasonably accurate representation of how both users and companies perceive the logic of app economics. Yet, many also noticed incongruities and ambiguities in the game as a model as well as in the data at hand. For instance, some

students aptly criticized that the original rules procedurally suggested that all four metrics were equivalent, as all points scored were simply added up. Others remarked that it was not clear whom players represented, for example individual app publishers or more abstract entities playing out one contingent app history over the course of one play session. Again others pointed out that the game didn't acknowledge the release date of the app – in fact, the only related metric available in the dataset was the date of the last update. It became clear that the participants initially expected the game to naturalistically represent a historical snapshot of the Google Play Store, an assumption that was further problematized by the fact that established platforms like Facebook or Twitter could be played after much recent

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[9] See https://www.tabletopsimulator.com/.

apps like Viber or WeChat. These examples could be seen as deficits of the game as a model, yet – as the focus lies on co-creation rather than any particular game version – they produce valuable insights. Attempting to create increasingly sophisticated games as supposedly comprehensive simulations can easily produce "simulation resignation" (as defined by Sherry Turkle, quoted in Bogost 2007, p. 106), that is an uncritical acceptance of the game as a mimetic representation of a real-world phenomenon. In our case, the obvious gaps and flaws in the design act as productive irritations that actively promote a more critical disposition as well as invite co-creation as a valid mode of engagement.

Playtesting the sample game already highlighted the important role that defamiliarization can play in the pursuit of critical data literacy. Eef Masson (2017, p. 31) argues that "one of the great merits of digital tools is their capacity for ostranenie: for 'making strange', or defamiliarizing us from, our objects of study – and by the same token, for calling into question our most profound assumptions about them" (Masson, 2017, p. 31). On that note, the play sessions pointed to otherwise often barely noticeable differences in assumptions between players, e.g. about the role the app size plays in user preferences or, more broadly, which overlaps exist between the seemingly unequivocal app genre categories on the Play Store. D'Ignazio (2017) emphasizes that understanding the "messy process of creating and categorizing data in the face of uncertainty and complexity" is one of the key challenges of self-reflexive data use (p. 11), and the sample game raised important questions to that effect. For instance, why is Tinder – unlike other dating apps – categorized as "lifestyle"? And if the app size is epistemically different from the other metrics like rating and review count, how could we make a game that more appropriately reflects the purpose of that metric?

Observations from the co-creation process

To explore these and other questions,[10] students formed groups after the initial playtesting to design a first variation of the sample game. These prototypes, which all used the same dataset, operated similarly to layout algorithms in data visualization tools like Gephi. Algorithms like ForceAtlas2 (Jacomy et al., 2014)

require particular types of datasets (e.g. lists of network relations, geographical or chronological data) to work, and shift the focus to particular aspects of the data in question (e.g. clusters of network activity or historical continuities and outliers). Similarly, not all game mechanics[11] are compatible with all types of data, and the selection and combination of mechanics shape the procedural rhetoric of the game-as-tool. As with the discussion of the sample game's procedural rhetoric, the data we gathered were derived from recordings of the co-creation sessions, reflection reports written by students in groups afterwards, as well as notes taken by the lecturers during the sessions.

An important aspect of these "games as tools for research and scholarly communication" (Saklofske, 2017, p. 1), especially compared to forms of textual knowledge production, is the focus on the player, i.e. on how the game as a nonlinear experience can formulate an argument in multiple ways. Saklofske (2017, p. 2) focuses on making text-based games, but, for the students, making and remaking data games can also be understood as "akin to constellating and curating not only ideas, but multiple pathways through such ideas". To better understand the social and cognitive implications of these sessions, including the frequent shifting between player, designer, and academic personas, further research is needed. For instance, Giddings (2009) provides useful vocabulary to conceptualize the "microethnography" (p. 149) of video game play that can be adapted to game co-creation processes. For the purpose of this argument, however, we primarily collected design documents and notes taken during group discussions throughout the different workshop phases following the basic principles of "organizational autoethnography" (Doloriert & Sambrook, 2012, p. 83), that is "self-observation […] within higher education" (p. 86), yet without systematically recording, transcribing and coding conversations. Below, several key findings from the workshops conducted to date will be briefly summarized.

First, rather than correcting missing or malformed entries (e.g. app sizes differing per version) in the sample dataset, students aimed to account for these inconsistencies by changing and extending the game rules. One group suggested putting counters on the app

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[10] During the first playtest, participants for example speculated on the connection between the number of installs and number of reviews for individual apps, or the impact that install size might have on different target audiences' app choices.

[11] For an overview of analogue game mechanics, many of which apply to board and card games alike, see e.g. https://boardgamegeek.com/browse/boardgamemechanic.

cards if two competing apps had variable sizes and to resolve (see Figure 5) which would earn an extra point if the app could be outperformed in another category, while others suggested a die roll to reflect that a hypothetical user could have a more or less recent version. D'Ignazio (2017) argues that "new learners tend to see information organized systematically in a spreadsheet as 'true' and complete" (p. 10). Yet, cleaning up "messy" datasets (Schöch, 2013, p.2) usually adds new layers of bias, since homogenizing entries and filling gaps requires making more assumptions that are not transparent. In that regard, both game design choices represent imperfect solutions and do nothing to approximate the numerical value in question, but they demonstrate critical engagement with the metric and its function within the game context at hand.

Figure 5. *A variation on the sample game using additional tokens, created by a student team*

Second, both game co-creation and (mock) playtesting create a narrative context that not only – in some cases – helped players memorize data but also allowed for exploring their potential ambiguities. Rather than transforming data into a knowledge object, e.g. a diagram or a 3D object, the data games students created afford play experience with several relevant characteristics. For instance, sessions differed considerably in length, pacing and social dynamics – some quickly produced an uncontested winner, others led to constantly shifting alliances in order to prevent

any one player from winning (and, thus ending) the game. Yet, all sessions produced "micro-narratives" (Devine et al., 2014, p. 274) that involved and re-combined entries from the dataset in different constellations. None of the prototypes had an explicit storytelling element, even though narrative card games like *Once Upon a Time* (1993) or *Dixit* (2008) were discussed as inspiration. Yet iteratively exploring and playtesting different designs prompted narrative inquiry (Kim, 2015), in other words activating a "narrative mode of knowing", which "incorporates the feelings, goals, perceptions, and values of the people whom we want to understand" through "the use of stories in research" (p. 11). Participants not only remembered cards that enabled successful or surprising strategies along with the context they were played in, but also addressed the fact that each dataset can produce multiple, only partially congruent stories. These different stories also reflect different perspectives that can be applied to the same data, and which are defined for example by different interests and knowledge about the subject matter as well as of the collection process among participants. One of D'Ignazio's (2017) five aforementioned "tactics" involves "creating a data biography" (p. 11), i.e. compiling information about the production and dissemination of the data at hand, which raises awareness of how a given dataset was collected and organized, and may point to potential underlying motivations and biases. In comparison, the game prototypes do not elucidate the origin of a given dataset, but contrasting and comparing prototypes allows for students to explore different ways of how that dataset can be used, which makes the multiplicity of viewpoints observable in the first place. For instance, one group aimed to make the app creator's perspective more immersive by suggesting the addition of a timer to signify the fast-paced decision-making in the app economy and the rapid – and therefore often flawed – processing of data to make those decisions. Another group introduced the role of an external entity (called a "broker"), which could distribute event cards and invest in player-owned apps, thus approximating the perspective of an VC firm or incubator. This addition prompted a debate about how the game of app publishing described by the dataset is shaped by the metagame of tech investment, drawing on Norton Long's notion of an "ecology of games" (as applied more generally by Lubell, 2013 to institutional complexity). The example above indicates that game prototypes, particularly by embracing unfinishedness and malleability, can work productively as "boundary

objects" (Leigh Star, 2010, p. 602). Due to their "interpretive flexibility" and "material/organizational structure" (p. 602), the prototypes do not require a conceptual consensus for learners from different professional and cultural backgrounds to collaborate, but instead make differences in assumptions visible to the group through re-design and re-interpretation. In that regard, D'Ignazio's (2017) "tactics" constitute one of the few data literacy frameworks that acknowledges the learners' idiosyncrasies, which standardized curricula are often ill equipped to accommodate. In contrast, games uniquely allow for expressing oneself beyond established player typologies (Tuunanen & Hamari, 2012), not least because – as suggested above – recognizing and acting upon other players' assumptions and mentalities is often helpful or even required to play effectively. As such, game co-creation can sensitize learners to the vast spectrum of potential assumptions regarding data, which would be exceedingly difficult to formalize in a traditional curriculum. Comparing these stories and perspectives via mock playtesting constitutes the basis for "mak[ing] a data-driven argument" (D'Ignazio, 2017, p. 8), an important criterion of data literacy, which not only addresses the intelligibility of a dataset but also the rhetorical dimension of working with and repurposing it. Visualizations frame data corpora through selection, juxtaposition of metrics, or choice of colors, yet through co-creation, this framing characteristically also includes the rhetoric of the game-as-tool itself. According to D'Ignazio's (2017, p. 9) tactic of working with community-centered data, literacy can be promoted by capitalizing on the learners' personal "context for working with the data", which can relate to personal backgrounds or a specific neighborhood the data refer to. In the case at hand, the narrativized experience of playing and co-creating their data games becomes another shared context for the participants, which helps make the data and assumptions connected to these data relatable.

Finally, while fully implementing the notion of Discursive Game Design as an ongoing conversation takes more than a one-day workshop, each student group proposed one modification of another group's game to critically engage with the rhetoric built into that game as a model for data analysis. Using the term "critical modification", (Loring-Albright, 2015, para. 1) exemplifies how changing game rules can allow for exploring the inevitable bias inherent in any game. In his

article, the author describes solving the alleged colonialist bias in the board game *Settlers of Catan* (1995) by creating a more self-reflexive version of the game that more explicitly incorporates the "First Nations of Catan". Yet, that new version again closes off the discourse, and Loring-Albright (2015) primarily describes its creation rather than expounding on how to make critical modification adaptable to different in-class scenarios. From a Discursive Game Design perspective, critical modification is always tentative, focusing on the process rather than any given outcome. For example, one group in the present study explored the possibility for cooperative gameplay by rewarding players simultaneously placing complementary app cards, as a way for players to resist the influence of the broker entity, using the data at hand as material and inspiration to challenge the rhetoric inherent in the original game modification.

SUMMARY AND CONSIDERATIONS FOR EDUCATORS

This article aimed to explore the epistemic benefits of making data playable as a new way of providing experiential engagement with data. The field of data literacy is continually expanding, as techniques like sonification and "physicalization" (Bader et al., 2018, p. 1) promise to make data accessible via different sensory modalities. In that context, harnessing what de Koven (2014, p. 149) calls the "sense of play" can first and foremost help foster a critical mindset rather than teaching a particular data curriculum. Playful approaches towards data become more numerous, too, thus the topic of this article is by definition a work in progress. For instance, in late 2019, the *Cirque du Data* in Utrecht demonstrated a different way of playing with data through a circus show, during which "datafication was reinterpreted as an exuberant theatrical performance" (para. 2).[12] By collecting data from the audience and via "an online tool through which visitors could [give away personal data to] influence the show" (para. 2), the project tapped into the more carnivalesque (in a Bakhtinian sense) qualities of play, temporarily upending and thereby exposing the established hierarchies within the digital data economy. Apart from artistic approaches, a few commercial developments also promise to facilitate playing with real-world data. For instance, Google Maps is making its vast repository

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[12] See e.g.
http://dutchdesigndaily.com/complete-overview/40286/.

of geographical and geo-coded data available to game developers to create immersive play experiences in real cities[13] (even though, unlike the co-creation method outline above, this will undoubtedly require developers to play by Google's rules).

The analysis above is intended as a blueprint for educators to integrate data game co-creation into higher education curricula, primarily (as in this case) but not exclusively within humanities-based disciplines. To conclude, we address several practical considerations regarding the adaptation of the method to different educational settings. First, each game prototype operates as a learning tool, but the co-creation approach demonstrates how the design of games-as-tools shapes our interpretation of the data they are used to process. Thus, educators should explicitly link this insight to the use of more conventional tools like Gephi or Tableau, which are much less flexible and easily used in a habitualized manner. In that context, it is helpful to distinguish, as do Rieder and Röhle (2012), between auxiliary and heuristic tools in higher education. While the former perform supplementary functions like "communication, knowledge organization, archiving, or pedagogy" (Rieder & Röhle, 2012, p. 69), the latter shape our view on the material at hand "by rendering certain aspects, properties, or relations visible" (Rieder & Röhle, 2012, p 70). Game prototypes can be both, and the workshop examples above illustrate that both functions exhibit more overlap than the distinct labels suggest, i.e. modifying the sample game demonstrates that the game-as-tool always has implicit heuristic functions shaped by the respective design choices.

Second, we used physical cards for the workshops but also implemented a digital version as indicated above. Both approaches afford unique learning opportunities, e.g. the immediate malleability of game components and rules via analogue play, or networked collaboration between geographically separate classrooms via digital tools like *Tabletop Simulator*. In a follow-up study, these affordances and their respective benefits for different types of learners should be more systematically unpacked. For children, co-creating games often comes naturally, either in the form of changing rules they don't like or inventing entirely new games and play experiences (Alcock, 2007). In contrast, adults often lose both the incentive and the capacity to easily co-create games, and become accustomed to consume them as products rather than as material for creative repurposing (not least because, due to their commercial success, digital games especially become increasingly refined and, therefore, black-boxed as products). Thus, follow-up research should more thoroughly investigate the notion of "constructionist gaming" (Kafai & Burke, 2015, p. 314), that is how game-making "not only [...] introduces children to a range of technical skills but also better connects them to each other, addressing the persistent issues of access and diversity" (p. 313), to help adult learners re-discover their capacity to not just play but (co-)create games. This also addresses one common but still understudied aspect of serious game research, i.e. that games only unlock their potential as a learning tool through repeated play. Indeed, among communities of players deeply familiar with the rules of any sufficiently complex game, metagames (Donaldson, 2016), i.e. habitualized strategies and playing styles that proved most successful, inevitably emerge over time, forming a body of shared knowledge that enables players to actually "think through the game" about a given subject matter, rather than thinking primarily about the game itself. Thus, preserving and continually re-designing data games can facilitate that kind of long-term engagement more than any single applied game. This long-term perspective is also important since our workshops so far suggest that playing, designing and evaluating data games activate different forms of cognitive engagement and produce different types of knowledge (Nelson, 2006). Experiences and insights from one phase do not automatically transfer seamlessly to the next, and these different activities should be interspersed as much as possible in the structure of the exercises to make students aware of how they are interrelated and can inform each other. This is especially relevant given the increasing cooperation between universities and institutions of applied sciences in the higher education sector; in these cases, specific emphasis needs to be placed on incorporating the more diverse design experiences of students, but also on addressing the different concepts of critical making and reflection.

Finally, to effectively participate in Discursive Game Design and to deliberately rephrase the procedural rhetoric of a data game via critical modification, players require knowledge of a wide range of game mechanics. Similar to the difference between active and passive vocabulary, mechanics like deck building, asymmetrical goals, worker/engine placement

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[13] See e.g. https://www.fastcompany.com/90164228/google-maps-cool-new-tool-turns-your-real-city-into-a-game.

or action point allowance can be easily taught but require time and practice to actively become part of the students' expressive repertoire, the seeds of which could already be observed during the 6-hour workshops conducted so far. Similar to how new layout algorithms offer different perspectives on data[14], becoming fluent in the language of game design allows for making increasingly nuanced arguments by playing with data. Hans-Georg Gadamer famously argued that "the real subject of the game [...] is not the players but the game itself" (quoted in Aarseth, 2014, p. 181). That is, "the attraction of a game, the fascination it exerts, consists precisely in the fact that the game masters the players" (p. 181), an epistemic ambiguity that arguably applies to both commercial and so-called serious games. In that context, game co-creation can not only help foster data literacy but also help people avoid being played by data games as tools of knowledge production.

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[14] See e.g. the creation of animated graphs representing spiraling global temperature increases (2016), which notably reframed the familiar underlying data as well as the societal

debate surrounding them; http://www.climate-lab-book.ac.uk/2016/spiralling-global-temperatures/.

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