The Nature of Games

Uri Globus*

This paper examines the nature of games and its relation to research, education and entertainment. We discuss the need and importance of having a better definition for the word 'game'. Ideally, such definition should be clear-cut, acceptable across various disciplines and coincide with common use of the word. We arrived at our definition by re-examination of some previous definitions and focusing on the distinctions between 'game' and closely related phenomena. It is suggested that 'game' may be defined as a partially ordered dynamic that has an element of tension; the structure of games is always a result of conflicting desires. This definition gives insights regarding the value of games for research, education and entertainment. Particularly, we suggest that a measurement for the entertainment of games should be dependant on the number of simultaneous tensions experienced, their degree and duration. We denoted this new fuzzy measurement as tension space. Using this new measurement, seemingly different games can be compared. The tension space is dependant on the game skills and knowledge of a player. We suggest as well, that measuring the communication i.e. the information transferred in a game, is another promising direction for further research. Lastly, we examine the metaphor "life is a game" in light of our new findings.

Keywords: Game, measurement, tension, education, decision complexity, context.

1. Introduction

Game research is an emerging interdisciplinary field attracting researchers from a range of academic disciplines as well as various industries. Each group has its own view regarding the nature of 'game' and its own unique game-related practice. It seems timely for a synergistic effort aimed at understanding this fundamental concept. This effort should stimulate exchange of knowledge and collaboration within the community of research using games.

We reviewed definitions from a few sources and could not find one that was fully satisfactory according to the criteria in the abstract above. This paper is a summary of our efforts to create a better definition and the implications and insights derived from this process.

An important implication in the field of entertainment computing is that measuring the entertainment of a game is dependant on the ability to estimate the degree of all the tensions involved in playing the game. We denote our new measurement as tension space (TS). In light of the new measurement seemingly different games can be compared.

We made an effort to present all our ideas according to contemporary rules of the game of science.

2. A Short Survey

Games have been a part of human culture since its very onset. Thus, it is not surprising that many of the great minds in human history have been attracted by and attempted to understand this phenomena. We present here only a few prominent ones.

Plato (360 B.C.E) regarded games as an activity deriving from excess of energy. He suggested as well, that games are the best means of education of a free man. We shall relate to this statement later when we discuss education and games.
According to Wittgenstein (1958), a word does not have a meaning by itself, but rather it’s meaning is revealed by the way it is used. We adopt this philosophy and use it as a basis for our research. Let us begin then from checking how the word game is used in English. When checking Miriam-Webster online dictionary (2004) we can see that the word game has a few different meanings.

Let us focus on four of them:

1. Activity engaged in for diversion or amusement: Play.
2. A procedure or strategy for gaining an end: Tactic.
3. A physical or mental competition conducted according to rules with the participants in direct opposition to each other: Contest.
4. The set of rules governing a game.

When we look at these definitions we can see immediately a source for confusion. In fact Huizinga (1949) showed that in some other languages the above definitions take special different words (i.e. ‘agon’ in old Greek is akin to definition 3. above). The first definition, play, requires knowing the purpose of an activity in order to classify it as a game. This purpose is a psychological attribute of the players. The second meaning, stresses a method directed towards a desired outcome, and does not require any attribute of the players (which may not necessarily be living creatures). The third, a structured contest, is so common that in some languages it has a special word. The forth definition, though seemingly cyclic, focuses on the structure of a perceived game (according to one of the other definitions)—literally its rules.

It may be suggested that the confusion is caused by the fact that the word ‘game’ points at a collection of different phenomena. However, when we classify a collection of phenomena using one word it makes sense that there is some commonality as well.

One of the prominent research works about games is (Huizinga, 1949). Huizinga’s approach was historical etymological, surveying the role of games in quite a few different cultures and the vocabulary used for describing them. Huizinga’s starting point was that play is not an activity monopole by mankind. Though Huizinga does not give a clear definition of a game, he certainly points out many of the important aspects of games. Then, he establishes the relation between games and other important aspects of various cultures. He further concludes that play is the constructor of society. As well, he concluded that playing games is a distinct phenomena within the range of human behaviors. In his research to define the concept of game, Huizinga noted the following indicators:

1. A game is an act of free will. A baby and an animal play for fun.
2. It is detached from “ordinary” life. Material utility does not play a major role.
3. It is bounded in time and space.
4. A game is order. Moreover, it brings completeness to a chaotic world. Aesthetical.
5. Tension—a degree of uncertainty and belief in a chance for success.
6. A mix of the strict commandment and the freedom of choice. We call it balance.

We find the above criteria as too narrow for our goal. Not all the criterions apply in any case. For example, the applicability of the first element is questionable when there are no human players. As well this is not a succinct definition.

For Berne (1983), games are first of all a mean for social contact. He investigated social games as deals, looking for interests and rewards. Berne defines: “A game is an ongoing series of complementarty ulterior transactions progressing to a well-defined, predictable outcome” (Berne, 1983, p. 48) he later adds: “The use of the word ‘game’ should not be misleading...it does not necessarily imply fun or even enjoyment.” (Berne, 1983, p. 49). Berne regards games as means to satisfy what he identifies as: “stimulus-hunger, recognition-hunger and structure-hunger” (Berne, 1983, p. 18). While Berne’s definition is suitable for the subclass of games that he investigated, it is too narrow for our purpose. The ulterior element is not necessarily present in other kind of games (i.e. Solitaire games). However,
there is an essence that Berne describes that can be generalized. In his words; "Games are a compromise between intimacy and keeping intimacy away." We find two elements in this sentence that can be generalized. First is the tension between desires and second, is the compromise between those conflicting desires.

3. **A Revised Definition**

We define game as a partially ordered dynamic that has an element of tension. The structure of any game is a result of conflicting desires. The perception of a game depends on the point of view. In the following section we give a few examples to support our definition.

When we look at two baby lions playing, what makes us call it a game? This question could be rephrased as: When does it stop being a game? As well, is this game a part of life or detached from it? Definitely if one baby lion would intentionally kill the other it would stop being a game. Obviously the fact that some option is excluded resulting in a higher order of activity is a requirement. On the other hand if the activity is too ordered we shall probably perceive it as a ritual or a procedure. We can learn a few things from this example: first, that playing is not an activity uniquely human. Secondly, that a balance of order and disorder is a necessary element of game. Now, suppose one baby lion "surrenders" willingly (i.e. stops playing). Now we see that the conflict or tension was necessary for us to perceive the activity as a game.

Do the two baby lions really play? We do not know. Still, when we say they are playing, we run little risk of being misunderstood. Therefore, we suggest that there are some qualities that we perceive, and the nature of game is actually a property of the mind. We identified two qualities that exist in any case we call something a game. Both are already mentioned by Huizinga (1949) but in a limited sense and scope (for example not inclusive of pure mathematical games). The first quality is tension. Tension is always derived from conflicting elements. However, we distinguish between three kinds of tensions. First is the tension perceived by an observer that we denote the game tension. Second, is the tension perceived by players while playing that we call the playing tension. Last, is the tension of desires effecting the creation of a game that we denote the generic tension of a game. It is likely that from one point of view a dynamic is perceived as a game and that from another point of view it is not. Take for example the gladiatorial games that were popular in the Roman Empire times. It is very likely that the audience, the gladiators and the animals involved experienced different kinds of tension. Therefore, baby lions, gladiators, computer programs or even phrases in a sentence may all be games for an observer.

Playing tension, as experienced by players, is subjective and relates to their personal desires as well as to their playing skills. In many games, good playing skill requires the ability to resolve (viz. balance) large and meaningful tension spaces. Here is a native example of some of the tensions involved in taking a decision in the game of Go:

1. Expansion vs. Solidification = Speed/power balance
2. Utilizing vs. Building potential = Investment timing balance
3. Attack vs. Defense = Power balance
4. Immediate vs. Positional move = Speculative balance
5. Solidity vs. Flexibility = Confidence balance.
6. Aggressiveness vs. Safety = Risk balance
7. Quality vs. Time = Operational balance

The structure of games is always a result of conflicting desires. A game, like a house is artificially designed as to facilitate acting out those original desires. We call the conflicting desires that inspire the creation of a game the generic tension of a game. The following classification is not complete and definitely not exclusive. Mathematical games lie in the intersection of interest and simplicity. Reductionism being the combination of both is the essence of mathematical elegance. Social games solve conflicts between personal and social desires. The kind of psychological games that Berne (1983) investigated are always a compromise between a desire for social contact (i.e. intimacy) and a desire for safety. These games are a subset of simulation games. Simulation games in turn are always a result
of a desire and its cost. Competitive games are essentially social games as Huizinga (1949) already showed.

Our definition is aimed to be as general as possible. For example, if we take out one element, it will stop being a game. It is suitable for the natural sciences and it allowed us an overview of games. However, from a participating point of view, this definition is insufficient. Understanding the human relation to games calls for a psychological description. It is “How we play?” and “Why we play?” that can help us discern between playing a game and other human activities.

4. Why & How We Play

For adults a game is a way to pass time pleasantly. The source of pleasure may differ from one person to another. It may be social, physical, mental, emotional and even spiritual. A person's desire suggests both the kind of games he chooses to play as well as his attitude of playing.

Some people desire company. They care little about the kind of game played and its outcome as long as their need for company is satisfied. Others desire reassurance. For them winning values more than the kind of game they play. Sometimes people have an acute need for attention that makes them choose games and strategies that reward that need best. Those in quite a few cases may include irrational and destructive games and strategies.

A game, being a satisfaction of one's needs is an act of recreation. The needs are real and the game is in most cases artificially designed as to satisfy those needs in the best way while avoiding undesirable effects that are present in real life. Thus, the structure of a game is very similar to a house. It is designed to create a space for the more desirable activity while releasing us from that part which is less desirable.

However, playing games always involve tension. Tension in turn being essentially a conflict of desires can be regarded as well as 'problem' or a 'trouble'. It is funny to see, though not less true, that at our free time we are actually "looking for troubles". It may be that a different kind of tension is desirable and induces pleasure and secondly, that

the playing tension of a game helps distracting one from one's life tensions, thus, providing him a temporal relief.

Adults usually regard games as a pastime that is distinct from reality. In fact, one of the common usages of the word 'game' in English refers to the pretense aspect of a game and 'playing' sometimes suggests insincerity. DiLalla & Watson (1988) showed that young children, roughly up to three years old, have no distinction between reality and pretense. Obviously, young children may not be playing in the same way that adults do. Young children's play is marked by a combination of focus of attention and a higher degree of exploration. This combination is absent in a child's other activities, such as crying, eating (though he often plays with his food) and sleeping. It is presumed that for a child at that age, a game is a way of digesting his environment and a way of expression.

Games are often a mean to gain vital knowledge, experience and skill that are very hard to obtain in normal life. For example a learning opportunity of managing an army in a battle or taking a very hard decision (such as sacrificing your Queen in chess) are rare in normal life but when the time comes a mistake is crucial. A game like chess or Go facilitates the learning of a good winning strategy by avoiding among other burdens the burden of morality. An insightful example is found in Card's novel (1977). The next section discusses the use of games as an education media.

5. Games as Educational Media

5.1 What is a good education?

We think that a good education stimulates growth and empowers a child yet preserving his self-sensitivity. Programming a child to be useful to society is something else.

5.2 How are games educational?

The first person we know of who suggested that play and toys are the best kind of education is Plato (360 B.C.E). His motive was that a free man (in contrast to a slave) must not be coerced as "no forced study abides in the soul." (Plato, 360 B.C.E). We wish to show how appropriate games may help
achieving the above educational goal:

1. Empowering - Most important aspect of education. It is the feeling that 'one can make a difference'. This feeling can only be achieved by interaction. The power to influence the course of a game is empowering. Playing in a group is socially empowering and is also a way of practicing responsibility. As we were told by a 9-Dan professional Go player and teacher, Yasuda Yasutoshi, getting your own turn means that someone is listening to you. Attention, according to Peck (1978), is the best sign of true love. This love is essential for a child's growth.

2. Stimulation - Playing games being a voluntary activity is by its nature self-motivated. The element of tension which exists in any game, creates a challenge. Together with the element of order (the game's rules) it gives the best conditions for autonomous learning. Regarding a tension and a difficulty as challenges gives a child a positive attitude needed to overcome life's hardships.

3. Discipline - "Discipline must come from liberty..." Maria Montessori, founder of the Montessori method. By its very essence discipline suggests freedom.

4. Skills knowledge and values - The acquisition of these can be pleasant with appropriate games.

5. Social association - Though we have not put this matter in our educational targets, it is the main aim of many education systems. The best way to form groups is by letting people have a shared task or activity. This procedure is facilitated with games. On top of that, games tend to form strong bonds.

As Berne mentioned in the end of (Berne, 1983), belonging to a group means being a player of the group's games. If one changes his game, he might become unwanted in his group but he can expect to be welcome in another group that plays the same game. Individual desires are often suppressed by society. Games function as pressure relief valves for those desires helping the assimilation of individuals into society.

5.3 The risk of games

We could see that games are potentially an excellent educational media. However, being a media it may convey also false knowledge and values - misuse. Another risk is if the rewards of a game cannot be matched in reality resulting in an addiction - overuse. As (Peck, 1978 p.107) nicely put "if a hobby becomes an end in itself, then it becomes a substitute for rather than a means to self-development ". Like any other media a game can serve narrow interests that do not align with ours - illness. Awareness to these risks can contribute to a successful use of games in education.

6. Game Measurement

Each game related discipline has some qualitative classifications as well as some quantitative measurements. However, it looks that general game measurement has much to be desired.

Mathematical Game Theory has a set of qualitative classifications such as zero-sum, cooperative, partial information, etc. As well, it has some quantitative notions such as combinatorial complexity, computational complexity and temperature.

Berne (1983, p.63-64) suggests a taxonomy for classifying the kind and degree of the psychological games he investigated.

Classical board games (i.e. Othello, Chess etc.) programmers use measurements that relates to the game tree search model. This has three elements: 1. Game tree measurements such as: average branching factor, average depth, size of the tree etc. 2. Evaluation function measures such as granularity and cost 3. Search algorithms measurements which include among many others measurements the depth of the search (that can be either variable of fixed) the order (i.e. best-first or depth-first), number of nodes visited, time.

6.1 Tension harmony and entertainment

We suggest that tension is the key element of entertainment. Tension is akin to potential in physics. We suggest that tension is a neuro-physiological potential that is built and released during a game. Pleasure is related to appropriate tension over time and its release. We believe that watching a good game is like listening to a good
musical piece. That means that the rules of harmony and of pleasure apply to both these activities. Lida et al. (2003) have suggested the following index for the entertainment of classical board games:

\[ E(G) = \frac{D}{b} \]  

(6.1)

'D' stands for the length of the game and 'b' is the average number of plausible moves for a player. It is presumed that if the above estimate is low the entertainment of the game is high and vise versa.

The number of plausible moves is dependant on the player's strength. It is presumed that a player's strength is in inverse relation to the number of plausible moves. A perfect player might consider only one move resulting in a relatively large E(G) estimate and lower degree of entertainment.

This formula suggests for example that the entertainment of one game of chess may be compared to the entertainment of playing a 24 rounds tournament of Roshambo (known also as Rock-Paper-Scissors and as Janken in Japan). This kind of comparison may be made only assuming no understanding of the game i.e. when having two random players playing those games.

In our view, the index suggested by (lida et al. 2003) captures the aspect of the accumulated uncertainty regarding the course a game will take. In our terminology that is akin to the game's tension.

However, in the next section we will show that it is only roughly related to the "playing tension", that is the tension experienced by those who play the game and by a knowledgeable observer (in some sense the latter is experiencing the playing tension).

6.2 Decision complexity and tension

For a human player a decision's complexity has to do with the tensions he has to resolve for making a decision. Thus we would like to present a notion of tensions space (TS). A tension is a conflict of two or more desires (i.e. criteria) of a player.

Let's suppose a very simple game that has only two options. The reward of each choice is given by an evaluation function \( E \) (with only 3 elements for simplicity) which measures the reward of each choice.

\[ E = f(E_1, E_2, E_3) \]  

(6.2)

Now, let's suppose a game \( G \) has only two options (two possible moves) namely 'a' and 'b'. The decision complexity in this game is related to the difficulty of comparing the possible rewards of each option. That is comparing between:

\[ E(a) = f(E_1(a), E_2(a), E_3(a)) \]  

(6.3) and \[ E(b) = f(E_1(b), E_2(b), E_3(b)) \]  

(6.4)

A simple formula for the preference \( P \) of move 'a' among 'a' and 'b' can be described:

\[ P(a|b) = E(a) - E(b) = f(E_1(a) - E_1(b), E_2(a) - E_2(b), E_3(a) - E_3(b)) \]  

(6.5)

If for every "i",

\[ E_i(a) = E_i(b) \]  

(6.6) then, we have no tension as the two moves are equal in our evaluation function.

If for every "i",

\[ E_i(a) \geq E_i(b) \]  

(6.7) then choosing 'a' over 'b' involves no tension at all. That could also be interpreted as no inverse relation between the various elements.

If the elements of \( E \) (equation 6.2) are independent of each other, or at least does not have an inverse relationship between them, then improving of one element, does not create any tension. However, if the elements of an evaluation function are dependant in an inverse proportion then we have a different case.

Suppose a simple reward function such as:

\[ E = f(E_1, E_2, E_3) = \max(E_1 + E_2 + E_3) \]  

(6.8) and suppose that the elements of \( E \) are all positive and related with a simple relation such as:

\[ E_1 + 2E_2 + 3E_3 = c \]  

such that 'c' is a constant. (6.9)

That means, that choosing a move with a higher \( E_i \) element, means getting at least one of the two
other elements $E_2$ or $E_3$ to be lower when we want all of them to be higher. This corresponds to the playing tension described in this situation.

What we actually showed is how choosing between only two options can become a constraint satisfaction problem (CSP) with any number of constraints depending on the context of the problem. Thus, we can see that the number of options doesn't correspond necessarily with the decision complexity and that the playing tension is dependent upon the number of tensions involved.

What makes that even more true in practice is that the function 't' (in equation 6.8) contains weights for each element. Usually, the exact weights are unknown and moreover they change (some times dramatically) during the course of a game, depending on the context (i.e. (E1,E2,E3)) of the game. That means that the elements are fuzzy and the decision complexity is not only dependent on the number of constraints but also on the degree of their fuzziness.

In a very small game like this, one would probably be better-off calculating the evaluation for both 'a' and 'b' and choose the better (if their fuzziness would allow it). However, in more complex situations (i.e. more elements and more options) human play is directed by a heuristic sense of balance, thus focusing only on a small number of elements that are likely to become off-balanced from a current position.

Another human heuristic is searching for moves that satisfy gradually more and more desires, thus gradually relaxing the tensions (i.e. constraints) involved in making a decision. This can be regarded as searching by iteratively widening the context.

It is known that some moves in a game are easy and some are very difficult. We suggest that this is due to the number of tensions involved in carrying a move and the degree of their fuzziness. If no context is available that can help us discern between options, a decision is very easy regardless of the number of choices (choosing randomly).

If we compare the tensions involved in playing chess for a knowledgeable player and playing any number of Roshambo matches, we could see that Roshambo is no match for chess. That is because of the relatively poor context that can affect the tension involved in making a decision.

According to our theory, the entertainment of any game (can be Golf as well as Go) can be modeled by the following index $\bar{E}(G)$:

$$\bar{E}(G) = D \times t \tag{6.10}$$

'D', like in the above equation of (Iida et al 2003), represents the game length and 't' represents the average tension that is experienced by the player during the game (related to the TS). Unlike $E(G)$ in equation 6.1 that is assumed to be in inverse proportion with the entertainment of the game G, our $\bar{E}(G)$ is proportional to the entertainment of game G. Though mathematically both options are equivalent, we find our presentation more natural. If one likes to compare equations 6.1 and 6.10 then one may use an inverse function of either one of them.

For complex board games like chess and Go, $\bar{E}(G)$ would be correlated to the decision complexity as perceived by the player. Estimating the variable 't' is a problem in fuzzy reasoning. However, it is conceivable that testing this theory can be done as well by combining players protocols with physical measurement.

What we can say now is that possibly, playing a game of chess for a prize of 1008$, might be compared to playing a game of Roshambo for a prize of 1000$ depending on the effect of the prize on the tension.

### 6.3 Knowledge and entertainment relation

We believe that tension increases the entertainment of a game. More knowledge (i.e. richer contexts) can either increase the tension (as we have seen in section 6.2) or decrease it. The reason a very strong player may not enjoy a game is because his knowledge and skill might relax the playing tensions faster (sometimes immediately). A beginner learning some new concept (i.e. enriching his knowledge) may find a game to become more entertaining because at each move he learns to experience more tension. However, as he become proficient at relaxing that tension his entertainment may decline.
6.4 Measuring the communication in games

One important aspect that contributes to the entertainment of games is their use as a media for communication between people. A possible direction to measure this aspect is by measuring the information transferred through the game.

The information of a move can only be measured in regard to a context, i.e. if all alternatives carry the same meaning in a certain context, then the move (choice) carries no particular meaning. However, even if a move carries a meaning relatively to the context that we “see” (i.e. our perception) the information it delivers is dependant on the context that was used by the player who conceived it. The same move coming from a random player and an expert carry different information. In the latter case, the move might have been conceived and tested in regard to a large body of knowledge (rich context). A move, however, can only convey a certain amount of information regarding the context from which it was originated. Without having any other knowledge regarding the player who played it, we can only try to understand it according to our knowledge of the game’s context (our perception).

Understanding the information in a move is therefore a reverse engineering problem of learning the context in which it was preferable by the player who made it. Having no other knowledge than our own context for describing a game it can be done by finding the maximal and minimal subsets of our context that “explains” the move (i.e. when using that context to describe the game the move made was optimal). If no subset of our knowledge ‘explains’ the opponent moves we may check the likelihood of the following options: 1. The opponent plays randomly (i.e. playing from an empty context), 2. The opponent is playing using a different context than ours 3. Our assumption that the opponent tries to play optimally is wrong (he may do so in order to achieve other goals than we perceived before).

Though we believe that this kind of measurement of the communication in games is important, we leave it open at the moment for a later investigation.

7. Summary

Attaining a consensus regarding what is a ‘game’ is a hard task. Nevertheless, the effort is expected to stimulate discussion and synergy among the various disciplines that utilize games. We have shown that in the broadest sense a game is a partially ordered dynamic that has an element of tension. Perception of a dynamic to be a game depends on the point of view. We distinguished between three types of tensions, namely the game tension, the playing tension and the generic tension. The last one can be regarded as a generalization of Berne's (1983) view of games to any kind of game.

When one observes a dynamic, such definition may be sufficient and therefore it may be appealing for the natural sciences and to a meta-observation of games. However, for adults, distinguishing between game and work requires Huizinga's (1949) first element of game, namely it has to be voluntary. Being voluntary suggests that it is desirable in a sense of self-satisfaction. Satisfaction of personal desires is subjective and therefore, one’s game may be another person’s X such that X ∈ {work, joke, life, hell, religion etc.}.

People generally perceive games to be a satisfying pastime that is distinct from life. However, young children (roughly under 3 years of age) do not distinguish between reality and pretense. It seems that for young children a game serves for digesting new information, as well as, a mean for self-expression.

A general measurement of games is a field that is far from being elaborated. We suggested two new directions for measurement. First, is a measure for the decision complexity based on the context (multiple fuzzy criteria) and the tensions (constraints on more than one criterion). Secondly, we have suggested that a context base measure of the information that is communicated in a game is a promising direction for further investigation.

We expressed our opinion that games are potentially an excellent educational media. Their focus, challenge and transparency foster exploration, autonomous-learning and acquisition of new skills, knowledge and values. Their inherent freedom and player’s involvement are empowering.
However, this media may be subject to misuse overuse and ill-use. Awareness to these risks is important for a good utilization of games for education.

Finally, in light of our definition, we can see that the metaphor “life is a game” is not coincidental. The needs that games satisfy are real. The conflict of desires that induce the creation of a game (viz. the generic tension of a game) is played out in a game. Thus, any human game is to a certain degree a simulation of life. The other direction, namely that life is a game, is far beyond the scope of this paper. However, we will only point out one of the limitations of the metaphor - if life is a game we each have to find what are the rules and the goals for ourselves. That is, we ought to discover the game.

References

[Contact Address:]
Uri Globus
Phone: 053-478-1456
Email: globus@cs.inf.shizuoka.ac.jp, uri.globus@yahoo.com

Information about Author

Uri Globus