[10] The biggest difference between magic in *AD&D* and powers in *Champions* was that super powers in *Champions* could be bought with points withheld from any of the basic characteristic categories (points were generic and universal), whereas in *AD&D* magical powers were based on the number of points inside specific basic characteristic categories. Thus, in *Champions*, super powers were treated more like basic characteristics than skills.

[11] Game mechanics concerning super powers were neither so clean nor so universal as were those concerning basic characteristics. *Champions* still relied on a list, rather than an algorithm, for its explication of super powers. And its implementation of elemental and multipowers created imbalances in game play. The original *Champions* designers were not able to keep the game alive; the game system was sold to ICE, which has now released an updated fourth edition (1990). New releases have expanded the original character generation system beyond the super hero genre.

[12] "After *AD&D*, and *D&D*, *Marvel Super Heroes* is a strong third and would be THE best selling game for any of our competition in the market" (CIS, 1985, Sept. 22).

[13] The newest edition of *GURPS Supers* (1991) acknowledged the limitations of its original power groupings, and in fact no longer attempted to simulate the super hero context in a formulaic (genre-specific) way. "The GM may pick the system (or systems) that best fits his campaign" (Blankenship, 1991, p. 17).

[14] See Myers (1984) for further description of the evolution of player-game relationships over time.

[15] It is intriguing to assume that some evolutionary pattern of play appears again and again, regardless of level of analysis. Certainly game character (magician), game player, and game designer each involve and manipulate contexts during play. And the transformation of the simulated self from *AD&D* fighter to *GURPS* super hero is similar to transformations at other levels of analysis: from *AD&D* novice character to *AD&D* advanced character, from *AD&D* fighter to *AD&D* magician, from game player to game designer. As it is above, so it is below.

Play & Culture, 1992, 5, 441-457

Time, Symbol Transformations, and Computer Games

David Myers
Loyola University

A symbol-transformation model of play is described, with examples drawn from popular home computer games. This model is used to explain the subjective distortions of time commonly experienced by computer game players. This model has many parallels with, but also some unique advantages and extensions beyond, alternative explanations for time distortion during play, including the notion of "flow." Conclusions concern defining the subjective experience of time during play with reference to the symbol transformations of opposition and contextualization.

Goals

I am here concerned with the relationship between transformational models of play and the subjective distortion of time during computer game play. Are the cognitive processes accompanying play (symbol transformations) related to the subjective compression of time during play? Perhaps, as Levi-Strauss suggests, "chronological succession . . . come[s] to be absorbed into an atemporal matrix structure whose form . . . is constant" (1976, p. 184). Or, perhaps "chronological succession" is somehow above and beyond the transformations of play.

The binary oppositions of Levi-Strauss, the Greimas (1983) semiotic square, and other similarly diachronically conceived transformational structures treat time in sharp contrast to those structures which, like that of Propp (1968) in his *Morphology of the Folktale*, conceive symbol transformation processes as linear and synchronic. Which is the proper treatment of time within a symbol-transformation model of play? Specifically, to what extent might the subjective distortions of time commonly experienced during play be explained in terms of player cognitive activities (symbol transformations)? More generally, why and how does time fly when we're having fun?

> I was playing Civ [*Civilization*] on a weeknight the other day. It was like eating potato chips (I'll just move these units . . .), when I looked up it was 4:30 AM and I get up for work at 6:30. (David, CIS GAMERS Forum)[1]

David Myers is with the Department of Communications at Loyola University, New Orleans, LA 70118.

Studies of Time

The perception of time has been studied by psychologists to the degree that we now know the minimum amount of time human beings require to distinguish between stimuli of various sorts: 15 to 20 milliseconds for auditory or tactile stimuli; about 75 milliseconds for visual stimuli (Edlund, 1987, p. 9). The "persistence of vision" phenomenon that makes still images appear to be moving in television and films is, in fact, based on our inability to discern the difference between separate visual stimuli projected at a rate much more quickly than 18 per second. Our estimation of external time appears likewise fixed and "is apparently most accurate around an interval of six-tenths to eight-tenths of a second" (Edlund, 1987, p. 10).

Of course, the ability to estimate time is not the exclusive domain of humans. Virtually all living creatures order their behavior according to circadian rhythms of one sort or another, and many species have demonstrated the capability, like humans, to estimate accurately much shorter durations during controlled laboratory experiments (Friedman, 1990). Nor is the study of time the exclusive domain of the behavioral scientist. The nature and meaning of time has been a central concern of both philosophers and physicists since Aristotle helped define the field for both. And recently, as Prigogine and Stengers (1984, p. xxviii) state, "*Science is rediscovering time*" (italics in original). The apparent conflict between reversible time, implied by Newtonian physics, and irreversible time, implicit in contemporary notions of entropy and evolution, is now being at least partially resolved in the work of Prigogine and others who study the formal relationships between chaos and order. (See Toffler, 1984, pp. xi-xxvi, and Gleick, 1987, for entertaining discussions concerning this relationship.)

Yet, despite at least a century of research dedicated to the exploration of psychological time (Fraisse, 1963), there appears little consensus on an appropriate perceptual model of time (Block, 1990). In many respects, time, like play, is both pervasive and evasive within human behavior.

Time and Play

Although play theorists—notably Brian Sutton-Smith (Sutton-Smith & Magee, 1989)—have investigated order and disorder in play, the study of play has dealt with the concept of time, so important to the investigation of order and disorder elsewhere, only occasionally and peripherally. While categorizing children's play as indicative of developmental stages, Piaget (1966, 1970) considered also the child's concept of time. Piaget opposed the Kantian notion of time as an *a priori* category and argued that time is constructed and learned by children in the same manner as other logical and mathematical forms are constructed and learned. Central to the construction of the concept of time, according to Piaget, was an understanding of velocity, or variations in movement and speed.

Piaget's position is similar in many respects to that of Aristotle, who defined time in terms of motion, so that there could be no motion without time, nor time without motion.[2] Time in this sense is a sort of information-processing strategy used by human cognitive functions (the brain) through which particular sorts of observations are ordered, catalogued, and compared. Physical play allows children to experience the realities of movement and speed, and thus, through trial and error and Piaget's "genetic epistemology," arrive at that common and objective time we share.

However, at least part of this common and objective time remains relative to the society and culture in which we live. Recently in this journal, Eisen (1991), inspired by Weber (1958), examined the concept of time and play as those concepts have been transformed and adapted to the needs of different religious groups. And differences in particular cultural definitions of time have been widely discussed elsewhere (see Nakamura, 1966; Needham 1966; Russell, 1966; for summaries).

Bateson (1972, 1979) is one of the few transformational play theorists who has discussed time in some detail. Unlike Piaget and the cultural theorists cited above, Bateson assumes time to be beyond the transformational powers of either the individual or society and necessary to the biological evolution of higher level thought, and creation of self. Simply put, Bateson understands time as that characteristic of a tautological system that allows it to function as it if were nontautological; that is, an organism can never return to the same thing, including itself, and be the same thing—due to the passing of time. In *Mind and Nature* (1979), Bateson concludes that systems "are necessarily discontinuous for reasons connected with *time*. . . . A world of sense, organization, and communication is not conceivable without discontinuity" (p. 202).

The concept of flow (Csikszentmihalyi, 1975; Csikszentmihalyi & Csikszentmihalyi, 1988) represents another culturally independent approach to the study of time and play.

> the argument in favor of the universality of flow is that the specific *content of the activities* producing flow vary from culture to culture; in the West, flow activities might indeed be on the whole more active, competitive, and controlling than in other parts of the world. But the *dynamics of the experience* that make enjoyment possible are presumably the same regardless of culture. (Csikszentmihalyi, 1988, p. 10)

Csikszentmihalyi and Csikszentmihalyi (1988) describe the subjective compression of time as characteristic of a flow experience that functions as a "homeostatic mechanism," similar to other such mechanisms of hunger, sex, and the avoidance of pain:

> Flow is not a homeostatic mechanism, but in other respects it very much seems to function like other universal sources of positive rewards, like food or sexuality. The function of flow is not to induce the organism to perform what it needs to survive and to reproduce. Rather its function seems to be to induce the organism to *grow*. Not in the sense of ontogenetic development, or maturation, but in the sense of fulfilling the potentialities of the organism, and then going beyond even those limits. The universality of flow might be accounted for by the fact that it is a connection evolution has built into our nervous system. (Csikszentmihalyi & Csikszentmihalyi, 1988, p. 367)

Whereas the Csikszentmihalyi notion of flow seems particularly applicable to the study of the subjective distortion of time during computer game play, I am unsatisfied with the definition of flow most commonly offered—as either the proper mix of anxiety and boredom or, alternatively (and more recently), as the proper balance between "the challenges perceived in a given situation and the skills a person brings to it" (Csikszentmihalyi, 1988, p. 30).

This latter definition of flow, as a proper ratio of challenge to skill, is close to what I have found elicits a positive computer gaming experience. However, I have not found that boredom "always happens" (Csikszentmihalyi, 1988, p. 30) when challenges surpass skills. In a significant amount of computer game play, players enjoy returning to previously mastered sequences of play and replaying these in a meditative, trance-like state quite different from boredom, a state which in fact combats boredom in many instances. Higher levels of complexity, that is, increasingly greater challenges, may be required to remain in flow, as Csikszentmihalyi defines it, but these are not necessarily required to remain in computer game play.

Therefore, in order to extend and amplify the concept of flow as it applies to computer game play, I would like to examine the subjective compression of time that is characteristic of the flow experience from a slightly different perspective: a symbol-transformational model of play. Many fundamental characteristics of the flow experience, including its universality and neurophysiological basis, remain intact during this analysis.

Symbol Transformations During Computer Game Play

Myers (1991) described the structure of symbolic transformations during computer game play. The generic model used to explicate these transformations, derived from the Greimas (1966/1983) semiotic square, is based on the opposition of game player and game opponent and might proceed, in outline form, something like this:

> The self is transformed into a game player through opposition to the game opponent; this opposition is defined with reference to the game context.
>
> The game context is transformed through opposition into a nongame context (reality), which may then be used to define the self.

Thus, in this model the player (actually the playing process that the creation of the player initiates) defines the self that defines the player, a recursive paradox of a sort common in play. More formally, we might represent this nested series of events rather simply, assuming only two types of symbolic transformations: opposition (′) and contextualization ([]) . . .

• self	S	
• in opposition to self	S′	
• the context of self	[S]	such that [S] is the "ground" for the "figure" S
• other, opposite, opponent	O	
• game player	p	
• symbolic transformation	->	
• If S and O,		If there is the self and the other,
• where O <> S′		where the other cannot be defined by the self,
• where O <> [S]		
• then S -> p		then the self becomes a player (nonself), and defines the other through the process of play.

During the process of play . . .

1a. p -> O′
The player is transformed in terms of the other (now an opposite).
1b. O,O′ -> [O, O′]
The opposition between the other and the player is transformed into an object of play.
2a. [O, O′] -> [O, O′]′
This new object (context) of play is transformed in terms of an other/opposite.
2b. [O, O′], [O,O′]′ -> [[O, O′], [O,O′]′]
The opposition between the two objects (contexts) is transformed into an object of play.

. . . and so forth.

This process might continue indefinitely, creating increasingly larger or increasingly smaller contexts for play. But at some point, at least for computer game play, the process of play is returned to the context of the nonplaying self, that is . . .

[],[]′ -> [S]

This effectively subsumes the other within the self and ends play: there is no longer anything to play against.

Let me introduce a couple of extended examples here, both to demonstrate the sort of oppositions involved in this process and to indicate the nature of the symbolic transformations to be discussed in more detail later with reference to direct comments by computer game players. These two examples are chosen for analysis because of their individual popularity and because they well represent two of the most popular and (superficially) distinct genres of computer games: strategy games and arcade games.

Empire

In *Empire* (a computer war game), the game opponent is at one level the commander of an opposing force, played by the computer; at another level the game opponent is any individual unit of that force (battleship, airplane, army) met in combat. In the former instance the game opponent commander is characterized by the interaction of its units. In the latter instance the game opponent unit is characterized by the interaction of its offensive, defensive, and movement values. That is, in *Empire*, an airplane is a fast moving army, and a battleship is a cruiser that has more potent offensive and defensive capabilities. Because these units are built from the same basic characteristics—offense, defense, and movement—they can be easily compared to one another inside a matrix, as the designer of *Empire* does here (Table 1) to demonstrate their relative probabilities of success in combat.

Table 1
Empire Units: Probability of Successful Attack

		Defender							
		Army	Fghtr	Trnsprt	Sub	Dstryr	Crusr	Acrier	Btlshp
Attacker	army	0.500	0.500	0.244	*	0.125	0.004	0.004	0
	fighter	0.500	0.500	0.244	0.391	0.125	0.004	0.004	0.001
	trnsprt	*	0.756	0.500	0.250	0.275	0.002	0.008	0
	sub	*	0.750	0.859	0.625	0.750	0.125	0.313	0.063
	destryr	*	0.875	0.725	0.391	0.500	0.019	0.055	0
	cruiser	0.999	0.996	0.998	0.947	0.981	0.500	0.687	0.145
	acarrier	*	0.977	0.945	0.688	0.789	0.019	0.158	0
	btlleshp	1	0.999	1	0.980	0.999	0.856	0.994	0.500

Note. From Baldwin, 1990, p. 60.

Similarly, the game player of *Empire* can build several different player selves (nonselves) by using the limited number of available units in different ways, according to different strategies, but always in opposition to the computer-controlled commander. These game-playing nonselves can then be cross-referenced to the computer game opponent, over time, in a matrix similar to the one above. This matrix too would demonstrate the relative probabilities of success in combat, and this matrix would be circumscribed by the same basic characteristics of offense, defense, and movement.

It is useful to think of these basic characteristic categories as forming dimensions of meaning, similar in many respects to the Snider and Osgood (1969) notion of "semantic space." Each *Empire* unit occupies a single position within the three-dimensional matrix of offense, defense, and movement. This unit has a fixed relationship to all other units within the matrix (a particular meaning), but this relationship (meaning) might be of greater or lesser importance depending on the game context. That is, the matrix might be twisted or rotated or stretched, depending on the analogy you prefer, so that different units occupy higher (more valuable) positions relative to the matrix orientation. That is, if the battles of *Empire* take place solely in a sea world, then ships have relatively greater value than armies, and in the beginning of the game—when exploration is paramount and the immediate context of the game world (sea world, land world, etc.) is uncertain—airplanes, with their greater ability to explore the surroundings, have greater value than ships.

Indeed, it is only within a matrix of this sort, appropriately rotated to represent the current game context, that the transformation of opposition can be properly defined. An airplane is no more or less the opposite of an army than it is the opposite of a battleship. Opposition can occur along any or all dimensions of the matrix. *Empire* therefore varies the number of oppositions it presents to the player by varying the number of contexts in which these oppositions are defined. And these contexts in turn might be defined by referring to the type of oppositions defined within them.

Tetris

Another example to demonstrate the abstract nature of opposition and contextualization within game design is *Tetris*, a popular computer arcade game. Here the basic characteristics of each bundled unit are not offense, defense, and movement but physical orientation in two-dimensional space. In the simplest version of the game, each unit is composed of identical squares arranged in different ways (see Figure 1).

The goal of the game is to rotate and move these objects in space so that they completely fill the shape of a singular game context: a smooth-sided rectangle, 10 (or some fixed number of) squares on a side. Once these shapes have been arranged in a rectangle of proper dimensions, they disappear and the original game context is reestablished. Each of these shapes might be considered the opposite of any other, given different game contexts; or each of these shapes might be considered the opposite of itself, when rotated through anything less than 360°.

During game play, *Tetris* presents the player with a random sequence of shapes to arrange in an orderly fashion. In terms of the model above, we might say the self creates an orderly player (nonself) in opposition to a disorderly *Tetris* opponent. Once these oppositions are realized, both player and opponent are more precisely defined in the context of the game: the player discovers how shapes fit together, learns what larger shapes to build from smaller shapes in order to increase the odds of forming a smooth-sided rectangle, and achieves higher scores. At some point during this process, the opponent is incorporated into the player; that is, the game player begins to play with, instead of against, the game opponent. The game player might even turn into game opponent at times, calmly allowing shapes to collect in seemingly disastrous towers before quickly restoring order and smooth-sidedness in a sudden flurry of action.

Contextual transformations, though present in both games, are less integral to *Tetris* play than to *Empire* play. *Tetris* play is based on the resolution of opposites within a bound and limited context; whenever these oppositions are resolved, that context immediately reasserts itself. Thus, game play in *Tetris* is sustained primarily through the random, and increasingly more rapid, sequencing of oppositions. In *Empire*, game play is sustained through the resolution and subsequent transformation into opposites of a larger number of more variable contexts. Instead of increasing the speed of opposition resolution during game play, *Empire* increases the complexity of those oppositions. The effect on game play, however, is very much the same: there is a subjective compression of time during play.

Time Within Computer Game Play

The subjective experience of time within computer game play varies over time; that is, as players become increasingly experienced and knowledgeable of

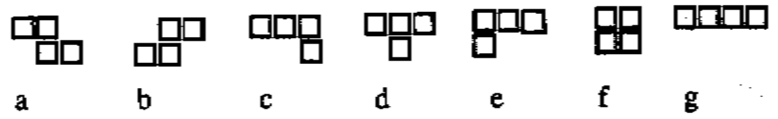


Figure 1 — Units of play in *Tetris*.

a game's transformations, their perception of the passing of time during play changes. This is true whether game play takes place in real time (e.g., in most arcade/video games, represented here by *Tetris*) or in nonreal time, where players have an unlimited amount of time between their moves or actions (e.g., in most strategy and role-playing games, represented here by *Empire*).

In the first case, the pace of the game picks up as play progresses. In *Tetris* for instance, random sequences of shapes fall through space more and more rapidly and, correspondingly, player decisions concerning where to place those shapes must be made more and more rapidly. But "rapidly" is relative here, with novice players finding the initial pace of the game much more rapid than do more experienced players.

In nonreal-time games, player decisions can be made at leisure while the computer pauses and waits for the player to respond. Normally, however, players impose a pace of their own on these nonreal-time games, either by inputting moves more quickly than a complete analysis of all options would allow or by waiting impatiently with fingers poised above the keyboard (or mouse) for the computer to reach a point in its calculations when it will accept their most immediate and forceful response (Myers, 1984). This need for speed during play extends to preplay as well, with players eschewing the rules of a game in favor of playing first and learning second.

> Jump Right In Method: This is the most popular with experienced computer game players. . . . Refer to the manual's instruction for help with problems that arise. (*Civilization Player's Manual*, 1991, p. 13)

Just as in real-time games, the pace of the nonreal-time game varies among experienced and nonexperienced players. Once the game's transformations are well known, time spent during game play becomes increasingly drawn out, monotonous, and intrusive to an enjoyable play experience. Based on player comments and interviews, the subjective experience of time during game play is in fact quite similar, whether the game design uses a real-time method of increasing the game's pace (by more rapidly presenting the player with oppositions to resolve within a singular context: *Tetris*) or a nonreal-time method (by more rapidly presenting the player with a variety of contexts within which to resolve oppositions: *Empire*). That is, the subjective experience of time within computer game play seems equally affected by either of these two processes (see Figure 2).

It is the subjective similarity of these two types of games that first intrigued me about the nature of time within computer game play. It appears that contextual transformations have some relationship to the passing of time, and in fact might substitute for it. Are the sequencing of oppositions and the contextual transformation of oppositions somehow psychologically equivalent? Does a symbol-transformation model offer any possibility of reconciling these two?

Time Within Civilization

In order to incorporate recent player comments as efficaciously as possible, I wish to discuss the subjective experience of time during computer game play primarily as regards a single example: *Civilization*. In simplest terms, *Civilization* could be considered a considerably beefed-up version of *Empire*. Like *Empire*, *Civilization* is a strategy/war game.

2.1. Increasing the relevance of time between transformations:

2.2. Increasing the relevance of context between transformations:

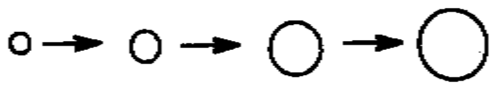


Figure 2 — Sequences of symbolic transformations during computer game play.[3]

Civilization was designed by Sid Meier and Bruce Shelley, distributed by MicroProse, and made available commercially just before Christmas 1991. The game almost immediately elicited a great deal of interest due to the success of the design team's previous efforts and the addictive quality of its play. An extraordinarily large number of messages and comments concerning *Civilization* flooded CompuServe's GAMERS Forum during the early months of 1992 and serve as the basis for the following discussion.

Civilization, again very much like *Empire*, requires players to resolve a number of different oppositions, most of them capable of being expressed empirically, as the following analysis shows:

> Let's suppose you have a size 15 city, with about 15 trade. Under Communism we lose 2 trade to corruption. Under Democracy we gain another 13 trade. You have a Granary, a Temple, a Coliseum, a Cathedral, and an Aqueduct in town, for a total upkeep of $11. You have 4 unhappy people, which we'll offset with 4 troops under Communism (costing 4 shields) and with 4 happy people (costing $8) under Democracy. I'm assuming we lose 2 trade to corruption under Communism. I'm also assuming anything not spent on upkeep goes into research.
>
> | | Upkeep Tax | (trade) | Research | Lightbulbs |
> |---|---|---|---|---|
> | Communism | $11 | 11 | $2 | 2 |
> | w/Market | $12 | 8 | $5 | 5 |
> | w/Market, library | $13 | 9 | $4 | 6 |
> | w/Bank, library | $16 | 8 | $5 | 7 |
> | Democracy | $19 | 19 | $9 | 9 |
> | w/Market | $20 | 14 | $14 | 14 |
> | w/Market, library | $21 | 14 | $14 | 21 |
> | w/Bank, library | $24 | 12 | $16 | 24 |
>
> (Gus, CIS GAMERS Forum)

This opposition between democracy and communism is obviously a complicated one that cannot be dealt with entirely successfully, in terms of the game's scoring criteria, without a sophisticated contextual analysis such as the one above. And even this analysis is incomplete, showing only the opposition's most obvious characteristics, so that experienced game players must extend and evaluate these characteristics in contexts specific to their own play.

While much of this sort of contextual analysis of opposition is possible from reading the rules alone, it is inevitably the result of unsuccessful play. That is, players analyze oppositions in as much detail as above only after unsuccessfully playing with the game's oppositions using their own personal set of contextual transformations concerning communism, democracy, and the like (the Jump Right In Method). In fact, many players never make detailed empirical analyses of games using matrices or other formulae, perhaps due partially to their lack of skill in such matters, but mostly due to those sorts of contexts not being as much fun to play with as their personal versions:

> I just played the Coneheads under King Beldar, who ruled from the capital city of Sixpack. He did about as well as you would expect. (Michael, CIS GAMERS Forum)

However, even if there is some part of the game (let us say its "math") that cannot be immediately contextualized within the playing self, it is still contextualized, but as a less bitter pill to swallow.

> I think Monarchy and Communism are vastly inferior to the other forms for an experienced player, but I think they're easier to master. I generally play just two government types now, Despotism and Democracy, the two extremes. However, it's much easier to make mistakes with them. (Gus, CIS GAMERS Forum)

Thus, the contextualization process is neither linear nor objective during play but might follow many different paths, particularly when involving the transformation of complex, multivariable opposites such as democracy and communism. In *Civilization*, players create their own idiosyncratic contexts for play, which may or may not include all those common and objective characteristics of the game that need to be mastered in order to achieve that game's highest possible score. The same technically inclined *Civilization* player quoted above is more likely to play the game for fun than for a high score, which is a common player sentiment:

> That's far better than any score I've reached, but I never really pulled out all the stops like you describe. The game does get rather boring if you have complete control of everything and you're just going for population growth. (Gus, CIS GAMERS Forum)

Now, using *Civilization* as our example, how long do players remain at the level of opposition after jumping in, and at what point do they begin to contextualize, that is, move from the consideration of matters involving single units to the consideration of matters involving the relationships among multiple units? Although there is both intrinsic (player inclination) and extrinsic (game goal) motivation to achieve contextualization as soon as possible, that contextualization is ineffective until some certain number of oppositions are experienced and learned. How many? The number of oppositions necessary for effective contextualization varies according to game design and player characteristics, but there does appear to be an upper limit.

Note that time does not necessarily have to be involved here; there could be a limit on memory capacity alone. But in fact player information does increase over time. During repeated play, game players remember and play more easily with both lower and higher levels of contextualizations already established. Therefore it seems that players contextualize, not at the point that they reach the limit of memory capacity but at the time they begin to forget. At least one important limit, therefore, appears based not on the number of oppositions in the sequence but rather on the time the sequence takes to unfold. That is, contextualization is characterized not by the immediate capability or desire of the player to achieve it but by the player's eventual and inevitable inability to sustain an extended sequence of oppositions.[4]

Contextualization in this sense is not a process that increases a player's information about the game. It rearranges (transforms) information into broader categories and classes of knowledge, which have successively greater impact on game play. We might say equally that contextualization replaces temporal categories (chronological succession) as a more effective, and seemingly more pleasurable, cognitive strategy during game play (see Figures 3 and 4).

If we adopt this explanation, then we can redraw Figure 2 to more accurately indicate the similar effects of increasing the relevance of time between transformations (speeding up the game) and increasing the relevance of contextualization between transformations (complicating the game). While game time (ticks of the computer clock) is determined by those arrows between the small round circles in the diagram above, subjective time during play is increasingly determined only by those arrows between the larger, rectangular ovals, indicating contextualization. That is, the subjective experience of contextualization dominates the subjective experience of time. Until the player experiences movement from one contextualization to another, reaching a stopping point,[5] time does not pass.

A last brief example drawn from *Civilization*: waiting for the first unit to be built. At the beginning of *Civilization*, the player must build a city and then choose what sort of unit or device to build within that city. Depending on the type of unit chosen, this building process may take several turns, during which the player has no opposition to face and nothing to do but wait. Initially this

3.1. Game players experience transformations in a temporal sequence up to some limit...

3.2. at which point contextualization begins and continues up to some limit...

3.3. at which point contextualization occurs again, etc.

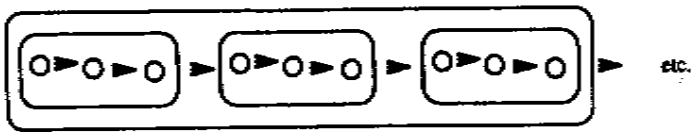
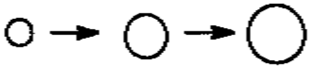


Figure 3 — Recursive contextualization.

4.1. Figure 2.2...



is now equivalent to...

4.2. increasing the relevance of context between transformations.

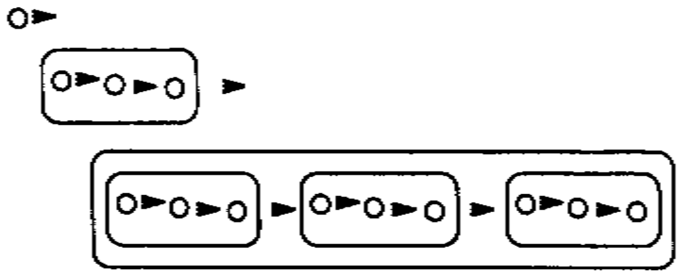


Figure 4 — Sequences of symbolic transformations occurring during computer game play (revised).

building sequence is allotted the player's full attention, as are all elements of the game. Soon upon repeated play, however, the lack of opposition within this initial building sequence is contextualized, and the player fast-forwards through this rather dull sequence as quickly as possible. The machinery of the game builds the unit at the same rate as before, but the player postpones attention, awareness, and experience of time to that moment when the game is ready for play within a new, and more transformable, context containing the newly built unit.[6]

Time in Context

If we assume that symbol transformations occur during computer game play, then the subjective experience of time during play can be fully explained by the sequencing of oppositions and contextualizations, without refrence to a common and objective time existing beyond the subjective experience of play. Paradoxically, however, the limits imposed by an objective time enable and motivate the contextualization process. If, for instance, players could remember precisely and completely all oppositions encountered during play, then there would be little need to contextualize, or adopt some other substitute information-processing strategy.

Likewise, oppositions are defined and grouped into a single contextual category most commonly according to their effect on game context, a recursive effect that takes time to reveal itself. As common as "jumping right in" is "saving and restoring." Computer game players frequently save game positions (moments in time) in order to return to those positions (times) should subsequent play prove unsuccessful. Using this strategy, players need not need reexperience the entire temporal sequence of game play. They seem rather to prefer to short-circuit certain portions of a temporal sequence and replay only those portions that are yet mysterious enough to resist effective contextualization.[7]

If the game does not allow previously learned sequences to be skipped, then repeated play within these already contextualized sequences becomes increasingly rote, leading either to boredom and dissatisfaction with the game or, upon occasion, a sort of trance-like mediation in which players manage to ignore objective time through their immersion within a well rehearsed mental dance of symbol transformation.[8]

Objective time may also be necessary, as Bateson (1979) suggests, for a very important type of opposition: the thing with itself. Or, in terms of the symbol-transformation model, the self with the player (nonself).[9] Consider this comment for instance, as regards, for our purposes, contextualizing a sequence of oppositions encountered during play:

> If any event is to depend upon some characteristic of a multiple sample of some other species of event, time must elapse for the accumulation of that sample, and this elapsed time will punctuate the dependent event to produce a discontinuity. But, of course, there would be no such "samples" in a world of purely physical causation. Samples are artifacts of description, creatures of mind, and shapers of mental process. (Bateson, 1979, p. 202)

Bateson appears to suggest defining common and objective time in accordance with what has come to be called, in physics, the anthropic principle (Barrow & Tipler, 1986). That is,

> Anthropic reasoning. . . . Start from the final observed state (now) and try to constrain the initial situation by asserting that it could only have been the one that would have given rise to a universe that's inhabited today by intelligent creatures such as ourselves. (Casti, 1989, p. 481)

What constraints must we place on time in order to give rise to playful creatures such as ourselves? Perhaps we must only define time as existing, on some perceptual microlevel, as a discrete variable. For without the initial perception of a discrete and discontinuous time, there would be no need to erase its discontinuities in the recursive contextualizations of play. But then for what purpose do we, as playful creatures, cover and mask these assumed imperfections within our temporal perception? And which is then more real—the perceptions or the play? Bateson's answer is, clearly, the play:

> This dichotomy, which obtains in our own scientific minds as we look "out" upon a world of phenomena, is characteristic also of relationships among the very phenomena which we seek to analyze. The dichotomy exists on both sides of the fence between us and our subjects of discourse. The things-in-themselves (the *Dinge an sich*), which are inaccessible to direct inquiry, have relationships among themselves comparable to those relationships that obtain between them and us. They, too (even those that are alive), can have no direct experience of each other—a matter of very great significance and a necessary first postulate for any understanding of the living world. What is crucial is the presupposition that ideas (in some very wide sense of that word) have a cogency and reality. (Bateson, 1979, p. 191)

Conclusions and Comments

The conclusion here, concerning computer game play, is that, indeed, "chronological succession . . . come[s] to be absorbed into an atemporal matrix structure whose form . . . is constant'' (Levi-Strauss, 1976, p. 184). However, this ''atemporal matrix structure'' is an active one composed not of static elements but of the relationships between the symbolic transformations of opposition and contextualization. And common and objective time, at least the perception of common and objective time as a discrete variable, is necessary to establish initially both opposition and contextualization.

Guiding the study of artificial intelligence is the ''physical symbol system hypothesis'' (Genesereth & Nilsson, 1987; Newell & Simon, 1981). This hypothesis states that symbol manipulation is a sufficient process for explaining intelligence. We might exploit this hypothesis for our own purposes here and say that symbol manipulation is an equally sufficient process for explaining computer game play.[10]

One of the most immediate advantages of this perspective in investigating play, in broader contexts than computer game play, is that it defines the play process as both a cause and effect of cognition, self-recognition, and consciousness. The parallels between theories of signification (Greimas et al.) and certain theories of play (Bateson et al.), only a small portion of which have been discussed here, are quite striking. Implicit in these models is the assumption of a neurophysiological mechanism initiating the symbolic transformations of play. From this point of view, the emergence (bootstrapping) of consciousness (the self) requires not that the consciousness ever be present as its own original cause, but only that this transformational process of play be somehow imbedded in the human nervous system. Are there physical analogs to opposition and contextualization? ''Entrainments'' (Laughlin, 1990) appear likely candidates for the roles.[11]

The symbol-transformation model also extends and amplifies many of the conclusions of Csikszentmihalyi (1975) and Csikszentmihalyi and Csikszentmihalyi (1988). By overlaying a symbol-transformation model onto the phenomenon of flow, we are better able to understand how an organism might ''go beyond [potential, ontogenetic] limits'' (see earlier quote) through symbol creation, symbol manipulation, and transformational play within a symbolic world. This seems more encouraging to future attempts to understand flow than does defining its structure solely in terms of other, similarly subjective experiences such as anxiety and boredom.

However, the most engaging aspect of a model of play of this type is that it suggests there might be some sort of predicate calculus that could be used to explain and reproduce play behavior. In fact, it may be that the attempt to build a machine to think (artificial intelligence) is unlikely to succeed without some initial success in building a machine to play (artificial play). The relationship between playing and thinking, and between playing and consciousness, suggested by models of this kind remains most intriguing.

References

Baldwin, M. (1990, November). [Letter to the Editor]. *Computer Gaming World*, p. 60.

Barnes, J. (Ed.) (1984). *The complete works of Aristotle* (Vol. 1). Princeton, NJ: Princeton University Press.

Barrow, J., & Tipler, F. (1986). *The anthropic cosmological principle.* Oxford: Oxford University Press.

Bateson, G. (1972). *Ecology of the mind.* New York: Ballantine.

Bateson, G. (1979). *Mind and nature.* New York: Dutton.

Block, R.A. (Ed.) (1990). *Cognitive models of psychological time.* Hillsdale, NJ: Erlbaum.

Casti, J. (1989). *Paradigms lost.* New York: Avon.

Civilization player's manual. (1991). Hunt Valley, MD: MicroProse Software.

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety.* San Francisco: Jossey-Bass.

Csikszentmihalyi, M. (1988). Introduction. In M. Csikszentmihalyi & I.S. Csikszentmihalyi (Eds.), *Optimal experience* (pp. 3-14). New York: Cambridge University Press.

Csikszentmihalyi, M., & Csikszentmihalyi, I.S. (Eds.) (1988). *Optimal experience.* New York: Cambridge University Press.

Edlund, M. (1987). *Psychological time and mental illness.* New York: Gardner.

Eisen, G. (1991). The concept of time, play, and leisure in early Protestant religious ethic. *Play & Culture*, **4**, 223-236.

Fraisse, P. (1963). *The psychology of time.* New York: Harper & Row.

Friedman, W.J. (1990). *About time: Inventing the fourth dimension.* Cambridge, MA: MIT Press.

Genesereth, M.R., & Nilsson, N.J. (1987). *Logical foundations of artificial intelligence.* Los Altos, CA: Morgan Kaufmann.

Gleick, J. (1987). *Chaos: Making a new science.* New York: Viking.

Greimas, A.J. (1983). *Structural semantics: An attempt at a method* (D. McDowell et al., Trans.). Lincoln: University of Nebraska Press. (Original work published 1966)

Laughlin, C.D. (1990). At play in the fields of the lord: The role of Metanoia in the development of consciousness. *Play & Culture*, 3 173-192.

Lenat, D.B. (1983). EURISKO: A program that learns new heuristics and domain concepts. *Artificial Intelligence*, **21**(1-2), 61-98.

Levi-Strauss, C. (1976). *Structural anthropology.* Chicago: University of Chicago.

Myers, D. (1984). The pattern of player-game relationships. *Simulation & Games*, **15**, 159-185.

Myers, D. (1990). A Q-study of game player aesthetics. *Simulation & Gaming*, **21**, 375-396.

Myers, D. (1991). Computer game semiotics. *Play & Culture*, **4**, 334-345.

Nakamura, H. (1966). Time in Indian and Japanese thought. In J.T. Fraswer (Ed.), *The voices of time* (pp. 77-91). New York: Braziller.

Needham, J. (1966). Time and knowledge in China and the West. In J.T. Fraswer (Ed.), *The voices of time* (pp. 92-135). New York: Braziller.

Newell, A., & Simon, H.A. (1981). Computer science as empirical inquiry: Symbols and search. In J. Hagueland (Ed.) *Mind design* (pp. 35-66). Cambridge, MA: MIT Press.

Piaget, J. (1966). Time perception in children. In J.T. Fraswer (Ed.), *The voices of time* (p. 208). New York: Braziller.

Piaget, J. (1970). *The child's conception of time.* New York: Basic Books.

Prigogine, I., & Stengers, I. (1984). *Order out of chaos.* New York: Bantam.

Propp, V. (1968). *Morphology of the folktale* (2nd ed.) (L. Scott, Trans.). Austin: University of Texas Press. (Original work published 1928)

Russell, J.L. (1966). Time in Christian thought. In J.T. Fraswer (Ed.), *The voices of time* (pp. 59-76). New York: Braziller.

Snider, J., & Osgood, C. (Eds.) (1969). *The semantic differential technique.* Chicago: Aldine.

Sutton-Smith, B., & Magee, M.A. (1989). Reversible childhood. *Play & Culture*, **2**, 52-63.

Toffler, A. (1984). Foreword. In I. Prigogine & I. Stenger, *Order out of chaos* (pp. xi-xxvi). New York: Bantam.

Weber, M. (1958). *The Protestant ethic and the spirit of capitalism* (T. Parsons, Trans.). New York: Scribner's. (Original work published 1904-1905)

Notes

[1] Player quotes are taken from the GAMERS Forum on CompuServe, during the months of January and February 1992. The GAMERS Forum serves as an electronic meeting place for game designers, publishers, and players, as does GAMPUB, its sister forum. The Forum is staffed by experienced computer game players with many hours of play-test experience; game publishing companies keep close track of comments in both forums in order to evaluate old products and test new ideas.

[2] Aristotle: "Not only do we measure the movement by the time, but also the time by the movement, because they define each other" (Barnes, 1984, p. 373).

[3] Usually the sequence 2.2 in Figure 2 will require moving from a smaller to a larger context, as in the *Empire* example of moving from a context of army-vs.-army to a context of general-vs.-general. But transformations do not always proceed in a linear fashion from small to large. *Empire*, for instance, requires that the player jump back and forth between battle and war in order to successfully counter (resolve) the oppositions of the computer opponent. The idea is that the player must successfully integrate a large number of increasingly variable contexts as play progresses.

[4] On the other hand, there is an upper limit on memory capacity, that is, on the number of items human beings can hold in short-term memory. "The human organism is limited to discriminating a maximum of about seven bits—or chunks—of information per unit of time" (Csikszentmihalyi & Csikszentmihalyi, 1988, p. 17). Therefore, contextualization might both delay the erasure of short-term memory and simultaneously pack information more efficiently for long-term storage—both hypotheses worth exploring, as both are seemingly advantageous information-processing strategies.

[5] This is of course exactly why it is so difficult to break away from a game such as *Civilization* for the more mundane matters of eating or sleeping: there is no game-determined stopping point. The transformations of play create each other: oppositions create new contexts, contextualizations create new oppositions. In terms of *Civilization*, the player is always right in the middle of a war that depends on a couple of different battles that depend on several different units that have to be moved over large distances by ships that have to be built at cities that have to be built . . .

[6] In *Empire*, where play also begins with a single city and a similar waiting period, the game design incorporates the player's subjective experience of time into the machinery of the game itself: the game speeds through the initial turns, without need of player input, before slowing to a more normal pace after the first unit is built.

[7] Almost all computer game designs take this preference into account and allow players to skip "levels" (temporal sequences) once these levels have been effectively contextualized. Thus, in *Tetris*, advanced players begin the game with very fast temporal sequences that novice players would associate with the middle or the end of game play.

[8] See Myers (1990) for a discussion of computer game player aesthetics and the relationship between computer game players who play games to be challenged and those who play games to be relaxed.

[9] I note in passing that my two young daughters (4 and 6 years old) appear to have more trouble making this transformation, that is, conceptualizing the game representation of their self (the player) as a nonself, and therefore are more afraid to "die" during play than are the adolescents I observe most frequently. It is unclear whether the greater willingness of adolescents to transform self and risk the frequent loss of the game-playing (non)self during play is simply the result of greater exposure to computer game transformations or requires reaching, in Piaget's terms, a specific stage of cognitive development.

[10] And in fact, some of the more successful AI programs, such as Douglas Lenat's (Lenat, 1983) *Eurisko*, have been designed specifically for computer-game-like environments.

[11] For further emphasis and amplification concerning closed systems of recursion, see the discussion on "learning how to learn" in Bateson (1972, p. 292ff).