ENGAGEMENT BY LAMINATION OF AUTOPOIETIC CONCENTRIC INTERACTION SYSTEMS IN GAMES: A STUDY OF FOOTBALL AND POKÉMON GO

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Abstract: *The aim of this paper is to rethink games and game design within the theory of self-producing interaction systems. With this research, I seek to identify several dynamics of play and engagement elicited by games that, by extension, can serve as game design parameters. The research is oriented toward an analysis of football (soccer) and Pokémon GO within the context of Niklas Luhmann's (2002/2012) theoretical framework of autopoiesis (i.e., self-producing interaction systems). The theoretical discussion of play situations in the two games reveals five concentric interaction systems through which games motivate play and engagement. These game dynamics are continuing simultaneous communication, multiple observations, double expectations, system autonomy, and unexpectedness through system coupling. The study further shows that when a game succeeds in eliciting these dimensions, functional, continuous, and changing structures allow for the emergence of numerous behaviors and the production of new interaction systems.*

Keywords: *game design, autopoiesis, self-producing systems, interaction systems, engagement, game structures, systems design.*

INTRODUCTION

The aim of this article is to rethink game functioning and design by analyzing games within the concept of autopoiesis and autopoietic systems as dimensions of communication, following the theory proposed by Niklas Luhmann (2002/2012). Autopoiesis describes how communication (i.e., a network of processes) between various components of a system leads to producing and reproducing the components that the very same system comprises (Maturana, 1975, p.18). The autopoietic system thus is not produced by something outside the system, but rather the components "reproduce themselves from within themselves, as for example a plant reproduces its own cells with its own cells" (Seidl 2004, p. 2). From a game perspective, autopoiesis could be exemplified by how the great masses of people (networks of processes) who played Pokémon GO interacted (with each other and their immediate environments) and, by such, established communication systems that produced additional communication systems associated with the gameplay, but in varying locations and with a different organization and intention. Thus, a communication system (play) produced a distinctly different communication system (also play).

Luhmann's (1990, p. 83) statement that "meaning is the link between the actual and the possible" formed the grounds for a theoretical analysis of how games can elicit play that leads to autopoietic systems and, in turn, meaningful experiences of play and engagement over longer periods of time. The intention with autopoiesis as an angle for the analysis is to allow a broader understanding of the functions of play and games. It also allows for further investigation of how these may represent engagement and, by extension, how the degree of complexity of play behavior relates to engagement and experienced meaning. Engagement is a vital component of game functioning, particularly in regard to how people relate to objects and to other people within the game system.

With this study, I seek to identify and define systems of interaction contingent on or created by games by way of a real-world team sport and an online collaborative game in order to identify the general properties of games that may describe engagement. To analyze the concepts of engagement and autopoiesis in greater detail, I selected the real-world game and team sport of football (also known as soccer) and the augmented reality (also known as mixed or hybrid reality) game Pokémon GO as the online collaborative game. Both games have experienced worldwide popularity. Although football maintains ongoing interest at various levels, Pokémon GO has seen a decline in popularity. The differences between the games (e.g., real-world vs. augmented reality, steady vs. declining popularity) provide an interesting stage to compare play behavior between the two games in regard to play, autopoiesis, and in-game communication. Further, analysis of these differences supports better understanding of what drives game popularity.

The study of engagement, or immersion, in game play is a new and interesting research line for understanding better what instigates players to join a game and, more importantly, remain playing (see, e.g., Abbasi, Ting, & Hlavacs, 2017; Brown & Cairns, 2004; Jørgensen 2011; Linderoth, 2012; McMahan, 2003; Schoenau-Fog, 2011). For example, Linderoth (2012, p. 490) found that children fantasized through role-playing as an associated activity when playing the computer game World of Warcraft to become more engaged in the game play. Subsequent to this role-playing, expectations emerged for future narratives to occur in forthcoming play. Accordingly, World of Warcraft served as a platform for autopoiesis, as a

new game of role-playing emerged, or was produced, by the network of processes originated by the game itself. The role-playing game fused into the entire game experience for these children. World of Warcraft (including role-playing) thus served as agency for engagement for either team play or independent-but-collaborative play. Pokémon GO, which functions both in the real world and in the fictional digital world (see the Appendix for an explanation of the game), comprises similar functions. The coincidental stimuli that happen outside game play but as a result of play—for example, the encounters with other players in a park—influence the total experience of the game play itself. Within this understanding, Pokémon GO is the origin for autopoietic functions in that the game leads to new networks of processes outside the game play that contribute to the total experience and increased engagement of play. In research on Pokémon GO, these functions often are referred to as social benefits or motivation and, to some extent, engagement (see, e.g., Kaczmarek, Misiak, Behnke, Dziekan, & Guzik, 2017; Rauschnabel, Rossmann, & tom Dieck, 2017; Tang, 2017). Immersion is foremost studied as a dimension of computer games and mainly described as "being caught up in the world of the game's story" (McMahan, 2003, p. 68), which McMahan referred to as the diegetic level. However, immersion also refers to the nondiegetic level that illustrates "the love of the game and the strategy that goes into it" (McMahan, 2003, p. 68).

Engagement, on the other hand, is understood somewhat differently in research on sports. Best (1980) used the notion "purpose" for purposive sports and "aim" for aesthetic sports. In aesthetic or "nonpurposive" (Kreft, 2015, p. 132) sports, such as freestyle skiing, the significance, and thus the degree of engagement, is influenced by "the manner of execution" in addition to the level of competitiveness (i.e., one's score is determined by turning technique, air maneuvers, and speed). However, in purposive sports, such as a 100-meter track sprint, solely the drive for a result elicits engagement (Kreft, 2015, p. 131). Nonpurposive sports and games thus, within this argumentation, incorporate engagement and an inner drive that can be described as a condition rather than a goal, a condition similar to the role-playing activity that Linderoth (2012) identified in children playing World of Warcraft. Accordingly, a nonpurposive activity introduces a drive that may not or cannot be fulfilled (i.e., there often is no objective outcome but rather subjective assessment of skill). Thus, it is the numerable experiences or feelings elicited during the sport that is of importance. Within this understanding, aim and drive in sports and games represent agency for people to become engaged, which can be described as the desire to participate in the game and to influence other players or the outcome. In purposive sports and games, similar mechanisms may be at work, however the lack of nonpurposive drives and aims narrow the space for variable experiences beyond the one of competition.

In this research, the term engagement is utilized to describe involvement: the drive for involvement and the manner in how this involvement is executed in a game unbound by the game's result. Thus, engagement is considered a nonpurposive condition (Kreft, 2015, p. 132) even in a purposive sport. The research on play behavior elicited by the games in this article is thus not oriented toward the particulars of the various experiences of engagement during play as much as *how* engagement is generated by play behavior (Brown & Cairns, 2004), play systems, and specifically, by autopoiesis.

Unlike stable social systems, dynamic communication systems may appear and disappear quickly. Dynamic communication systems are driven mainly by the expectations and needs of the people within the functioning system, which are, as well, based on a history of expectations and interactions (Maturana, 1975; Maturana & Guiloff, 1980), or "interaction systems," which

is the term Luhmann (2012) used to describe such autopoietic systems. Interaction systems, like all social systems, "reproduce themselves on the basis on communication" (Seidl 2004, p. 14–15), and thus they are autopoietic. Interaction describes personal encounters, meaning they are contingent on active physical (or virtual) presence in contrast to any other social system. "Since the interacting objects involved in interaction, [*sic*] act too," interaction is contingent as well on a player's "interaction for intervention in the course of events" (Luhmann, 1995, p. 523). Interaction thus describes an active communication role in personal encounters performed in order to intervene and influence—but may also describe the act of playing—a complete game, both which can be understood as autopoietic interaction systems. However, in order to explore engagement during play, I have separated play into distinct temporarily subordinated interaction systems or encounters that emerge in a timeline of playing a game. The sequence of encounters of the kind that is produced by play itself to enrich play is what Goffman called "concentric frames" or "keying" (Davis & Goffman, 1975, p. 599). Concentric frames embody subordinated interdependent frames during play that make up the total frame of play. The concentric frames within the context of play, which function as autopoietic interaction systems yet compose only small sequences of a strip (or sphere) of playing a game, are referred to as concentric interaction systems in this article (see Figure 1). Concentric interaction systems thus represent the various subordinated frame levels. An example of a concentric interaction system could be the encounter by and interaction with Pokémon GO players, who transform the basic elements of play into the further experience of play.

The focus of this paper thus is the role of autopoiesis (i.e., self-producing systems of interaction that are self-organizing structures) in games and game engagement, whether the game is online or offline. The extant discourse within the research field of computer games contributed
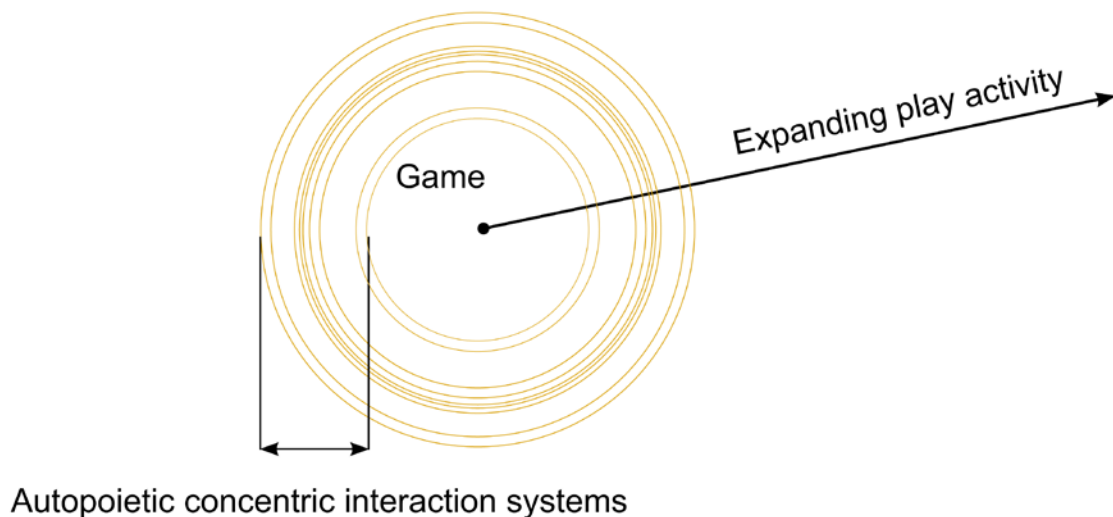
Figure 1. Intertwined layers of autopoietic concentric interaction systems (circles) emerge during play. The play activity is a complex process that expands in all directions once the activity begins. Thus, the play activity is illustrated here as starting in the center with the initiation of play; the graph widens and the laminations thicken as play continues. The layers of autopoietic concentric interaction system are designated as circles. The composition of the concentric layers is quite varied by type of game or how a particular game is played; they also vary throughout the game based on the changing circumstances of play.

contributed to the research design I established to explore engagement in Pokémon GO and football. As a reciprocal effect, the gained understanding of engagement in football may contribute to the description of immersion on the nondiegetic level in computer game research. The concentric interaction systems recognized as eliciting engagement, identified in both games by theory on autopoiesis, contribute to rethinking game theory, game design methodology in general, and specifically in augmented reality games and sports. The presentation of these systems as layers (sequences) of play that elicit engagement may represent a way of thinking that can lead to the identification of additional systems based on a similar research design. In addition, the concentric interaction systems can serve as analytic tools for understanding other games, as well as design methodology for creating new games—from offline reality to digital virtuality—for the full range of gaming experiences. In addition, the findings support a methodology in both service and product design that is capable of activating and motivating users.

METHODS

The role of this paper is to investigate concentric interaction systems and processes and to explore how they may serve as engagement in play. In doing so, this research extends the concept of autopoiesis into the exploration of game design. My research seeks to answer two primary questions: How can football and Pokémon GO be described through theory on autopoiesis? How does autopoietic concentric interaction systems relate to feelings of engagement and the processes of keying?

Football and Pokémon GO (see the Appendix for brief descriptions of each game) were selected from myriad virtual, augmented reality, and physical games because I wanted to study two games with different dynamics that clearly elicited engagement. As a general criterion, I considered the popularity of the two games a consequence of play engagement. Both games were highly popular worldwide in 2016. Just a few weeks after Pokémon GO was released, over 100 million players from 30 countries had downloaded the game and played 1 hour per day on average (Zsila et al., 2017). Secondly, research on both games suggested that the social or communicational facet of playing these games is a key factor for their popularity (Giulianotti, 1999; Tang, 2017). Third, I wanted to study games that had similar levels of accessibility. Both games are easy to grasp and were at the point of this study typically played by people of all ages, gender, social status, and skill levels (Giulianotti, 1999; Kogan, Hellyer, Duncan, & Schoenfeld-Tacher, 2017; Tong et al., 2017). That is, the players of the two games do not need to be gamers nor elite performers. Additionally, at the point of writing this article, both games were common activities in various cultures, making it natural to talk about and observe play in numerous public spaces.

The two games are different in many ways. Accordingly, a direct comparison of the game mechanics is not the major intention of the research design. The differences between the two games are significant and one may criticize the choice of the two games as being too diverse. I could have chosen a massively multiplayer online role-playing game (MMORP) for this study due to its degree of stimulating online communication among the players (Linderoth, 2012) and it being more in line with the practices in real-world football play. However, Pokémon GO represents a game that elicits few types of play yet it enables

activities that are both physical in a geographical sense and online (Tong et al., 2017). Thus, the choice of this game opens analysis of hybrid gaming. In regard to the challenges in comparing the selected games, I saw no need to search for equality in game structure and ways of play; on the contrary, I found that the absence of a dimension in one game served to elicit insights about the other.

The study is primarily a theoretical exploration supported by examples identified in qualitative research through fieldwork based on typical ethnographic principles that stress the immersion of the researcher within a specific social setting to "engage with the group on its own ground" in order to attain a holistic understanding of a situation (Hobbs, 2006, p. 3). The fieldwork consisted mainly of my own playing and observing of others while playing football and Pokémon GO. My aim in undertaking this approach was to gain insights into concentric interaction systems and their complexity and the communication among players and its influence on gameplay (see Mortensen, 2002). My ethnographic approach builds primarily on a synthesis of self-ethnography (Alvesson, 2003, p. 168), or autoethnography (Allen, 2017, p. 2), which represent similar concepts, and "virtual ethnography" (Hine, 2008, p. 2). For this research, virtual ethnography was employed to some extent to explore the "social interactions that take place in virtual environments (Kozinets, 2012, p. 2)." Although Pokémon GO represents an augmented reality environment, the observed in-game online communication was marginal. Therefore, the virtual ethnographical study concentrated both on communication within the game and, to some degree, communication through Instagram, where players informed each other about aspects of game play. Autoethnography, which is an autobiographical type of ethnography that "emphasizes the lived experiences of researchers to access culture as communicative accomplishment" (Allan, 2017, p. 2), was chosen as a method to collect data from the two games because I was "highly familiar with" and "had direct access to" (Alvesson, 2003, p. 167) the particular play situations for the study. Alvesson (2003, p. 168) underscored the struggle researchers face between "utilizing closeness to [an] empirically rich situation" and of being a native, which implies familiarity that may hinder a richness in the approaches for collecting data. However, by playing both games, I have had the opportunity to be an "active participant, more or less on equal terms with other participants" (Alvesson, 2003, p. 174), as well as benefiting from play that involved a "personal engagement with the subject [which] is the key to understanding a particular culture or social setting (Hobbs, 2006, p. 102).

The quality of the empirical data collected by autoethnographic studies in skill-demanding games relates to the skills of the ethnographer (Linderoth, 2012). I have attained experience as a football player through playing the game in arranged and recreational settings for 25 years. As for Pokémon GO, I played on a daily basis for 6 months, beginning with the game's release in Norway in July 2016. The emphasis of this study thus lies on playing these games rather than spectating. Accordingly, the insights attained about the games are derived from theory, my own play experiences, and some observation of other players. The findings emerged during my analysis of play within the framework of sociology and Luhmann's (1995) theory of autopoiesis.

The autoethnographic study generated by playing the two games and the comparative analysis between the empirical data and the theory on autopoiesis led me to identify and define several (autopoietic) concentric interaction systems (i.e., engagement, communication, and complexity in gameplay). By extension, I analyzed these concentric interaction systems from

the perspectives of game and play theory (see, e.g., Caillois, 1961; Goffman, 1961, 1986; Huizinga, 1949/1980; Juul, 2011; Perinbanayagam, 2006; Salen & Zimmerman, 2004; Suits & Hurka, 1978/2005; Sutton-Smith, 1997), with an emphasis on the concept of framing (Goffman, 1986), in order to discuss how the game dynamics relate to feelings of engagement. The empirical data support a theoretical argument for discussing the phenomena (e.g., Pedhazur & Schmelkin, cited in Nelson & Nilsson, 2002) rather than substantiating them. The engendered data built upon the observation of systems, but the discussion in this paper focuses on understanding exceedingly complex communication systems as a facet of play.

The epistemological position for systems theory lies somewhere between a positivistic/systemic view and a social-constructivist view. For example, Varela (cited in Reynolds, 2005, p. 540) acknowledged existing systems as "closed organizations" and thus possibly observable entities, while Churchman (cited in Reynolds, 2005, p. 541) noted that "systems are predominantly in the mind of the observer rather than in the real world." The views of Maturana (cited in Reynolds, 2005, p. 541) lie somewhat between these perspectives and in line with second-order cybernetics (i.e., self-observing and adjusting systems). Rather than approaching reality as observable and outside oneself, the researcher recognizes him/herself as a participant of the same reality that is the object for the study (Pickering, 2010). Accordingly, the researcher "is being a co-creator of that reality" (Budruss, cited in Bell & Morse, 2008), a description that also illustrates the ethnographic method for this study.

Because a player has agency and is nurtured by a game's structure and rules to behave in a certain manner, the "theory of action must have difficulty imagining how the recursive closure of the social system and the production of something from its own products might take place" (Vanderstraeten, 2012, p. 384). That is, believing the possibility that the creation of something new by playing a game (systems of communication, behavior, etc.) in accord with the very rigid structure established by the game (i.e., predefined behavior by rules) presents a dichotomous position to the constructivist. This is because social constructivism explains how a given context constructs specific ideology, behavior, skills, knowledge, and attitude (see, e.g., Hacking, 1999; Latour & Woolgar, 1986), which is opposed to theory of autopoiesis that describes the creation of something new (known and unknown) on the basis of given and new contexts (structures).

Luhmann (2002/2012) sought to explain social behavior through communication as a dimension of interaction systems in order to distinguish systems theory from the action-oriented constructivist view. In this research project, I acknowledge Luhmann's perspective, but I also recognize that interaction systems can be part of or function by movements and behavior (Gibson, 2015; Kreft, 2015). Behavior in this context can be understood as a living being's perspective or attitude that is observable as movements or actions (Maturana & Varela, 1987, p. 136). The emphasis of this study, therefore, is on communication in social interaction in its broadest sense, in line with Porter and Samovar (1997), who defined communication as encompassing all behavior (i.e., speech and body movements) that has meaning to another, whether or not it is intended. This research project draws on research that explores communication created among players as one example of autopoiesis in action.

Finally, the benefit of autopoiesis as a tool for analysis is that it also can be a metatheorical approach. Maturana (cited in Luhmann, 1995) suggested that autopoiesis is a metatheory because it engenders instructions for empirical research by asking "What if?" questions. Systems thus can

be understood as whole systems judgments used primarily to raise people's understanding through enabling the right questions to be asked.

LAMINATION OF COMMUNICATION LAYERS IN GAMES AND PLAY, DEFINITIONS

A clarification on how game and play are understood is necessary in order to perform the analysis of this research. I therefore introduce some ideas and definitions from central works within research on game and play. Further, I synthesize and discuss these works toward a suitable understanding for this research context, which covers both video and physical games.

Games and Play

Games, as seen by Salen and Zimmerman (2004, p. 96), are systems. Within these systems, a player's "agency is based on cognitive processes that are oriented to the others in the relationship as they are put into practice" (Perinbanayagam, 2006, p. 11). Hence, games invite a "reciprocal relationship of some kind between two elements [players or things] in a system" (Salen & Zimmerman, 2004, p. 58) that influences game play. Juul (2011) categorized games by how they challenge players through either an emergence or progression structure. An emergence challenge is characterized by small sets of rules that "combine and yield large numbers of game variation for which the players must design strategies to handle" (Juul, 2011, p. 5). These actions typically take place in sports (particularly team sports), card games, and strategy games. Progression structures involve leading the player through a "predefined set of actions in order to complete the game" (Juul, 2011, p. 5), typically seen in video games. Within this distinction, football represents an emergent structure because it is easily accessible and has rules eliciting an abundance of varieties of play. Pokémon GO, on the other hand, may fit both categories. The game introduces several predefined sets of actions to perform (i.e., catching Pokémon); however, the manner of how the player approaches these activities may vary. For example, the player decides where to go, which Pokémon to catch, and how to pursue whichever parts of the game s/he finds most interesting: merely collecting Pokémon, finding rare spots, competing in gyms, and so forth.

Juul (2011) argued that fantasy and rules in games are so intertwined that they create a complete experience and stimulate each other by establishing circumstances that are experienced as "half-real" for the player. Thus, if a person who is deeply engaged in the Lord of the Rings storyline plays a related computer game, s/he may become so immersed when playing that the gaming world or activity may feel somewhat real. Hence, games can be seen as a relation between rules and fiction (Juul, 2011). Linderoth (2012), in contrast, found that engagement is not achieved by a game's rules and fiction alone but includes personally constructed narratives through, for example, role playing as described in the World of Warcraft example. He also found that a technological progression structure may hinder the occurrence of role-playing. In Pokémon GO, the player functions simultaneously as a real person in the material world and as an avatar in the fictional augmented game reality, a situation that resembles role-play in description and the half-real play experience. However, even though some Pokémon GO players also share communication among real players via

the Internet or through personal encounters during play, the progression structure does not rely on encounters of any sort nor role-play. Role-playing and fiction serve different functions in football but may be present by, for example, children acting similarly to their heroes, choosing teams as imaginative settings for a match, and so forth.

Play, on the other hand, can exist either within the structure of a game or as an autonomous activity, although I focus in this research on play in relation to games. Sutton-Smith (1997), a play theorist who investigated play through interdisciplinary approaches, described play as a phenomenon that comprises several dimensions, depending on the complexity and variability of the situation. Based on Fagen's understanding of play, Sutton-Smith (1997) suggested that the psychological side of play represents a continuous variation that creates a condition in which social simulation can occur alongside the player's mastery of skills or failure to take control. Within this framework, play is dependent on imaginative eventualities, potentiality, and/or experiences, which in turn form the foundation for fantasy and imitation, which may further lead to the creation of play narratives, fiction, and rules. Huizinga (1949/1980) defined play as a fun, voluntary, and free activity outside ordinary life. Similarly, Fagen (cited in Sutton-Smith, 1997, p. 34) understood play as "aesthetic performance" and a "motivational attitude of well-being." Drawing on Piaget, Sennett (1977) argued that infants often take risks and abandon existing sensations of pleasure during play in order to find new kinds of pleasure. Thus, by extension, when people direct a play activity through experimentation and risk-taking, that is, taking control over one's own self and in cooperation with others, they "step away from immediate desire or instant gratification" (Sennett, 1977, pp. 315, 318). They pursue new and complex play situations in their quests for variation, socialization, pleasure, or fun. This is in line with Huizinga (cited in Mandoki, 2007, p. 220), who stated that "the opposite to play is not seriousness but the automatic."

Thus, play relies on engagement and games elicit engagement. Suits and Hurka (1978/2005, p. 10) described games as a "voluntary attempt to overcome unnecessary obstacles." This definition considers both rules and playfulness, but fails to include the importance of engagement or the affective and communicational dimensions of playing a game. Juhl's (2003, p. 36) version takes this dimension into account, noting that "a game is a rule-based formal system with a variable quantified outcome, where different outcomes are assigned different values… and the player feels attached to the outcome." The engagement or emotional facet that Juul (2003) referred to, however, describes how a player becomes emotionally attached to the outcome of play and not to the play itself. Perinbanayagam (2006), however, incorporated the engagement, social, and dialogic dimensions of games, indicating that games are

> acts that human agents undertake, as players or spectators, to achieve cognitive involvement and emotional engagement with the other. The playing of games is, in fact, a conversation, a dialogic activity that systematically involves other agents, a continuation of the other processes of everyday life. It is also a means by which a human agent achieves intercourse with the other by using a range of symbols that is broader than language. (Perinbanayagam, 2006, p. 3)

Perinbanayagam's (2006) understanding of game play is that it involves aspects of daily life, but it does not include how personal interactions have direct consequences for reality. However, Perinbanayagam underscored that the degree of complexity of communication within

game play, particularly in team sports, is broader than general language use. Such complexity within an emergent structure such as football involves tactical and motoric activity as well as simultaneous communication among multiple players.

Framing

Goffman looked upon a game as a frame that serves as a boundary or membrane that allows "world building activities" (Goffman, 1961, p. 21) in that the frame isolates personal encounters (planned or unplanned) within focused gatherings (1961, p. 8). Thus, a frame serves as the "principles of organization which govern events—at least social ones—and our subjective involvement in them" (Goffman, 1986, p. 10–11). A frame then is a temporary shared environment for the participants within an activity (Linderoth, 2012) where they solve challenges posed by the activity parameters by abiding by common rules (Goffman, 1961). The frame becomes established by the rules and/or by the physical and augmented environment. Goffman's (1986) concept of frame is presented as permeable, and thus differs from Huizingas' "magic circle" (1949/1980, p. 10), which is consciously outside the conception of daily life. Permeability illustrates how the frame membrane allows the passage of something, which explains how a player is connected with real-life situations while playing. Further, permeability reflects how the choices and actions during play can have consequences not only for the fictional part of the game, but also for players' (and spectators') lives beyond the game.

Goffman's (Davis & Goffman, 1975) frame analysis presented two components: the cellular and the concentric (peripheral). The cellular dimension in Goffman's conception of frames involves describing the specific or temporal membrane that surrounds an activity. With games/play as the example, the description of the cellular dimension of the frame involves distinguishing what is considered the play itself, which represents the cell nucleus, from the plasma (i.e., the variety of outer activities involved in allowing the nucleus to take place) and from the concentric dimensions of a frame. Concentric analysis describes the break-down of various peripheral layers, like onion peels, that frame a moment of activity and the specification of the ways a primary social event is transformed into less fundamental ones (Davis & Goffman, 1975), such as, for example, the communication layer that transforms the concept of a fight into a play fight. Accordingly, analyzing the concentric transformation layers, or layers of "keying," as Goffman (1986, p. 82) called it, involves investigating the added concentric layers of transformation to the experience of an activity. Playful fighting then is an act of keying because of the transformation of the primary activity of fighting into a ludic activity (Caillois, 1961; Mortensen, Linderoth, & Brown, 2015). A frame, however, is a vulnerable construct, and if a participant in this playful fight suddenly demands the activity to stop because s/he is afraid, the activity is drawn back toward reality, in what Goffman called downkeying. The action of adding layers within a frame that elevate play away from reality is called upkeying (Goffman,1986, pp. 352–366). A primary activity also can be upkeyed by rekeying. In this process, the nature of the activity is changed to allow keying, done for example by adding a layer of fiction to the activity in order to adjust the narrative within a culture toward a ludic activity. As an example, a game inspired by the systemic organization of World War II could be rekeyed by involving fictional countries to avoid the need to address the ideology of Nazism (Chapman & Linderoth, 2015, p. 141). Moreover, concentric transformations may allow or protect play activity from the norms

within the culture that would normally prevent it. For example, football allows legal moves that are appropriate in football but not on the street, such as a tackle.

The second kind of a frame transformation that Goffman mentioned was "fabrication," which is the intentional effort by one player to induce the other players to develop a "false belief of what it is that is actually going on" (Goffman, 1986, p. 83). All players agree upon the function of keying but only some parties are aware of the fabricated transformation (Davis & Goffman, 1975, p. 599). An example of fabrication is known as the "backdoor move," often exhibited in basketball (Schmidt, O'Brien, & Sysko, 1999, p. 576). Such a move involves an attacker advancing the ball toward his/her opponents' goal then suddenly turning around and taking a couple of steps toward his/her own goal, followed by a quick turn back toward the opponents' goal. The backdoor move aims to exploit "the space just created behind the ensuing defender" (McGarry, Anderson, Wallace, Hughes, & Franks, 2002, p. 778). The offensive player created in the mind of the defender a false expectation that the first move toward the goal was the actual play, when in fact it was the second move forward.

The concept of framing involves different levels of communication and interaction systems. Thus, in order for the game to function, the players must inform and agree upon the terms of the frame and to influence and follow the wavering of up- and downkeying during play, as well as shown and hidden information. Fabrication and keying are dimensions of engagement when functioning. Downkeying can only take place when play has already added concentric layers of upkeying; it may serve to destroy or end play. That is, if a child in the middle of play proclaims that s/he does not want to be a superhero any more, play loses a layer of keying as the child turns into just being a child again, and play may end. Similarly, if a football player leaves his/her designated attacking position during a match and decides only to prevent goals by the adversary team by standing in front of his/her home goal, a layer of keying or engagement is taken away. Moreover, that strategy may result in altered or distorted communication and/or cooperation.

In his work, Goffman highlighted games and fun, but his primary emphasis was on developing "the study of face-to-face interaction as a naturally bounded, analytically coherent field—a sub-area of sociology" (Goffman, 1969, p. ix). However, researchers have found Goffman's theories useful in the sociology of sports (see Birrell & Donnelly, 2004) and within research on videogames, analogue games, and sports (see, e.g., Chapman, 2016; Giulianotti, 2005; Kreft, 2015; Linderoth, 2012; Stenros, 2014).

Theory on framing in light of Goffman (see, e.g., Linderoth 2012) provides an understanding for how the function of keying can initiate and alter play engagement. Keying depends on a common agreement among the players and occurs in multiple layers and forms. Hence, when communication among players in a game serves as an influencer on the way the game proceeds, play activities will waver, take many directions, and cause exceedingly complex interaction systems to occur. In order to understand how concentric interaction systems are experienced, I find the concept of framing an important basis for analysis, given the exceedingly complex systems in games. Further, an analysis can be performed without the need to reflect on narratives, and thus the diegetic dimension, but yet include the fictive or fantasized.

Rethinking game design within the concept of autopoiesis may then be illustrated as an investigation of the lamination of communication layers that autopoietic concentric interaction systems create in games. Additionally, the analysis involves how these layers serve as keying and fabrication, and thus engagement.

AUTOPOIESIS

In systems theory, autopoiesis explains how new systems emerge from given settings through interaction and how these emerged systems can produce additional new systems. Autopoiesis was first proposed by Maturana and Varela (1987) and describes the nature and functioning of nonlinear self-producing systems in biology. Luhmann (1995) reapplied this theory to sociology. Complexity theorists also found these concepts useful in the study of dynamic, exceedingly complex systems (see Hernes & Bakken, 2003; Pickering, 2010). Tangen (2004) utilized Luhmann's theory to explore behavior in relation to sports and sport facilities.

In any activity in which two or more entities are involved, communication forms an essential means to bind them within the goals and interpersonal interaction of the activity. This is true whether the entities are humans or technology. Luhmann (2002/2012) was inspired by cybernetics and by Gregory Bateson, who defined information as "a difference which makes a difference" (Bateson, 2000, p. 315; see also Vanderstraeten, 2012). By this statement, Bateson meant that the entities not cognizant of someone (e.g., a person passed by in a park but not seen by a Pokémon GO user because of the user's concentration on the game interface) do not inform a situation, in that people do not get stimuli from things that, even though present, are not perceived. Communication then is formed by a person's selections from observed information made available through functioning systems (Shannon & Weaver, 1949, p. 218; also van Assche, Duineveld, Verschraegen, During, & Beunen, 2011). However, individuals do not have to discover entities themselves. In other words, people may also perceive because of the shared perception of others in that the decisions and selections made on the basis of information by others is communicated by behavior. For example, a Pokémon GO player may not see a Pokémon on his/her screen, but through discovering and following running by other players toward a rare Pokémon, the one player who did not see the Pokémon on his/her screen is suddenly informed.

Accordingly, when information is (re)acted upon by another, an individual is given a new or parallel possibility to discover (interpret) information. This secondary layer of communication thus works similarly to an augmented filter in that the player can react (play) on the basis of other players' understanding of a situation (interaction systems). Such a possibility may facilitate the emergence of interaction systems (including parallel or subordinate systems). Logically, it also increases the complexity of the interaction system. In such a context, an interaction system can be understood as an aspect of language itself. Yet the comprehensibility of any communication system relies on participants or spectators understanding the linguistic/behavioral code and the dynamic nature of communicative applications (Hughes & Bartlett, 2002).

Autopoietic systems emerge amid specific contexts, constraints, and structures. Within these systems, communication among entities or participants is created and influenced, resulting in actions that impact the structures, contexts, and constraints. At times, the process results in entirely new systems and structures that, at times, can exist and operate simultaneously alongside the originating system.

Structures and Self-Organization

A structure is what makes a functioning system possible. Everything that the system makes use of is what defines the structure (Luhmann, 2002/2012). Luhmann understood society as a variety of complex and intertwined interaction and communication systems. Each system

(games, people, things, microorganisms, etc.) emerges out of and exists within an enclosed structure, thus creating its own reality and forming the basis for sustenance, necessities, decisions, and selections of information, among many processes. The autopoietic activity influences the structure that makes the basis for the system, and the structure influences the activity. As a result, the structure is "self-organizing, in the sense that [it is] produced by the systems' own operation" (Luhmann, 2002/2012, p. 70). Any operating self-organized structure "serves as the point of departure for many further operations" (Luhmann, 2002/2012, p. 70) and structures. Accordingly, a system may emerge and function because of a structure while it concurrently influences or reproduces the structure. As an example, people may create a game and start to play (self-produced system) because of a sudden awareness of a round object and a flat ground (structures), and the play (functioning system) ultimately may influence the structure by, for instance, the decision to add baskets to catch the ball, which again may stimulate the emergance of rules (structure) that will change the original structure (e.g., by adding lines on the ground). The structure served as the origin for new systems to emerge (autopoiesis) and the restructuring of the subsequent systems result from experiences of play and self-organization (Luhmann, 2002/2012, p. 72). Structures are temporal in that they exist only when they are part of a functioning system. Accordingly, a set of rules, a field, or a board game does not represent a functional structure unless it influences interaction or play (e.g., the use of the game or talking about the game). Furthermore, physical constructions (i.e., buildings, goals, fields, smart phones, computers, game systems) and physical characteristics (e.g., players, locations on the field, field quality, ball velocity) form part of a structure only if they contribute to the system. Hence, if a seagull should fly just above the grass of a football field during a match without influencing the play in any sense, the game structure is not affected: The bird is neither part of the structure nor the system.

As a result, a functional structure presents a specific, transitory context in which a system is active, and the context consists of everything limited to the functional structure or confined environment (Luhmann, 2002/2012). These dynamic systems result from activities that are always in flux and are driven primarily by assumptions based on expectation phylogeny, current intentions, and future goals (Maturana, 1975; Maturana & Guiloff, 1980), which, in this context, is the game.

For this research, my view is that play elicited by emergence game structures (Juul, 2003, p. 73) produces concentric interaction systems enabled by functions of framing and keying. The player must take risks to create something new or advance toward the intended outcome. Concentric interaction systems in games rely on adaptability and change and hence play. According to systems theory, it is possible that automatic behavior in games may stimulate autopoietic processes. That is, just doing what is always done may unintentionally serve to influence or create when colliding with a new type of organization. For example, playing with the very same type of game strategy regardless of what kind of opponent a team may encounter in a football match may produce new autopoietic interaction systems. Therefore, even though the organization is unchanged from one match to another by one team, the structure (conditions) of the match changes because of the differences in football philosophy by the opponents, the players, field conditions, atmospheric conditions, and so on. However, automatic behavior, echoing play behavior from many other occasions, lessens the chance of play and/or engagement and the creation of new concentric interaction systems. Creating a new organization or system thus relies on engagement and the will to change the organization of the frame (Luhmann, 2009).

When communication among players leads to self-organization of any kind, play defines the game structure, as well as ongoing and further communication. Then play is autopoietic, in that interaction is produced by interaction. Communication in play systems are therefore influenced by autopoietic processes, the consequent communication history, and the ultimate change as a result of these processes. The communication that emerges during play does not work outside the frame of play as it happens, in that the play is dependent upon the structure for which it was created to function. This is because the play system involves self-referentiality, meaning it reorganizes without obtaining resources from outside the system (Luhmann, 1995, p. 62). Thus, play may establish "a kind of internal environment through which one can peruse, feed, and correct communication" (Luhmann 1995, p. 414) explicitly because they are self-driven. These internal environments are autopoietic interaction systems (Luhmann, 1995, p. 409). Therefore, interaction systems are autopoietic systems in that they produce interaction systems without external resources. They require nothing from outside the system to function, to stimulate interaction, or to reproduce interaction. However, they are easily interrupted or perturbed by the nearby or surrounding environment (Luhmann, 1995, p. 414), such as, with football as an example, by a sudden thunderstorm or unruly fans. Thus autopoietic systems function in ways similar to permeability within frames as described in Davis and Goffman (1975).

Concentric Interaction Systems

In this research, concentric interaction systems are understood as layers of self-producing communication that serve the keying that occurs during gameplay. Concentric interaction systems in this conceptualization, thus, are autopoietic in nature. And at their most fundamental, they comprise the activity of playing a game.

For the purposes of this analysis, I have focused on concentric interaction systems and how these can be understood in an analysis of game engagement from an autopoietic view. In many ways, a functional structure resembles a frame as described by Goffman (1961). The functional structure and interaction systems thus equate to a game in a cellular perspective, and the self-organization of these structures and systems represents autopoiesis or concentric interaction systems layers. The specific concentric interaction systems represent functions of keying. For my purposes in this analysis, I focused on a few concentric interaction systems identified in literature on autopoiesis and through my autoethnographic field studies (i.e., playing and observing football and Pokémon GO) that come into play during game engagement and autopoiesis: These are continuing simultaneous communication, multiple observations, double expectations, system autonomy, and unexpectedness by systems coupling. These concentric interaction systems are not hierarchical; rather, they can be observed at any stage during play, be absent, or reoccur. However, as will be explained below, some concentric interaction systems impact the presence of other related systems.

Continuing Simultaneous Communication

Luhmann (2002/2012, p. 53) saw communication as "the synthesis of information, utterance, and understanding" that can be either understood or misunderstood. Researchers in cybernetics, such as Ross Asby (cited in Pickering, 2010), worked with and described systems that adjust or restructure themselves to maintain stability in accord with exterior influences. Based on a

helical thinking model, Luhmann (2002/2012, p. 54) stated that "communication is connected to communication" and, furthermore, autopoiesis is formed by "communication's triggering further communication" (Luhmann, 1995, p. 218). Thus,

> communication should not be understood as mere information transmitted from a sender to a receiver, in the sense that the information is seen as parcels of information that move from one to the other. Instead, information is seen as being created with the receiver through interaction with his/her existing cognitive framework. (Maturana, cited in Hernes & Bakken, 2003, p. 1513)

In terms of game play, particularly team play, communication in all manners (verbal, nonverbal, behavioral) takes place continually and frequently simultaneously. Thus, when communication is created with a receiver through simultaneous interaction, the system instigates "continuing communication" (Tangen, 2004) or, rather, continuing simultaneous communication. Perinbanayagam (2006, p. 145) stated that only theories that do not insist on analyzing network and nodes separately can handle simultaneous occurrences. Yet, he did not fully utilize this concept to understand or study the possible simultaneous creation of communication as a facet of network communication. The concept of simultaneity describes a slightly different communication system than the network of multiple dialogues Perinbanayagam (2006) suggested. That is, simultaneous communication should be conceived not as dialogic but as a means to allow everybody to communicate (or create communication) at the same time.

In fast-moving sporting games, information sharing through verbal communication often is less important than nonverbal and behavioral for a variety of reasons, such as distance between the players, the quick pace of the game, and for executing offensive or defensive strategies. Verbal communication, then, could serve to delay or destroy actions in play, like functions of fabrication, for example, when luring the attacking team into an offside trap[1] in football. Moreover, the primary way to inform and to receive information in such dynamic and immediate activities is through communication created within the moment. In affordance theory, it is precisely elements like the movements, postures, placement, glances, and positions of hands that form the basis for selection of information that leads to interpretations, understanding, or misunderstanding (Gibson, 2015). When a player conceals intentions by movements to fabricate, s/he makes explicit use of movements to communicate, as in the backdoor move.

During the experience of play, many movements are meant to communicate; yet, some are not. A player thus may give off additional unintentional "expressions in its posture, emotions, gestures, and that these telegraph one's intentions to act" (Collins, 1981/2013, p. 242) by his/her "incapacity to inhibit warning signs of self-consciousness" (Goffman, 1969, p. 33). Thus, players cannot always control how their behavior communicates intentions (even hidden ones). Players perform movements to highlight planned tactics or sudden plans (based on unexpected opportunities) to teammates and to deceive or trick opponents. Thus, behavior in this context is defined not through a metaperspective, as described by Luhmann (2002/2012), but as an aspect of direct and indirect communication. It is clear that the acts, glances, and movements performed in team games such as football elicit reactions. Accordingly, these serve as a basis for the selection of information and, by extension, understanding (within the receivers' cognitive frameworks) and communication (Vanderstraeten, 2012). This is in line with Perinbanayagam's (2006, p. 3) definition of games, in which communication occurs with a range of symbols broader than a spoken language. Such broadened language builds upon simultaneous communication and

involves observation on multiple levels due to the constant ontogenies[2] caused by the interaction systems. Similar functions of simultaneous communication may function in computer games or augmented reality games by, for example, the nondiegetic aspects of a game. Sounds within a game (e.g., warnings, music) that do not influence the communication between the characters or avatars may be picked up by the player and therefore influence the choices made.

Multiple Observations

In all games, observation is a key element in that the player, whether working alone or with others, cannot achieve the goal without clarity on what is happening within the game and/or with other players. Particularly in team sports, multiple layers of observation are necessary and players learn to attend to planned and unplanned actions of their teammates and opponents. In football, for example, a midfielder with the ball needs to quickly scan and perceive the potentialities available and then make a split-second decision on how to proceed; this process is happening simultaneously with other players as well. This instantaneous activity includes numerous eventualities concerning what other players (both offensive and defensive) on the field may be thinking, choosing to do, are capable of doing, and strategizing. The actions of one or more players can either open up or eliminate options and, as a result, require a new round of observations and decisions. On the opposing team, the defenders will attempt to predict what the midfielder might do with the ball by examining the situation. Accordingly, football players engage in a great deal of communication and information exchange through their movements, prior movements, knowledge, expectations, and (to a small degree) verbal communication, all of which influence the play.

This same process takes place, although in slightly different form, in video and augmented reality games, particularly online collaborative strategic games. Gamers need to continually observe the environment and behaviors of other entities (other players' avatars or game-generated characters) and possess knowledge of previous events within the game. As in live games, the players of online games often make quick determinations of potential actions and split-second decisions/reactions. For example, as a Pokémon GO player, it would be essential to observe the screen depicting the Pokémon environment, the real world, and the movement of others. The player's skills in observation influence the journey within Pokémon GO as it takes the player to new places and people. However, the progressive structure of this particular game and its simplicity results in only marginal player influence on game play and, by extension, the number of levels to observe.

In summary, observations—particularly in games with multiple players and/or dynamic action and/or changing environments—happen at multiple instances and levels. This process involves observation; interpretation of expectations communicated, verbally and behaviorally; and deciphering environmental clues. Thus, the player's situation analysis is connected to communication, self-observation, observations of others, and the environmental conditions.

Double Expectations

In-game communication, particularly continuous and simultaneous communication, is influenced by players' expectations and "expectations of expectations" (Tangen, 2004), or double expectations. Players' expectations are fed by the players' phylogeny, that is, their history of

ontogenesis, or interactions, exchanges, and expectations. It would be impossible for teammates to execute a backdoor move or any multiplayer action without personal expectations and the interpretations of the expectations of others acquired through multiple levels of observations, current and in past play, tempered by the context. Thoughts like, "I expect that s/he expects me to…," occur as a result of the specifics of the game. Such cognitive–rhetorical questions may thus prepare players for what will happen or serve as obstacles to new possible moves. Thus, expectations form "the basis for a definition of structures" that "consist of mere experience or action" (Luhmann, 2002/2012, p. 72) in games, particularly multiplayer games. Such structures make it possible to "imagine that stimulus and response do not stand in a fixed relation to each other but instead are controlled by the expectations of the system. A system can only be identified if one has certain expectations" (Luhmann, 2002/2012, p. 72).

Although such expectations can come into play in many video or online games, particularly in the transfer of previously mastered skills, in line with Luhmann (2002/2012), Pokémon GO elicits no expectations in a systemic communication perspective. That is, the algorithms are based on fixed stimulus and response relations and cannot be tricked, and the expectations of the player can only be detected as a variant of play progress. Thus, tricking in Pokémon GO is not possible in the present version of the game.

System Autonomy

When stimulus and response do not stand in a fixed relation to each other, communication contexts build on the eventualities, decisions, and expectations produced by the interaction systems prior to and during the act of communication (Maturana & Guiloff, 1980; Tangen, 2004; Varela, Maturana, & Uribe, 1991). For interaction systems to function, these context-dependent factors of the present produce a system's autonomy, which is the basis for autopoiesis (Maturana & Guiloff, 1980). A system is autonomous "when it can specify its own laws" (Maturana & Varela, 1987, p. 61) or rules for what is suitable for its functioning.

For researchers or game designers to understand the autonomy of players in a game, "we must understand the organization [the game] that defines them as unities" (Maturana & Varela, 1987, p. 63), in this context what Goffman (1986) would call frames. The players' autonomy becomes explicit when it becomes apparent that what defines them as unities is their autopoietic organization, such as the team, rules, formations, expectations, communication, and structure. The degree of a system's complexity and the subsequent autopoietic organization thus seems to relate to the autonomy of the system and players. Moreover, communicative ability is related to the players' general experience and skill. For example, a novice may experience much of the communication on the field as an unfamiliar language.

In both Pokémon GO and football, unities form. In Pokémon GO, it happens through the physical encounters in the real world, by communication during play, and somewhat through digital media. Football, on the other hand, is based on teams as units, and the constant flux of continuous simultaneous communication and other behaviors form numerous additional unities (dialogues) of play, such as described by Perinbanayagam (2006). The formation of such a unity "always determines a number of phenomena associated with the features that define it" and, by extension, "the phenomena they generate in functioning as autopoietic unities depend on their organization and not on the physical nature of their components" (Maturana & Varela, 1987, p. 65).

Accordingly, Pokémon GO and football form autopoietic organizations. The autopoietic organization in football comprises phenomenon such as relations and hierarchy, formation, ideology, and history of actions, all of which represent expectations within a team and for the adversary team. As a result, autopoietic organization also involve a potential autonomous act of braking free from these aspects that, again, represents an extreme diversity in behavior, couplings (see the chapter below), and expectations and, thus, a higher degree of autonomy. Such diversity in behavior is what Maturana and Varela termed third-order couplings or cybernetics (1987, p. 170). By contrast, actions performed while playing Pokémon GO have little autonomy, even though the seeking of Pokémon may result in the forming of crowds existing of thousands of individuals who may meet and interact. The communication among these individuals does not change the game beyond its cellular membrane. Potentially members of the group support a possible catch—an action that is to be expected due to the rules of the game—but that is not necessarily the sole purpose of the gathering.

Unexpectedness by Systems Coupling

Being part of a game or play structure or system involves the coupling between systems and structures. Systems coupling may be described as the "history of recurrent interactions leading to the structural congruence" (Maturana & Varela, 1987, p. 75). These scholars characterized this concept through the biological process of cells combining with other cells.

A cell's reproduction is autopoietic and the process is ontogenetic, meaning a structural change takes place without loss of the organizational basis (Maturana & Varela, 1987). In the sports context, for example, interaction systems in football create interaction systems (self-production), and the interaction systems will alter ontogenies (i.e., structural change brought about by players and the ball being in different positions or new players entering the game and being communicated with in a different manner). However, the character of the interaction systems remain (i.e., same organization controlled by the rules).

Ontogenesis generated by playing Pokémon GO, for example, may involve the change caused by (and agreement in) the coupling among systems functioning at schools and in traffic, which in turn involves the coupling with other crowds of pupils, cars, pedestrians, and players. These interactions and perturbment will interfere with issues of safety, destroy or trigger attention, or impact the immersion of play at school, in social situations, and so forth.

When two systems meet in a football match, each team typically tries to measure during the initial phase of the game how the other team works or manages their expectations of the ontogenesis and thus structural changes that they will undergo during a match. Although both teams often use scouting reports and analyze the content of former matches (phylogeny of coupling with other systems) and team standings, every team's play is influenced by the play of the opponents and the ontogeny that occurs within the interaction systems within the specific context of that match. Communication must therefore be tailored by and among players through the convergence of concentric interaction systems, such as double expectations, continuing simultaneous communication, and multiple observations. Such encounters or couplings represent whole systems that merge or interact, thus creating new systems of interaction beyond those initially expressed, communicated, and created by the teams. During the coupling of two teams or systems, the complexity and diversity of behavior increase, resulting in an autopoietic organization that causes autonomy and, ultimately, an

unexpectedness produced by the organization (game). This leads to new nodes, units, interaction systems, and framing of situations (e.g., fabrication and backdoor moves) that continually change and emerge during a match (Perinbanayagam, 2006). Thus, the combination of entities or players forms units that may lead to further communication or noncommunication, depending on the plasticity and unexpectedness of the structure (Maturana & Guiloff, 1980). Accordingly, if an understanding of a coupling does not occur, one of the teams may fail to understand the play of the opposing team, resulting in misinterpreted or mistaken expectations and the inability to plan, resulting further in unexpected actions and outcomes. However, over time, the tactics and structures that initially served as perturbment eventually trigger a system change, illustrating the intelligence of the system of play (Maturana & Guiloff, 1980).

These examples show that although a tactical surprise or unexpected system change may be identified instantly by an opponent, the process of altering established double expectations must develop over time amid changes in one component of the system and the eventual acquisition of the skills necessary to address the new overall system. In other words, although systems have plasticity, altering them takes time (Maturana & Guiloff, 1980).

Expectations and double expectations as facets of interaction systems and the degree of their influence in play are connected to the organization of the systems. Fabricating a move in football, for example, in comparison to similar functions in computer games, and Pokémon GO specifically, differs. In football, fabrication can lead to unexpected changes, and thus opportunities for tricking or deceiving. Trickery in computer games however (e.g., by short cuts in game progression) is based on algorithms (i.e., procedures for how a sequence of play must be executed in order to function), and thus coded and already known by the creator of the game. Such tricks will open up unknown situations for the player, but the conditions for these variations to happen are limited by the game design. That is, they are designed by the creators of the games and not the player. In Pokémon GO, the possibilities associated with self-initiated activities are many, but tricking or fabricating as part of the game seems impossible.

Similar functions may be observed in computer games that are difficult to learn. The threshold of skills necessary to be able to play is sometimes so high that some players give up and leave the game. The players that endure, however, attain the required systems, understanding, and skills to continue. These skills often make the rest of the game easy to play unless they couple with other systems and novel ontogenetic situations occur. The Pokémon GO system, however, couples, perturbs, and is perturbed by several other systems, but the game rules do not elicit interaction with other play systems, and thus the game does not produce autonomous play systems. Obviously, a player can connect to other types of play (e.g., to explore the arts and cultural creations that Pokéstops introduce), but the game does not rely on coupling. Moreover, some couplings are unwanted and are expressed by the Pokémon GO system warning the player not to play while driving or not to trespass on private property while playing.

THE CASES OF FOOTBALL AND POKÉMON GO

Football

Football has been played in a similar form for more than two millennia and formalized within the last 150 years (Giulianotti, 1999; Fédération Internationale de Football Association [FIFA],

2007; see the Appendix for basics on the game). The game depends on a frame that involves physical boundaries and elements (e.g., the pitch [i.e., the playing field], goals, the ball) in order to function. These physical boundaries and elements partly make the structure in which autopoietic systems may emerge and function. However, football exists in many versions (keyed), from improvised play in random spaces like street junctions and schoolyards, with the number of players available, to up against walls and to the formal events such as cups and series. The nature of the sport has been described as social interaction (Best, 1980; Birrell & Donnelly, 2004; Kreft, 2015; McGarry et al., 2002; Perinbanayagam, 2006), interpersonal communication (Passos, Davids, & Chow, 2016), "dialogic," "dynamical systems," and "complex interactions" (McGarry et al., 2002, p. 771), "dynamical self-organizing system[s]" (Best, 1980; Frencken, Lemmink, Delleman, & Visscher, 2011; McGarry et al., 2002), and "self-organizing processes" (Schmidt et al., 1999, p. 558). In this article, football is described as an interaction system that comprises several embedded subordinated concentric interaction systems, autopoietic in nature.

The elements and players of football partially lead to and enable the activity on the pitch by the representation of agency, the teleological meaning the elements have, and the restrictions the elements and players establish for the activity. However, football cannot form an active structure without rules. As Goffman (1986) noted, the rules serve to frame the structure. Tin (2011) found that creative practitioners become more inventive and transgressive within specific frames (such as graffiti) when they are restricted by rules. Thus, the rules invite and inspire football players to explore possible new ways of play within the norms of the game by seeking unconventional behaviors in order to surprise, exhibit, perform, and win, among other objectives. Within the restricted space that the rules create, the players possess a type of autonomy that allows them to explore dimensions of play and to exhibit nearly endless variations in play moves and strategies and the combination of these in order to break with what the adversary players may expect. In action, these variations of moves and strategies function as concentric interaction systems.

In a team sport, such as football, the rules demand complex communication and system thinking among players. One example of such rules is an offensive player being offside. Thus, in the attempts to avoid or cause a foul, teammates must devise numerous strategies that demand precise communication for either the defense to lure the adversary team into offside positions or the offensive players to time runs exactly to avoid an offside call. The attackers, in addition to their own play strategies, must be aware of and seek to understand the different functions of the defense system. Moreover, these concentric interaction systems typically take place within split-second decisions amid larger play strategies and fast-break opportunities for both teams.

The game structure thus motivates players to communicate in specific ways to advance their strategic goals. In actuality, the structure is what makes the system functional. The constant shifting of the structures through, for example, various formations of the players on the pitch and the location of the ball, allows for the emergence of new subordinate concentric interaction systems that may serve as keying factors in that they add layers of communication that are only functional in the game structure and within context-specific situations. Unlike dyadic sports, in which pairs compete, structures that occur in multiplayer team sports such as football allow multiple communication and interaction systems to exist simultaneously, creating communication patterns and structures that are, at times, difficult to grasp. This is especially true for novice footballers, who often demonstrate a lack of understanding in strategic ways of thinking as well

as the concentric interaction systems of the game that happens among the other players. Often this can be seen in inexperienced players solely running after the ball. It certainly influences play but perhaps not in a desired way because the act describes an individual process rather than systems interaction. Team play in football fundamentally involves irregular, flexible, and varied events that, along with structural change and momentary couplings and decouplings, create several concentric interaction systems (McGarry et al., 2002, p. 788).

Accurate and changing communication is essential when teams or players attempt fabrication, such as the backdoor move (Schmidt et al., 1999), so that, depending on the application, a player can (or does not) misinterpret or be tricked (or trick), as described by the backdoor move. Therefore, playing football gives rise to certain functional structures. The happenings within the players' agreed-upon frame change constantly and, as the structure changes, interaction systems occur, evolve, and influence the production of new systems. The situation of a midfielder with the ball and the need to quickly scan and create communication simultaneously with many others in order to decide for how to proceed is one such elicited concentric interaction system. For the many subsequent moves, the structure will re-form (i.e., self-organization of players in relation to goals, ball, and pitch) and new concentric interaction systems emerge due to the structural change.

The complexity of the communication needs for achieving strategies in football, ultimately, stimulates the emergence of self-organized (autopoietic) systems. A main driver for the emergence of autopoiesis is expectation. The backdoor move can be effective because a defender expects the continuance of the first move. The expectation can lead to misunderstanding of the play in action—and a misjudgment of an appropriate defensive strategy. Thus, the sequence and content of experiences, activities, and operations during play are related to expectations as stimuli for the players in this context (Luhmann, 2002/2012, p. 72).

In analyzing the activity on the pitch, however, it becomes clear that football gives rise to nonlinear and dynamic systems in terms of play selection, communication, defensive posture, and so on. These are not stable social systems; rather, they represent "many degrees of freedom in a constant flux" (McGarry et al., 2002, p. 772), appearing and disappearing and drawing on expectations phylogeny and interactions, that, when taken together, are considered interaction systems (Maturana, 1975; Maturana & Guiloff, 1980). Expectations of playing football, thus, involve or rely on players' competencies with respect to knowledge, skills, tactics, interpretations, planning, tactical understanding, prior expectations, and expectations by others. Accordingly, in football, where structures change, merge, and collide constantly, new expectations emerge continually and serve as a basis for communication within an autopoietic environment.
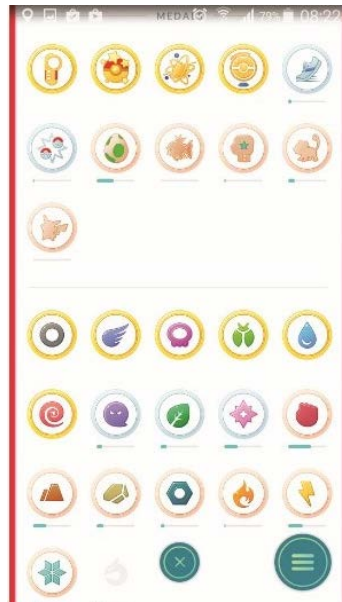
Pokémon GO

Pokémon GO became the world's most popular digital game in July 2016, motivating 45 million people a day to walk, run, and drive to find and capture Pokémon (Kawa & Katz, 2016). However, its meteoric success was short-lived. By August 2016, according to Kawa and Katz (2016), 15 million daily users had left the game. Nevertheless, the game remains popular (Smith, 2017).

Pokémon GO (see the Appendix for an explanation of the game) presents an augmented reality system within smartphone technology (Salen & Zimmerman, 2004). In action, Pokémon GO relies on two keying levels: the graphical user interface (GUI) on the smartphone and the

physical playing field upon which the GUI is applied or augmented. This playing field typically consists of urban, suburban, and village areas unhindered by size; it is defined by the saturation of PokéStops, the spawning of Pokémon, and gym locations. The GUI filter serves as a very concrete example of keying in that it provides an alternative reality to the real world for the players. Unfortunately, this has led to numerous situations where fully engaged players seemed to forget that the playing field actually consisted of real-world locations. Consequently, several players have crashed into other people, street signs, and buildings, or had crossed streets with moving cars without noticing (Joseph & Armstrong, 2016; Rauschnabel et al., 2017, p. 280). Not surprisingly, augmented reality games such as Pokémon GO have been associated with a rise in reports of distraction-related injury (Joseph & Armstrong, 2016; Sharma & Vassiliou, 2016).

The focus of the game is to capture Pokémon visible via the GUI, either for the personal satisfaction in the hunt or for later combat with other players. Pokémon GO is a typical Skinner box game[3] in that it builds on people's urge to collect (Portnow, 2010), and thus game play relies heavily on reward systems. For example, although players typically manage to capture spawned Pokémon, they sometimes fail. Hence, the capture is a reward in itself, and the awareness that not every Pokémon can be captured reinforces a player's drive to continue his/her quest. Players also are stimulated to witness the evolution of their Pokémon, to earn points and currency, to capture rare Pokémon, to earn medals and bonuses for catching, walking, gathering of resources, and so on (see Figure 2), to battle and win, and to station Pokémon at gyms.

The systems used in Pokémon GO are related to communication and movement. While playing the game, players move in certain patterns defined by the geographical positions of PokéStops, gyms, and Pokémon. Through such movements, players can engage and interact with other players if they wish (see Figure 3). Although players may either plan routes or let the game lead them, in all cases the behavioral choices do not determine game outcomes. The main

Figure 2. Medals overview in the Pokémon GO game, depicting medals (bronze, silver and gold) for various achievements such as walking distance, number of evolved Pokémon, number of catches (divided into the different types of Pokémon), number of hatched eggs, and more.

Figure 3. Children gathering around a PokéStop in Namsos, Norway. Although Pokémon GO is an individual-player game, the nature of the game is enhanced by collaborative play and communication via in-person, online, and social media channels outside the game.

argument for this statement is that playing Pokémon GO does not demand contact with other players or a change in routes in order to play. However, curious players may experience different and new places by playing and may meet and interact with a variety of people and, by so doing, possibly find a wider range of Pokémon (Kaczmarek et al., 2017; Kogan et al., 2017; Marquet, Alberico, & Hipp, 2018; Tabacchi, Caci, Cardaci, & Perticone, 2017; Tang, 2017; Zsila et al., 2017). However, it seems spending time with the game, rather than actual performance, is the most influential process for the game progress.

The resulting communication that may occur by playing Pokémon GO systems is based on sharing collections, seeking common goals, gathering around PokéStops, chasing rare Pokémon, posting information on Instagram or Twitter, and talking about the game in general. Communication also happens through the collective movements of players. For instance, a player might come across masses of people walking and running toward a rare Pokémon, showing, first of all, that they are playing and, secondly, engaging in play-related discussion or indicating where other interesting Pokémon are available to catch. (Numerous videos have been posted on YouTube depicting such situations.) Social gatherings emerge and are self-produced as a result of playing Pokémon GO.

Comparing Football and Pokémon GO

Analyzing the concentric interaction systems in football and Pokémon GO through the lens of autopoiesis results in interesting distinctions between the phenomena in these two games. In Pokémon GO, autopoiesis takes place as a result of the game, while in football it occurs both during and as a result of the game.

In looking at Pokémon GO, the self-producing systems or concentric interaction systems involving other players while playing Pokémon GO is not necessary for gameplay. Basic gameplay is not designed as social, and because all possible social interaction happens outside the game, playing Pokémon GO does not represent an interaction system. Playing Pokémon Go can motivate social activities and encourage people to gather around PokéStops and gyms and exchange catches and progress. However, since the communication among players is limited to the transmission of information about catches, locations of rare Pokémon, and so forth, the communicational facet of the play activity represents a sort of parallel play in which, for example, players catch the same Pokémon together. Therefore, although the communication patterns and system structures of Pokémon GO only minimally influence gameplay, they may serve as additional activities for some players, but at the players' own initiation. Therefore, playing Pokémon GO is an individual activity that can be shared.

In football, concentric interaction systems emerge and disappear continuously as the structure changes. Thus, when two team's couple, the ball moves, the players initiate and run, and the constantly changing structure demands or stimulates new communication, and as a result, new concentric interaction systems emerge. For example, when double expectations function or serve as a concentric interaction system, they influence subsequent thoughts and, (re)actions. Moreover, if the double expectations served to give understanding of a situation that produced a desired outcome, it will influence the next instance of a similar system occurrence. Hence, football is a group activity that depends on sharing and creating continuous simultaneous communication or concentric interaction systems for the play system to function.

CONCENTRIC INTERACTION SYSTEMS, ENGAGEMENT, AND KEYING

The aim of this study was to rethink game design within the concept of self-producing systems, or autopoiesis, based on two research questions: (a) How can football and Pokémon GO be described through theory on autopoiesis? and (b) How does autopoietic concentric interaction systems relate to feelings of engagement and the processes of keying?

In the process of illuminating various aspects of this research question, I introduced play and game theory with an emphasis on Goffman's (1961, 1986) concept of framing. Game and play theory was further explored through the perspective of communication within and among systems and autopoiesis, in line with Luhmann (2002/2012). By a combination of identifying and explicating these theories and my ethnographic fieldwork, I identified and defined five concentric game dynamics that explain various dimensions of self-producing interaction systems. These concentric interaction systems describe game dynamics in football and, to an extent, in Pokémon GO, namely: continuing simultaneous communication, multiple observations, double expectations, system autonomy, and unexpectedness through system coupling. Each of these concentric interaction systems manifests a separate frame level, hierarchically unbound in game dynamics but entangled and variable in a play situation.

This research contributes to game theory in several ways but more specifically in regard to autopoiesis, the nature of concentric interactions systems, and framing. Autopoietic organization is comparable to the notion of framing in that it describes a situation that stimulates dynamics and subsequent change. The specific contextualization for exploring autopoietic organization in this research, however, contributes to the theories on framing and on

games and play through the identification of five concentric interaction systems. These subordinate frames describe game dynamics that potentially create diversity in behavior that stimulates exceedingly complex and autopoietic interaction systems. This occurs especially when interaction systems couple to create a new and distinct system. The production of new systems not only serves to add concentric layers (keying) within a game's functioning, but it also refers to the permeability and succeeding dynamics within a game's periphery, Further, it describes what happens when such systems couple with other systems within an organization or frame. Thus, the concentric game dynamics broaden the understanding of keying. These build upon Goffman's (1986) crucial work on framing and keying and Luhmann's (2002/2012) understanding of autopoiesis.
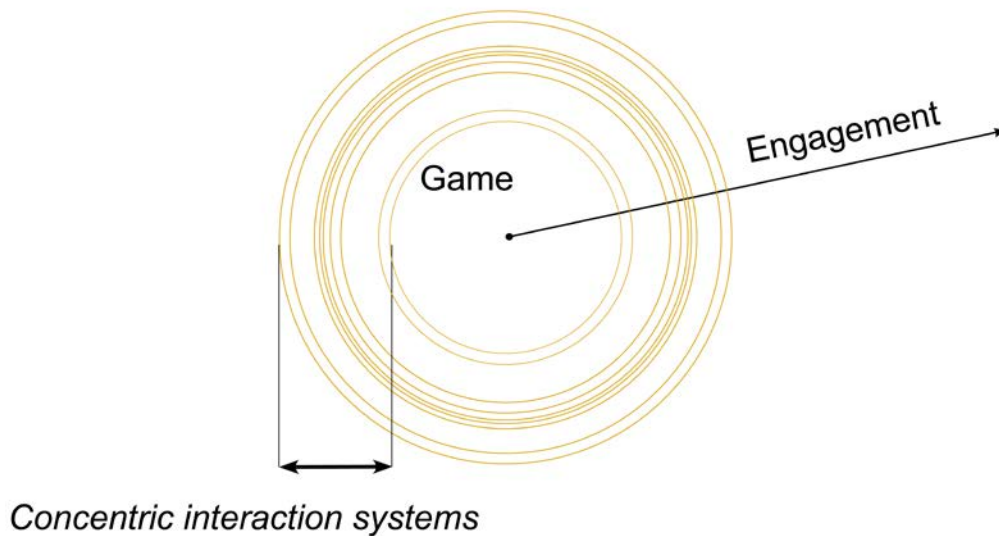
Concentric Interaction Systems as Framing

In practice, the concentric interaction systems produce and describe exceedingly complex interaction systems during play and, consequently, they function as "world building activities…that it is seen by the participants to be something quite else" (Goffman, 1961, pp. 21, 43-44). The descriptions of the five concentric interaction systems extend the concept of framing, thus opening opportunities for applications in various practices.

Concentric Interaction Systems as Fabrication, Keying, and Engagement

The identified concentric interaction systems describe behaviors that demand a certain presence and engagement in order to function. The emergence of concentric interaction systems leads to unexpectedness and the production of new interaction systems (i.e., autopoiesis). Thus, they describe the manner of execution in complex systems of play that represents an aim to change or to create new purposes within the game limits. Accordingly, concentric interaction systems stimulate a drive in a player not only to reach a goal but also to create conditions that engage, test the limits of the game organization, and potentially over time, influencing the future development of the game. Thus, they describe a journey that the player chooses to take that, by extension, uplifts the internal and self-referential experience of play to an experience beyond the reality of life outside the game. Hence, the concentric interaction systems function as dimensions of keying that serve to generate engagement and further ensure system functioning (see Figure 4).

Particularly in multiplayer games, the player must have an inner drive to inform and agree upon the terms of the frame and its influence, follow the wavering of up- and downkeying during play, and to show and hide information for the game to function. That is, in light of autopoiesis, fabrication and keying are dimensions of engagement and interdependence in a functioning interaction system of play. A backdoor move, for example—which in itself represents upkeying in that it characterizes a dialogue where all concentric interaction systems are at work within the bigger play system—cannot function if the defending player is not trying to hinder the attacker performing the move. In other words, if the defender does not react to the initiation of the backdoor move (i.e., is not deceived by the movement), then s/he is not part of the dialogue in play, and thus influencing the game by downkeying and system dysfunction.

Concentric interaction systems

Figure 4. Engagement by transformation of play through the emergence of concentric interaction systems that serve as keying. The layers of autopoietic concentric interaction system are designated as circles. The play activity is a complex process that expands in all directions once the activity begins. Thus, the play activity is illustrated here as starting in the center with the initiation of the game; the graph widens and the laminations thicken as play continues. The circles also indicates how the concentric interaction systems serve as framing in that they create a protected environment inside the circle (play), which is different from the real world outside the circles. Furthermore, the number and composition of concentric interaction layers also tells something about the degree of complexity of play and how these intertwined layers define communication and future expectations. The composition of the concentric layers varies not only by the nature of the game but a result of a game in progress.

Concentric Interaction Systems in Light of Football and Pokémon GO

According to Huizinga (1949/1980), play is the opposite of automatic behavior. One way to understand automatic behavior is that it does not involve the search for new or more complex experiences; rather, it involves pursuing instant gratification (Sennett, 1977). Moreover, to Sennett (1977), play is achieved through experimentation and risk-taking, which by extension is a process of taking control over one's own self and cooperating with others. Hence, automatic behavior hinders play and certainly engagement.

Both Pokémon GO and football are games easy to grasp in terms of understanding the rules. However, while the interaction systems in football are progressively challenging for the players to understand, to orient oneself toward, and to perform while simultaneously supporting the emergence of new systems, the same is not true for Pokémon GO. Because of the design of the game, Pokémon Go demands the same type of gameplay regardless of one's location, communication setting and whether a player is a beginner or veteran. Therefore, football stimulates play, and Pokémon GO induces automatic behavior.

Pokémon GO does engender autopoietic behavior and thus ontogenesis; however, these systems lie primarily outside gameplay. For example, there is no autonomy in playing the game, except in the choice of which Pokémon to catch, where to go to find Pokémon, or which Pokémon to battle against at which gym. Pokémon GO thus elicits no expectations in a systemic communication perspective and therefore it represents a goal-driven activity, easily

fulfilled, where progress depends solely on the amount of time invested and motivation driven by gamification. The game does not depend on the involvement of other players, nor does it give players any influence over the game experience explicitly, the play outcome, or the opportunities for future play. Risk-taking and engagement that the five concentric interaction systems can elicit by functioning as keying do occur while playing Pokémon GO. However, they function outside gameplay, not during play. Because the game is performed individually, the activity does not form interaction systems in play; instead, the social aspect of the game can be described as a sort of parallel play, in that the communication with others happens outside the gameplay and only if the player desires. The aspects that have made Pokémon GO as successful, therefore, must lie beyond the concentric interaction systems dimensions identified in this research. Exploring that aspect of Pokémon GO would be an interesting future study.

The concentric interaction systems describe football as a game that creates or meets an inner drive. Football thus is opposite of Pokémon GO in that the emerging (and changing) structures stimulate and depend on concentric interaction systems, inner drive, and engagement to function. Any skillfulness in or lack of it, attention or carelessness, or (in)ability to contribute or (mis)interpretations of a concentric interaction system will have great impact on the game. Additionally, these systems that are integrated within play serve as keying, along with the teleological aspects of the game.

Concentric Interaction Systems as a Game Design Method

This research suggests that when specific concentric interaction systems (i.e., continuing simultaneous communication, multiple observation, double expectations, systems autonomy, and unexpectedness by system coupling) are infused into a game design process, whether for online or offline engagement, the chances of engaging players in the game over long periods of time improve. Although the intent of the game (particularly those aimed at individual players) may influence which of these concentric interaction systems that can be integrated, how it would take form, and how it relates to the other identified or still-to-be identified concentric interaction systems of game design, a clear understanding of the concepts of play, communication, expectations, and framing can open up elements of games that provide for autopoiesis and thus player engagement in the present and over time (see Figure 4).

Accordingly, I suggest that Pokémon GO would have been more successful in the long run if its creators had infused the concentric interaction systems identified in this research as functions of complexity and keying in the game's dynamics. Dynamics such as autopoiesis, observation of expectations, game autonomy, and multiplayer systems couplings, for example, could have transformed an individual game into a collaborative game, even if temporarily or for specific goal-related outcomes. For example, how would the Pokémon GO play experience changed if the game rules had set premises for a minimum number of players to collaborate in approaching, surrounding, and/or collecting specific Pokémon or game enhancements?

The various concentric interaction systems that games such as football engender create situations of simultaneous and consecutive functions. Various skills and understandings useful in these game contexts may be communicative, physical, or strategic, among others. Thus, when the concentric interaction systems identified in this study are implemented in a game, various entry points are generated that support the engagement of people with different interests, experience, and skills, thus expanding the range of players participating in the game and diversifying ways to play.

CONCLUSIONS

This research utilized Goffman's (1986) notions of framing and keying and demonstrated how the theory on autopoiesis can be applied to analyze communication systems or subordinate frames within games and play. Further, it has shown how these theories are applicable in exploring individual play and players, groups of players, and teams as a function of games. The rethinking of games within the concept of autopoiesis led to the description of five concentric interaction systems (i. e., continuing simultaneous communication, multiple observations, double expectations, systems autonomy, and unexpectedness by systems coupling) that describe subordinate lamination of frame levels of concentric interaction systems in play elicited by games. These concentric interaction systems may also serve as methods for creating new games that elicit keying and thus engagement.

The five concentric interaction systems illustrate that the process of designing new games requires an emphasis on what games can never be as physical objects or digital user interfaces. This involves accepting that structures are temporal in that they exist only when they are part of a functioning system. Knowledge about concentric interaction systems thus underscores the necessity to emphasize designing for potential variable structures that may stimulate the needed autonomy for autopoietic systems and thus keying and engagement to emerge by, for example, the occurrence of numerous (and not all yet known) functional concentric interaction systems during play. To design games that engage players over a long period of time requires an elaboration on the structure or structures that can be made active and changeable by functional concentric interaction systems that may emerge during play, how these are experienced, how these are influenced or altered, and in what way they are facilitated.

A game that succeeds in eliciting the concentric interaction systems will be capable of performing within both the unexpected and the expected (or automatic) gameplay. The creative activities on which these dimensions rely may also serve as continuous stimuli for honing and developing new skills, game variations, and interaction systems.

This research involved the study of two very different games, one played in the physical world and one employing augmented reality. Given the limitation of the empirical data in this research project and its theoretical focal point, the five concentric interaction systems would benefit from additional validation through the analysis of other games and game types. The massive number of games on various platforms that currently exist exemplify various qualities of engagement in play; study of these games within the context of autopoiesis and systems theory may contribute to a deeper understanding of the five concentric interaction systems identified in this research. Additional outcomes of such research could possibly engender additional concentric interaction systems that describe and elicit engagement through games.

The dynamics of the identified concentric interaction systems describe functions of change that may be difficult to implement in an algorithm and thus computer or video games such as Pokémon GO. Some MMORPG games do allow considerable freedom in player behavior that is not specifically coded within the game. Yet even so, the variation in play behavior does not extend beyond the potential that the game creator established within the game design. That is, the player cannot influence play within the rules (or parameters) of the game that the designer has not thought of, such as an offside trick or back door move possible in real-world team sports. In future research that builds on this study, it would be interesting to explore how the identified concentric interaction systems can describe or serve as a platform for creating individual or

MMORPG games that can specify their own laws. As in football, the digital players could, within the organization of play, specify and hone their very own variant of play (a concentric interaction system in itself that leads to engagement) that, when coupled with other teams, may produce different or new concentric interaction systems that lead to victorious outcome. This could result even if the players who initiated these variations of concentric interaction systems were considered far less skilled than their opponents (general expectations). That is, it is not always the most recognized or talented team that wins or produces the most attractive play. Rather, it can be the teams that are skilled or creative in handling and generating new concentric interaction systems that exhibit exciting play and influence the game. Adaptive, autonomous, or cybernetic systems represented by, for example, players' influence on the structural dimension of play or artificial intelligence (AI) would seem logical directions to study for implementing such game dynamics. AI, in its nature, involves ontogenesis. The change of play that AI can support and the history of such ontogenesis that can be further conveyed in the game allow for exceedingly complex systems of interaction to occur, change, and reproduce.

Accordingly, the emphasis of future research should be within experimentation on how the concentric interaction systems can serve as parameters for creating new games, not merely for the analysis of existing games with unchangeable structures or systems. Future research on the concentric interaction systems as premises for designing and testing new games would offer much insight to how interaction systems stimulate upkeying and engagement in play.

The identified concentric interaction systems in this research primarily describe play behavior bound by abstract dimensions such as rules. Accordingly, they have a transfer value to other fields of design. The result of playing games with the identified concentric interaction systems implemented is that they stimulate autopoietic interaction systems. Thus, research on the effect of their implementation as part of service or product systems would open new insights into the functioning of the concentric interaction systems in other fields and areas (gamification) as well as how to elicit engagement.

IMPLICATIONS FOR RESEARCH AND DESIGN

My analysis strongly suggests specific approaches to game design would improve the notion and experience of play for physical, virtual, and hybrid games. The integration of the five identified concentric interaction systems (i. e., continuing simultaneous communication, multiple observation, double expectations, systems autonomy, and unexpectedness by system coupling) in new game designs will initiate and support autopoietic systems during play. Moreover, this research suggests that the concentric interaction systems will serve to enhance complexity and keying and therefore stimulate engagement within the frame of the game.

The five concentric interaction systems contribute to the understanding of game dynamics in design, framing, and game and play theory. They also allow for and support the analysis of exceedingly complex autopoietic systems in games and play. Collectively, the research results provide insights and practices that could be employed in various entertainment, learning, and service applications.

ENDNOTES

1. In football (soccer), a player is in an offside position if "any part of the head, body or feet is in the opponents' half …and any part of the head, body or feet is nearer to the opponents' goal line than both the ball and the second-last opponent" (FIFA, 2017, p. 91–95). It is not a foul for an offensive player to be in offside position unless that player is made active by a pass or intended pass from a teammate. The law is further described with several conditions or subrules defined for various situations (FIFA, 2017). In short, it prohibits an attacking team player to pass the ball to a teammate who has no adversary player in between him/herself and the adversary keeper. Thus, an offside trap is a defensive play in which the defenders set a play to increase the chance that an attacking player is offside and thus causing a foul.

2. Ontogenesis is a "structural change without loss of organization in that unity" (Maturana & Varela, 1987, p. 74). The history of ontogenesis is called phylogeny, which also influences future ontogenesis by way of expectations (Maturana & Varela, 1987, p. 76). Thus, ontogeny represents a current activity while the phylogeny represents a continuity (or longitudinal collection) of the various ontogenetic processes.

3. Skinner box can be described as the making of an illusion of engagement through operant conditioning. The term Skinner box games is used in the game design discourse to describe games that are played merely because of such reward systems, also often referred to as gamification (Portnow, 2010). That is, the player learns to associate a particular behavior with a consequence (reward or not). This theory is based on an experiment performed by Burrhus Frederic Skinner, a psychologist who discovered that when pigeons actively performed something (pecking a button with their beak in a box) to get food or a reward, they were more likely to continue or increase the activity. The active role is what modifies behavior in that it involves more than just automatic reaction to stimuli even though the activity has no causal relation between natural behavior and presentation of food (i.e., pecking a button or running in circles are not functional strategies the birds in the wild use to find food). The forming of behavior can be reinforced by holding back rewards at arbitrary instances; this makes the drive to continue stronger.

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APPENDIX

Football (also known as soccer)

The official rules for adult players exists of two teams each with 11 players on a field (known as the pitch) with the size of approximately 50 x 100 meters, although FIFA has rules for different pitch and team sizes with 9, 7, 5, and 4 players (FIFA, 1994, 2012). Similarly, FIFA has defined different timespans for different types of matches and various ages, but the official game for adults lasts 90 minutes, in two 45-minute time periods (plus stoppage time). The street corner version of football may consist of no teams but where the players do tricks and passes without pursuing goals for winning. However, the type of football that is analyzed in this study exists of two competing teams. Thus, a competitive system serves as keying (Caillois, 1961, p. 18).

The general setup for a match consists of a pitch, a ball, 2 goals, lines on the ground depicting some rules (e.g., play stops and the ball is given to the adversary team as a throw-in when a player causes the ball to cross the two longest outer lines of the field), two teams, and a minimum of one referee. The team that places the ball into the adversary's goal most often wins (and acquires three points in a series). When the game result is that both teams have the same score, nobody wins (and both teams acquire one point in a series), unless the match is played in a cup where one team must win and therefore settled by either extended time (2 x 15 minutes) or penalty kicks.

To win, the players must both attack and defend. Typically, the players represent a specific team structure based on their coach's philosophy and where each player or group of players has a different role. A typical formation for the national team in Brazil, for example, is 4–3–3 (meaning four defenders, three midfielders, and three forwards, which is considered an emphasis on the offensive), plus the goalkeeper. In this formation, the four defenders are placed nearby their own goal. They have the collective responsibility to defend their own goal against adversary attackers in addition to an offensive role, typically occurring when the ball is intercepted in their defense zone and they need to initiate an attack. The three people in the midfield have similar defending concerns but they also function as playmakers for the three attackers (forwards), whose main role is to score goals on the other side of the field. Almost exclusively, teams place one player in the goal; this is the "keeper," whose role is to prevent goals and to start play when the ball has crossed the short end line of the pitch or has been intercepted. The keeper is the only player who can touch the ball with his/her hands, although with one restriction. The rest of the players can use any part of the body except their hands and arms.

The regulation of the game takes place by 17 laws defined by Fédération Internationale de Football Association (FIFA).
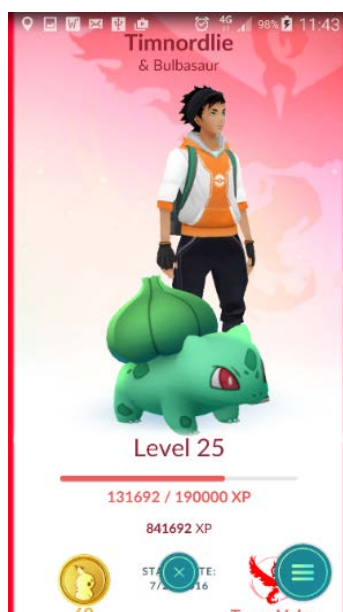
Pokémon GO

Pokémon GO builds on the early versions of the Pokémon role-playing video games (RPGs) developed for the Nintendo Game Boy in 1996. The games were strategy games and part of the total transmedia storytelling toy concept Pokémon (Jenkins, 2010). In these games, the player would immerse him/herself in the world of Pokémon and control the actions of a

chosen character (the trainer). The Game Boy versions of Pokémon were played via a controller and against either a machine or other players.

Pokémon GO differs from the Game Boy versions in that it presents an augmented reality system within smartphone technology (Salen & Zimmerman, 2004), serving as a second reality for viewing environments, and thus a keying layer. The second reality seen on the game display of one's smartphone provides an additional layer that superimposes game elements onto reality (see Figure A1). These elements comprise Pokémon creatures, Pokémon gyms, and PokéStops (where trainers can gather Poké Balls and other resources). All these virtual elements are positioned geographically on a GPS map and become available when players draw close. The main objective of the game is for a player (or, rather, a player's avatar, i. e., his/her Pokémon trainer [see Figure A2]) to catch Pokémon that spawn into the map, to gather resources, to increase the combat abilities for the Pokémon, and to prepare for battles against other Pokémon in gyms, which provide the only platforms for competition. The player must catch a certain number of Pokémon before the game allows the player to evolve the various Pokémon (a process similar to the metamorphosis that a butterfly caterpillar goes through that increases the power of the Pokémon). A player (via his/her avatar) can catch the Pokémon with Poké Balls that are either gathered through gameplay or purchased with game currency. The catch is done

Figure A1. A screenshot from Pokémon GO during gameplay in Oslo, Norway. The user's avatar is shown in the portrait in the lower left and illustrated in full person (1) when walking (shows real position in the map by the GPS funcions in the smartphone) toward a virtual PokéStop (3). A virtual gym (2) is presented in the top right corner, and the spawned Pokémon Spearows is at multiple positions (4).

Figure A2. The Pokémon trainer Timnordlie (the boy), which was my avatar, and my buddy Bulbasaur (the green creature by the feet of my avatar). The Gold Pikachu coin in the lower left takes you to a shop and the medals overview. The red symbol in the lower right (underneath the meny button) shows the "team" or tribe that my avatar belongs to (Team Valor).

by moving a finger on top of a Poké ball on the screen, which gives it speed and direction, when the finger is lifted away from the screen, the ball is thrown, and mostly, if the ball lands close to the Pokémon, it will capture it. The game currency can be earned by placing a Pokémon at a gym after defeating Pokémon that were placed there by others (see Figure A5). Pokémon gyms are virtual locations in each digital environment in which a player's Pokémon can be tested for strength; winners remain in the gym for future completion but losers remain in the player's cache of Pokémon to continue evolving (when it has recovered its health). The competition at gyms involves choosing (or letting the game chose for you) the suitable Pokémon for the match (with its programmed skills) and by moving the Pokémon with a finger to attack or jump away from attacks. These actions are, to some degree, skill dependent, but there is little variation in possible moves.

The game builds largely on the game platform for the art-catching game Ingress. Thus, PokéStops are located at places or monuments of cultural importance, such as sculptures or churches (see Figures A3 & A4). Shortly after the release of the game, Niantic, the game creator, allowed users to suggest spots for PokéStops. This possibility allowed companies and cultural destinations to use Pokémon GO to attract visitors.

Some Pokémon are rare and difficult to catch. For every Pokémon a player captures, the player earns experience points (XP) and Pokémon-specific "candy" that can be used to evolve the Pokémon from one evolutionary stage to another (three stages maximum). Evolving a Pokémon increases its fighting abilities by increasing its combat power (CP). Users can also battle against other Pokémon stationed at gyms (see Figure A5).

The outcome of each battle depends on the Pokémon chosen by the player, its characteristics, its combat points (CP) that are upgradeable with stardust and candy, and the agility of the player. In the current version (still in play in 2018), users do not battle against other players but against

Figure A3. Activated PokéStop showing a sculpture in Oslo. The users can gather more info about the sculpture, artist, when it was created, and so on, by tapping the circle.

Figure A4. Screen save of a PokéStop from when I entered the vicintity of a PokéStop at St. Hanshaugen, Oslo. The three bubble-like objects are resources granted the player (two Poké-balls used to capture Pokémon and one raspberry used to increase the chances of capturing a Pokémon) by spinning the inner circle (with a finger movement on the screen) with the picture of the building that is the center of the PokéStop in the real world and virtually.

Figure A5. A screen save that shows the Pokémon Dragonite that the player (avatar) Salapalmer has left in the gym after beating the those that were stationed in the gym beforehand. To take over the gym at this point, one has to battle against Dragonite.

the game itself. Players who succeed in battle can place their own Pokémon in the gym. When a player succeeds in placing a Pokémon in a gym, s/he earns game currency that can be used to purchase various items and benefits. Game currency can also be purchased with actual money. Pokémon with high CP and health points (HP) perform best in gyms. As a player progresses through the game, s/he gains access to new functions and items, such as better Poké Balls, more efficient Pokémon medicine (potions), and new Pokémon. Spawned Pokémon often will have higher CP levels as the game progresses. Furthermore, as a player collects more Pokémon, s/he will be awarded with medals (e.g., the 'Collector' medal for capturing 2,000 Pokémon; see Figure F2).

Pokémon GO has experienced several iterations. For example, some months after the release, Niantic allowed individuals to buddy up with their favorite Pokémon to earn extra candy (see Figure A2) where the avatar Timnordlie is standing with his Pokémon buddy Bulbasaur). In November 2016, the reward system was extended to give players bonus rewards for the first catch and PokéStop visit of each day, as well as an additional bonus for 7 consecutive days of catches and PokéStop visits. In February 2017, Niantic released 80 new Pokémon, along with special items capable of evolving eight specific Pokémon to stages that were previously not available.