Notes - Design - Gamification and games

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A brief intro to gamification and games relative to application and interface design.

Contents

Intro We may consider motivation and persuasion as we design and implement our interfaces.

In effect, can we design our interfaces and applications to help motivate our users, and thereby potentially increase their productivity.

This may be a serious consideration for design and development of user participation applications, productivity tools, and community related apps.

If we compare this type of application to gaming, which is often adept at engaging and keeping a user's attention, we can start to see where games are perceived as compelling or even addictive, and modify characteristics to fit our requirements.

Compelling and addictive nature of gaming There is a current trend in design, rightly or wrongly, to consider those aspects that make games addictive and compelling, and then apply them to application design. This is known as *gamification*. So, let's consider briefly some of these perceived addictive game elements.

- gaming is, more often than not, a *voluntary* activity. By its very nature, such an activity is one that people are more likely to choose to do, an act of free choice, rather than any element of coercion. It's not normally something that most people have to do as part of their daily work routine.
- most games have goals and rewards, which encourage and incentivise a user. There is often a built-in incentive to get to the next level, and a sense of satisfaction at completing this part of the game.
- some games will also introduce quite elaborate systems of player rankings, thereby allowing a user to progress as their skill levels improve. Their promotion through such rankings acts as a direct validation of skills gained and applied.
- by applying such ranking and reward systems, a game is offering visible, easily quantified levels of feedback to its users.
- as players achieve such goals and rewards, there is an inherent sense of progression and development through the task at hand, i.e. the game environment, and thereby a sense of improvement in skills.

- many games, in particular those online, are multiplayer, and offer an element of competition. A user's sense of validation, skills, and standing is enhanced by the opportunity to compete and win. This element of competition is also directly reflected and acknowledged in *high scores* on a game's leaderboard.
- multiplayer games also offer a sense of *social* connection and community. This can often be reflected in head-to-head gaming, group playing scenarios, or simply the ability to share, compare, and discuss score, tactics, and so on. Online role-playing games are a good example of social awareness and collaboration. These *massively multiplayer online games* are well aware of the benefits of both community and competition, and continue to grow due to such popularity. Their addictive qualities naturally help as well.

For example, the Khan academy makes good use of general gamification to help students learn and strive to achieve badges. Subjects are organised as a series of constellations on a star chart, and users are rewarded with meteorite badges and energy points. If we consider the early learning example of the Scratch programming language, developed at MIT, we can also see the importance of gaming to its usage and the overall community.

examples of gamification A list of examples and links for gamification information &c.

- good examples of the use of gamification within social context
  - source - Yu-Kai Chou & Gamification
- Khan Academy Knowledge Map
  - source - Khan Academy
- Play to Learn with Khan Academy
  - source - GCO
- Scratch Programming Language
  - source - MIT

Changing the brain game

> "The immense amount of time spent with games during a child's formative years has led them to be literally 'hardwired' in a different way than those who came before"

- Carstens, A., and Beck, J. 2005. "Get ready for the gamer generation." Tech Trends 49. PP.22-25.

> "Immense changes in technology over the past thirty years, of which video games are a major part, have dramatically and discontinuously changed the way those people raised in this time period think, learn, and process information…The change has been so enormous that today's younger people have, in their intellectual style and preferences, very different minds from their parents and, in fact, all preceding generations"

- Prensky, M. 2001. "Digital game-based learning." McGraw-Hill. P.17.

In order to leverage the minds of these gamer generations, Prensky also recommends that educators plan learning environments that,

- are fast-paced to take advantage of *twitch speed* information-processing capabilities
- emphasise high control and multiple tracks to leverage greater multi-tasking abilities, and
- actively engage participants in highly visual environments that encourage learning by exploration

When employing games and simulations you might consider some of the following questions,

- will a simulation or game result in higher engagement rates compared to competing options?
- what is the cost benefit of simulations and games?
- will players feel more positive about the experience?
- is the game or simulation effective within its given context?

and so on…

What is a simulation in a gaming context? A simulation is a model of a real world system. Simulated environments respond in dynamic and rule-based ways to user responses.

There are two basic types of simulations for such purposes, operational and conceptual.

Operational simulations are primarily used to teach procedural skills. Whereas, conceptual simulations focus on the learning of domain specific strategic knowledge and skills.

e.g. operational simulations have been used for training in software applications, medical procedures, &c.

In contrast, conceptual simulations such as scientific concepts (law of genetics, physics laws and concepts &c.) are primarily designed to build far-transfer knowledge of a specific domain.

What are games? Games come in many different shapes and sizes. From solitaire to Doom, there is a broad array of formats and features.

There are, however, some common elements that we may consider for the use of games in many of these genres.

For example,

- a competitive activity with a challenge to achieve a goal
- a set of rules and constraints
- a specific context

For example, the following image shows a dragon genetics game.

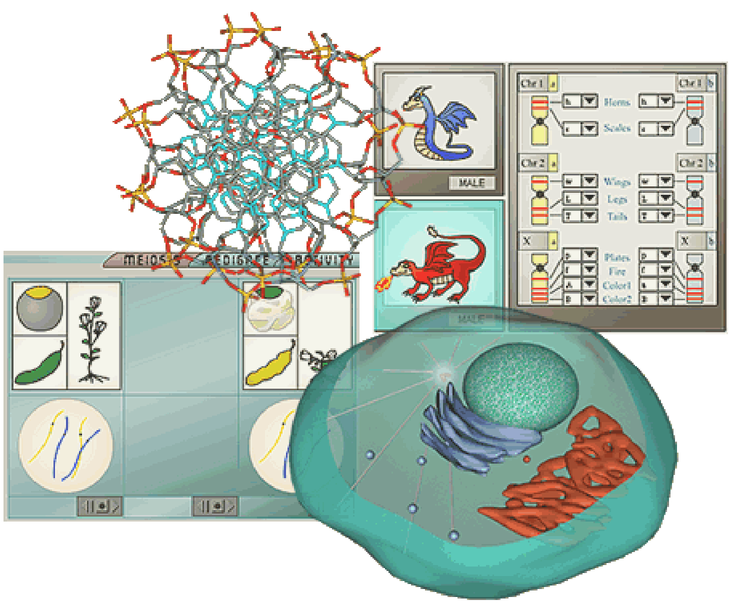

Figure 1: Games and learning with dragons

- BioLogica - Legacy

The goal of the game is to match the features of the test dragon, the bottom one, to the target dragon at the top by changing the genes of the test dragon one at a time. As the genes of the test dragon are changed, the learner receives immediate feedback by seeing a change in the dragon's features.

Basically, gene changes result in feature changes based on the laws of genetics.

Like many similar adventure, action, or strategy online games, this game also involves a simulation.

- BioLogica - Current

Figure 2: Games and learning with dragons 2

In a similar example, Rieber, in 2005, tested the effectiveness of the following simulation for teaching the physics principles of velocity and acceleration.

- Rieber, L.P. 2005. "Multimedia learning in games, simulations, and microworlds." The Cambridge handbook of multimedia learning. Cambridge University Press.
- Hays, R.T. 2005. "The effectiveness of instructional games: A literature review and discussion." Technical Report 2005-004. Washington.

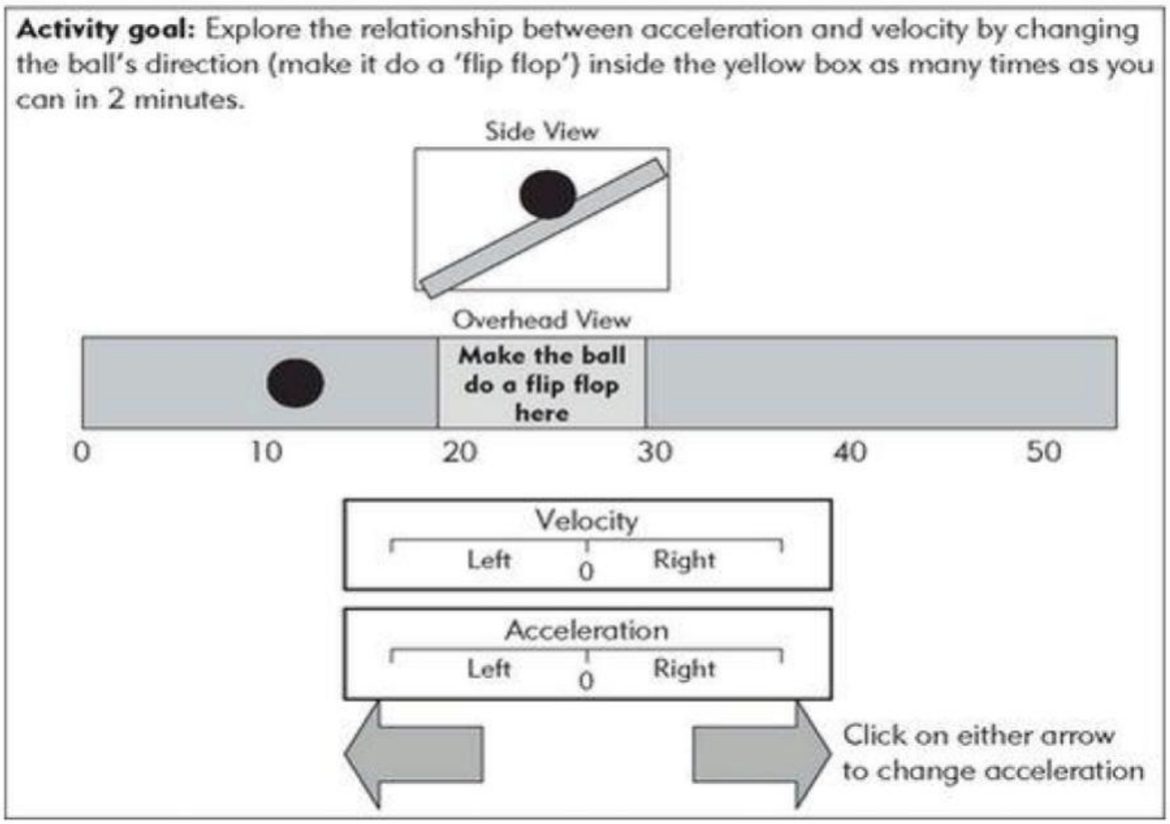

Figure 3: Games - flip flop

The player manipulates the ball's acceleration by clicking on the large arrows. To add a motivational element to the simulation, some participants were given a game goal to earn points by making the ball flip-flop as many times as possible inside the small box in the top centre.

Participants using the game version reported much higher enjoyment than those who worked with the simulation without the game goals. However, when tested on physics principles, the gaming group scored significantly lower than those who explored the simulation without a game goal. The game players also became obsessive, focusing exclusively on improving their scores, and in the process failed to reflect on the physics principles underlying the model.

Rieber concluded that whilst the gaming environment can be a lot of fun, it can also depress learning. The same goals for both groups led to behaviours that were antagonistic to the instructional goals within the gaming group.

A famous game, *The Oregon trail*, was designed to teach school children the problem solving challenges of managing food, dealing with disease, and crossing rough terrain in a covered wagon. However, Hays, in 2005, found that children converted the game into a target practice and racing game by shooting as many animals as possible and by getting to the end of the trail rapidly. Most of the domain specific information was ignored.

Therefore, in this context, games need to be designed in such a manner that they promote learning. Often, it's easier said than done.

Match game to learning goal To be effective, the goals, activities, feedback, and interfaces of games and simulations should align with the desired outcomes, instructional or otherwise, of both the developers and the target audience.

The Oregon trail and physics games included elements that were antagonistic to the intended original objectives. Learning took place, unfortunately not always the intended learning.

In the Oregon trail example, children appropriated game features, such as shooting animals, that did not contribute to the desired learning goal. The physics game was seen as counter-productive to the deeper reflection needed to learn the given physics principles.

However, is this inherently a bad thing? From a learning perspective, the original intention for these games, yes, but there are many examples of such transference. One of the inherent benefits of *playtesting*, for example, is that we shift testing focus away from developer and designer goals and preconceptions to the players themselves. This strikes me as a positive, healthy switch in priorities!

For example, Van Eck in 2006 suggested considering categorisation of gaming types as follows,

> "Jeopardy-style games, a staple of games in the classroom, are likely to be best for promoting the learning of verbal information (facts, labels, and propositions) and concrete concepts. Arcade-style games…are likely to be best at promoting speed of response, automaticity, and visual processing. Adventure games are likely to be best for promoting hypothesis testing and problem solving. It is critical, therefore, that we understand not just how games work, but how different types of games work and how game taxonomies align with learning taxonomies.."

- Van Eck, R.N. 2006. "Digital game-based learning." Educause Review 41. PP.17-30

Learning and game characteristics - guidance By learning about our target audience for a game, including instructional usage in this initial example, we may design games and simulations in ways that offer structure and sound learning support.

So, for this particular genre or type of game, we'll now look at the following considerations for designing such games and instructional learning

- incorporation of instructional explanations
- the need for consideration and reflection on instructional content

- the need to manage complexity within our games or simulations
- and the provision of instructional support

Learning and game characteristics - explanations So, an explanation is a brief tutorial that states the principles or concepts being illustrated in the game or simulation. You can think about integrating explanations as feedback to responses, or offer them in the form of hints appearing between game levels or simulation rounds.

We see this throughout games. It may be explicit guidance and examples, or subtle in its usage and intent. However, it's there to help the player learn about the game, its gameplay, mechanics, goals, and so on. This guidance or nudging is there to help reinforce concepts in the game, by simply trying to help a player learn as they progress. Learn about the content, the mechanics, the general gameplay and story, and so on.

When using a game or simulation lacking explanations or hints, players and learners alike try to achieve the goals of the game and learn at the same time. These two activities may lead to mental overload, and it is normally the game, and not the learning, that takes precedence. Again, we may use this concept as we design increasingly complex and challenging tests within a game. However, we also need to be careful to encourage and help a user to reach this point. We may often consider this as a way of progressing from *easy to learn to difficult to master*. A simple hook for the game itself!

Consideration and reflection Achieving the goal of a game or attempting to master a simulation may preclude necessary reflection. This is reflection that is customarily perceived as necessary to enable abstraction of lessons learned from the game.

> "The experiential nature of an educational simulation is very compelling - users often become very active and engaged in a simulation, similar to the experience of playing a video game. However, the intense and demanding interactivity of many simulations may not provide adequate time for the user to carefully reflect on the principles being modeled by the simulation"

- Rieber, L.P., Tzeng, S.C., and Tribble, K. 2004. "Discovery learning, representation, and explanation within a computer-based simulation: Finding the right mix." Learning and Instruction 14. PP.307-323.

This principle of reflection effectively states that learning from simulations and games will be better when learners have opportunities to actively explain correct responses.

Complexity in games There are a number of ways to help learners manage mental load in games and simulations. These can include, for example, incrementally managing the complexity of the game or simulation goal, optimising the complexity of the interface, as well as providing instructional support in the form of memory aids or activity guidance.

Again, we may see this in the general concept of progression within most games. From text-based games to platformers, role-playing, racing simulators, and so on, each will provide the gamer with the opportunity to learn and progress. This is inherently what we're doing within a game. As the player learns, adapts, and improves within a game, the game may progress without causing mental overload to the player. If it does, then the player will need to restart, learn and adapt, and then once more try to progress.

So, we'll now work our way through some approaches to managing complexity in games and simulations.

Managing complexity - goal progression Learning and game characteristics to help with managing complexity and associated goal progression,

- start with a relatively easy task or goal
- move gradually to more complex environments
- consider options to allow a player to manage their level of complexity
- consider learner, and gamer, experience levels
- dynamically adapt game complexity based on accuracy of responses

Managing complexity - training wheels Carroll, in 2000, described a training wheels principle for games and simulations. He recommended that learners and players alike work with a simulation where only some of the functionality is enabled. Although the full interface may be visible, only relevant elements of it work. In that way, players cannot go too astray during early trials and tests. As more tasks are learnt and acquired, the functionality constraints are gradually released until the player is working with a highly functional system. For example, when working with a game or simulation, only a few commands or icons are functional. As the player gains experience, greater functionality is added.

Managing complexity - faded worked examples Another option is to use faded worked examples. In general play and instruction, we might begin with a complete demonstration of the task. Next, players view a demonstration of the first few steps of the task, and finish it on their own. Gradually, the player assumes more and more task responsibility until they are doing it on their own. A game or simulation may also incorporate such a fading strategy. The player can observe a successful game segment or level, with accompanying explanatory commentary. For example, a computer generated agent may demonstrate how to play the game or interact with the simulation. In the next round or level, the agent completes some of the steps, assigning others to the player. Gradually, players assume greater control until they are able to complete all steps or actions by themselves.

Managing complexity - control of pace Control of pace within a game or simulation is also important to the potential outcomes. Indeed, fast-paced games are likely to lead to greater overload and to fewer opportunities for reflection. This may sound counter-intuitive for general game design, but it manifests itself in many different concepts. By pace, we may refer to the rate of introduction, for example, of gameplay concepts, such as options, difficulty of tasks, rewards, and so on, or simply the perceived actual pace of a game.

Consider how different games handle pace, and the impact this may have on the general gameplay, rate of adoption of a given title, longevity of gaming, and so on. How we manipulate and use pace in our games may affect a player's rate of learning, and their enjoyment of the game.

Learning to play a game Let us briefly consider the provision of instruction in actually using a game. A game or simulation will require cognitive effort to master the mechanics of the environment. This is cognitive effort that will not be available for learning goals or outcomes. We know this happens, so we may need to modify the game and its general play to help maintain a balance between learning the game and actually enjoying the game.

So, one explicit option is to try to free such mental resources for learning the instructional goals by explicitly teaching how the game works. The focus of this suggestion is on the mechanics of the interface, and not necessarily the detailed strategic decisions required by the game itself. A computer generated agent can start the game or simulation, for example, with a tour or example of how the goals are achieved by manipulation of the various interface elements. This could actually be as simple as summarising keyboard controls for movement, or navigation elements of the interface.

We can also consider providing memory support. Many problem solving or strategy games and simulations take place over a period of time, during which the participant accumulates data or draws required conclusions from experience. Provision of facilities for records of actions taken, facts accumulated, and conclusions reached can help with this learning experience. Such records can also help learners derive conclusions based on a series of tests, or experiments, or examples.

We might also consider including process guidance. As a player progresses through the game, their actions may be recorded so they can view their progress, their breadcrumb trail in effect, upon completion of a game or segment.

A further option is visualisation support. Success in some simulations or games may rely on spatial skills. Instructional aids promote learning by providing external spatial representations as guides. For example, Mayer and colleagues in 2002, evaluated different types of support for a geology based game called *The Profile Game*.

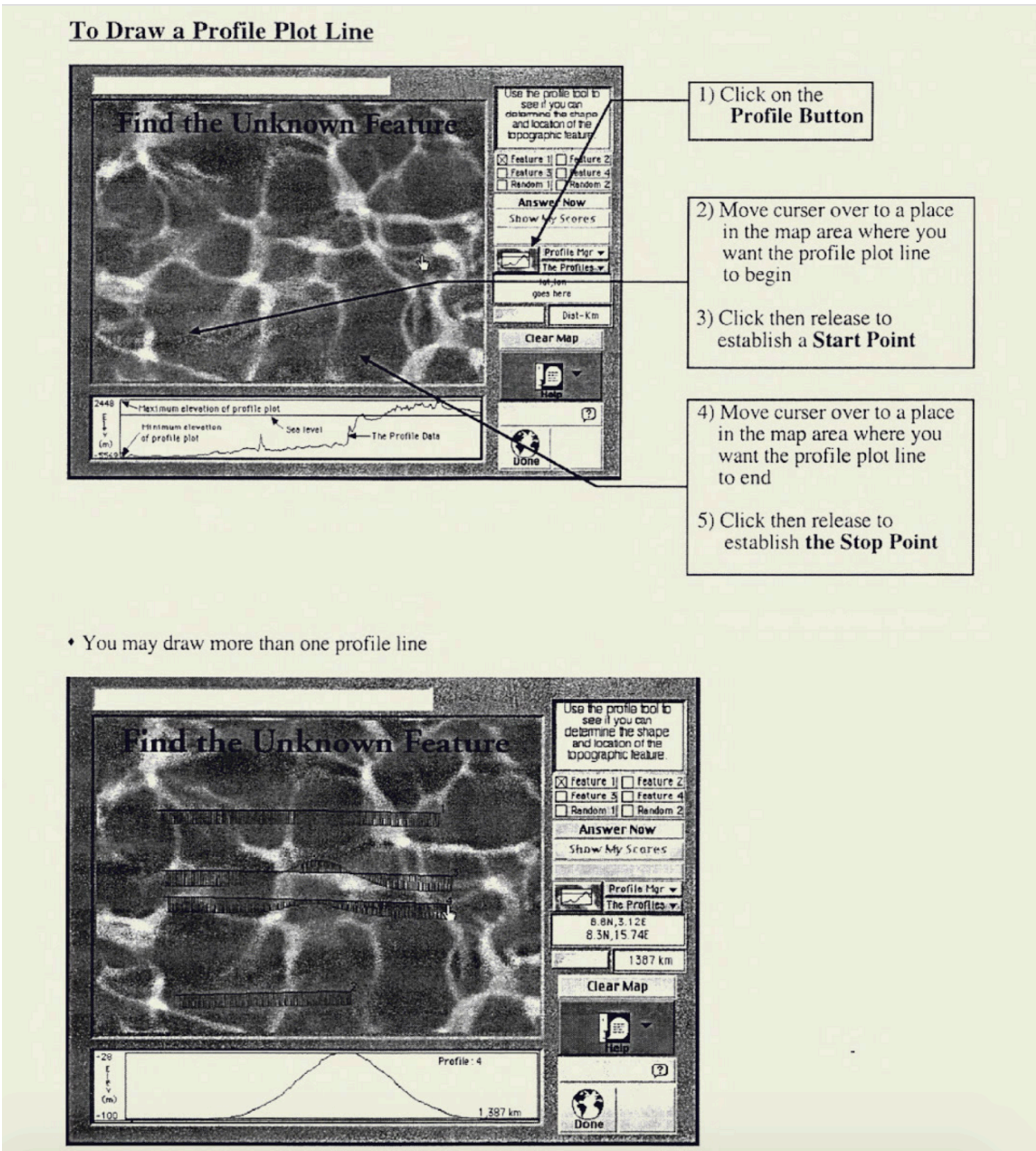

Figure 4: The Profile Game

During the game, players collect data from a planet whose surface is obscured by clouds. Players draw a line and the computer shows a profile line indicating how far above and below sea level the surface is at each point on the line. By drawing many lines, players can determine whether the section contains a mountain, trough, island, or other feature. Players were provided with strategy aids in text, visual aids diagramming features such as mountains, islands and so on, or no aids.

The result, players with the visual aids produced the best game performance.

So, the research team concluded that,

> "students need support in how to interact with geology simulations, particularly support in building and using spatial representations"

- Mayer, R.E., Mautone, P., and Prothero, W. 2002. "Pictorial aids for learning by doing in a multimedia geology simulation game." Journal of Educational Psychology 94. PP.171-185.

Resources

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