Subliminal learning. What do games teach us?

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Abstract. In video games, organic tutorials are first levels of the games, designed to teach their basic controls while the player plays. They provide some kind of subliminal learning, are very effective and natural and teach without losing the fun, but they are not easy to be properly designed. The purpose of this research is assisting the designers in the task of defining organic tutorials by proposing a guide of design principles and patterns. After reviewing the learning theories and design techniques for organic tutorials, an analysis of some representative video games is performed. Then, a guide made of ten principles is proposed. This guide helps the developers to clearly understand the fundamentals of organic tutorials and sheds light on what games teach us. It helps to understand some kind of subliminal learning and opens the way to design other learning experiences based on the proposed principles.

Keywords: Organic tutorial · videogame tutorial · subliminal learning

1 Introduction

Video games are one of the most important industries nowadays. Thousands of video games, with millionaire budgets, are published every year, but not all of them reach success. One of the key factors in a game's success is the way its rules are learned. Nowadays, the use of manuals has declined mainly due to the digital format boom, the high printing costs and the high complexity of the current video games. This is how the tutorials come up. The function of the tutorials is giving some guidelines during the first stages of the game so that the player acquires enough knowledge to be able to overcome the rest of the game. A tutorial is a first level that teaches the player the basic controls and mechanics of the video game. The more complex mechanics are introduced, progressively, throughout the game. In spite of being the first level to be played, the tutorial is usually the last level to be developed.

In broad outline, there are two main types of tutorials: direct and organic tutorials. Direct tutorials are based on text and images that explain in detail what actions players can take. Organic tutorials, on the contrary, indirectly teach the players while they play the tutorial level. They are characterized by proposing

a controlled and limited environment where the player learns by trying the mechanics and has the feeling of advancing with no external help but with ones own merit. There fore, this type of tutorials provides some kind of subliminal learning, which is very effective and natural. While being part of the video game, they fulfil the dual purpose of teaching without losing the fun. Unfortunately, organic tutorials are very extremely difficulty to be properly designed and implemented.

This research work arises to assist in the task of designing organic tutorials. Its objectives are:

– Analyse the psychological, behavioural and learning theories, and the design techniques used to indirectly guide and teach the player in video games with organic tutorials.
– Analyse a set of video games, of different genres and time that teach players the playable mechanics through level design.
– Develop of a guide of design principles and patterns of organic tutorials for future designers.

The first objective is developed in section 2, Context, which presents a deeper study about the relationship between video games and learning, the previous studies about organic tutorials and an analysis of the concept of subliminal learning. Section 3 describes the methodology used to perform the analysis of the first level of different video games, to be able to extract some principles for the design of organic tutorials. Since the amount of video games that use organic tutorials is too large, a selection of 8 representative video games has been chosen to make the study. The guide of design principles is described in section 4, made of three fundamental features of a well-designed organic tutorial that are decomposed, in turn, in 10 techniques for level design and gameplay. Finally some conclusions and future lines of research are presented in section 5.

2 Context

2.1 Learning and video games

The twentieth century is considered the century of the cinema, because of its technical and artistic evolution and the imprint left in society, establishing the concept of seventh art. It is very likely that the 21st century is the century of digital interactive entertainment, that is, the century of video game. Hundreds of video games with multi-million dollar production costs and thousands of video games of medium and independent studios are published every year. In addition, more and more people, of any age or sex, play video games on the wide variety of available devices.

Video games have changed the way young people (and also adults) conceive reality and interact with each other [15, 24]. One can say that good video games have the ability to optimally convey much information of a particular type, causing the player to pursue more information. According to Prensky [17, 18] video games attract players for several reasons: they encourage participation, motivate

users to gradually achieving small goals, offer rewards or immediate punishments, and difficulties of each level are adjusted according to the players skills. Hamari et al. [10] have investigated the impact of flow, engagement and immersion in game-based learning environments. Although most psychological studies focus on the negative effects of video games on adolescents, there are other studies that argue and document the benefits: voluntariness, competitiveness and co-operation, immersion, sense of control, achievement of goals (objectives), but especially satisfaction. Granic et al. [9] have conducted an extensive review of the literature on the benefits of video games and their potential.

Playing is inherent to human beings [11] and the game is a driving element of mental development [25], it improves learning and arouses curiosity, so the games are a great teaching tool. Fun involves new information fixed in the brain, so that the secret of optimal learning lies in the fun [13]. Good games get this fun, while the player learns their contents [7, 12, 6]. Analysing how games achieve the objective of fun is essential to design similar strategies in other areas and get to convey the information we want to be learned and fixed [14]. The principles of video games can help us achieve an innovative and effective training model, that particularly enhances student motivation, and the mechanisms to measure real progress in learning, that is, a truly continuous formative evaluation [8, 16].

2.2 Organic tutorials

During the development of a video game, one of the most important problems that designers must solve is teaching users to play their game. A video game, unlike cinema or music, is an interactive and immersive product so, for the player to fully enjoy it, he or she needs to know its rules: what you can and cannot be done in that new virtual environment. Currently, teaching players through printed manuals is not feasible because of the high complexity of video games. This is way the most common solution is the use, during the game, of tutorials that teach the player the controls and mechanics of the video game. The function of a tutorial is achieving that, once completed during the first levels of the game, the player has the knowledge necessary to overcome the rest of the game. The more complex mechanics will be progressively introduced throughout the game.

The wide variety of video game genres derives in diverse types of tutorials. Keep in mind that there is no tutorial that is valid for all genres: an inappropriate tutorial for an action game can be excellent for a complex strategy game. In general terms, two types of tutorials can be differentiated: direct and organic tutorials. The direct ones are those that use pop-up windows with text and images to explain in detail what actions players can take. On the contrary, the organic ones avoid the use of text and integrate the rules in a specific level so that the player can learn the mechanics in a more natural fashion. The organic tutorials are most appreciated by players since they indirectly teach through an intelligent design of the level.

The organic tutorial term has been coined by game design specialist Josh Bycer[2], referring to the organic game design, which in turn comes from the concept of organic architecture. It is a philosophy created by the architect Frank

Lloyd Wright [27] to refer to fully integrated constructions in their natural surroundings. They are also called non-tutorials, integrated tutorials or invisible tutorials because, at first glance, they may seem not to exist. However, it is quite the opposite: these tutorials are so well designed that they are completely merged with the level and flow of the game. The main problem of organic tutorials is the high difficulty to properly design and implement them, as well as the risk they entail. A poorly designed organic tutorial can frustrate the player by not correctly teaching the mechanics, causing him to leave the game. Although difficult to implement, they are very effective, since what is naturally learned, while playing and having fun, is better recorded in memory. A good organic tutorial should not be obvious to players.

The fun in video games, as in other conventional games, comes from the action of playing them, not from learning how they work. A tutorial that is not evident, and that is part of the video game, fulfils the dual purpose of teaching without losing the fun. The environment of an organic tutorial is controlled and limited so that the player can learn by testing the actions that designers planned during the game conception. Moreover, these tutorials allow the players to feel that their progress is an achievement made by themselves, without outside help from the developers. Since there is no direct guide, the rules are learned by trial-and-error. This method requires a well-studied learning curve so that the player improves his skills while the challenges increase in difficulty, preventing him from becoming frustrated or bored, and leaving the game therefore.

2.3 Subliminal learning

Humans are able to unconsciously perceive stimuli. Subliminal stimulation and subconscious power have been widely studied in the field of psychology [1, 20]. Nowadays it has recovered a new impetus even talking about the rebirth of the subliminal [5]. Subliminal learning would occur as a result of exposure to a subliminal stimulus, with no conscious attention from the subject, although this type of learning is far from being passive and requires high level processing, as Seitz and Watanabe state [23]. They consider that diffuse reinforcement and learning signals are complementary to focused attention in subliminal learning. In reinforcement learning, a reward signal links the neural response with task performance, whereas focused attention allows knowledge to bias the neural response and involves cortical processing. They show that presenting a stimulus that is relevant to a task can give rise to an internal reward that works like an external reward in reinforcement learning [23]. Moreover, subliminal learning may involve attentional processing, but attention does not need to be directed to a feature for that feature to be learned [22]. Among other fields, subliminal actions have been extensively treated in the world of advertising, even talking about subliminal advertisements in electoral campaigns, fully entering into the field of political communication [21]. The aim of our work is trying to transfer this concept to the field of education.

A similar term, from the point of view of our purpose, is that of invisible learning of Cobo and Moravec [3], in the sense that invisible is what exists, but

cannot be observed. It is based on three axes: sharing experiences and innovative perspectives, aimed at rethinking strategies for continuously learning and unlearning; promoting critical thinking about the role of formal, informal and non-formal education at all educational levels; and contributing to the creation of a sustainable and permanent learning process, by innovating and designing new cultures for a global society. This work analyses the impact of technological advances and changes in formal, non-formal, and informal education, and the meta-spaces in between. The authors offer the reader an overview of options for the future development of education that is relevant for this century. The invisible learning project analyses the role that technological advances play in transforming the learning process and it goes beyond the traditional distinctions between formal, non-formal and informal education, reflecting how it is possible to learn in the 21st century.

It is in this sense that we use the term subliminal learning in this research: that formal or informal learning that occurs without the conscious attention of the individual to such learning. And it is in this sense that we look at the world of video games to see how they incorporate this subliminal learning into their games to give their instructions.

3   Analysis of level design in video games

3.1   Methodology

Although the use of organic tutorials is not a very common practice, there are a high number of titles that use them. Therefore, the first step for the analysis of video games is selecting an affordable and representative number of games. To select a representative sample of this population, we started with an initial set of 74 video games (14 obtained from our experience as players and 60 recommended through a petition in social networks). This number was still high for a detailed analysis, so different filters were applied to reduce the number of video games to be analysed: votes in social networks, adaptation to the study objective and variety in terms of generations, genre and technology. Finally the following eight video games were selected for analysis [19]:

– *Super Mario Bros.* (Nintendo, 1985).
– *Mega Man X* (Capcom, 1993).
– *Super Metroid* (Nintendo, 1994).
– *Half-Life 2* (Valve Corporation, 2004).
– *BioShock* (2K Games, 2007).
– *Portal* (Valve Corporation, 2007).
– *Dark Souls* (From Software, 2011).
– *Jouney* (ThatGameCompany, 2012).

In the final sample, there is little presence, even absence, of strategy, resource management, board, sports, simulation and role-playing games. This is due to the fact that in these genres it is not advisable to use organic tutorials, due to its high complexity, abstraction and randomization.

3.2 Analysis elements of organic tutorials

The design of video games, their levels and their tutorials, is closely linked to psychology, since the objective of any interactive entertainment product is producing some reaction of the player. When developing video games, some design techniques based on previous studies of human behaviour and learning are used to guide and teach the player and transmit what they want. An example is the shift from left to right in 2D environments. In most 2D platforms video games the character moves to the right to reach the end of the level. This largely accepted convention was considered to be due to the success of *Super Mario Bros.* game, but the movement from left to right seems to be an intrinsic preference to the human being [26].

Specifically, the elements to be studied in this analysis of the initial levels of video games are:

1. *Guidance and direct navigation.* One of the biggest challenges that designers must overcome is to guide the player through the video game so that he follows the correct path and meets the objectives in the established order. However, the player must not become aware of this guidance since a perception of freedom must be achieved. The direct way to keep the player on the road is to create obstacles, points of no return, restrictions and artificial rules that force him to follow the pre-established route to the goal (what is called *railroading*).
2. *Guidance and indirect navigation.* In addition to direct ways of guiding the player through the level, there are more subtle forms that can be used together to obtain a better result: tactical elements, focal points that draw the player's attention, scene composition (foreground, centre of interest and background), views, landmarks, guide lines, lighting, colours, coherent shape language, information silhouettes, level of detail, animated elements or audio tracks.
3. *Teach through contextual practice.* When a player learns a new skill, it must be put into practice immediately, but allowing the player to decide where and when. For example, subtly placing obstacles that can only be overcome with the latest mechanics learned, so that players immediately practice a new action in its context. The effect is a natural and fluid way of learning.
4. *Antepiece, Setpiece and Conveyance.* The *antepiece* is an initial section that prepares the player through practice, without being aware, for a greater challenge, usually called the *setpiece*. Overcoming simple obstacles, mechanically similar, with an appropriate and increasing difficulty curve, allows the player to develop his skill and obtain the necessary clues to overcome the *setpiece*. The *conveyance* is the fact of learning simple lessons that are then used for more complex problems. The result is that the process of in-depth understanding the video game is the same as the one of learning to play it.
5. *Teaching through failing.* In a video game, failing usually results in a loss (loss of resources, time, progress...). As a consequence, the player learns a lesson that will last in his memory depending on the importance he gives to the lost resource and its ability to take on failure.

6. *Teaching through accident.* It is when the video game incites the player to accidentally perform some action, allowing him to learn something new in the process. Making an accidental discovery causes surprise, so the player will remember what was learned during that discovery better than if he had read it.

7. *Safe areas.* It is imperative that the first area of the game is free of hazards, such as enemies or pernicious scenery elements. However it must have enough elements for the player to learn the basics of the game and test the controls on their own. They are also often used to introduce new enemies and dangers: in safe areas the player can observe and learn their patterns before confronting them.

8. *Short iteration cycles.* The tutorial is the first contact of a player with the video game and it is essential prevent him from getting to the point of frustration and abandon the game. The earlier he leaves, the higher the possibility of definitive withdrawal. Checkpoints and savepoints are usually closer in the initial levels and they are more separated as the game progresses. Short iterations are essential for trial-error learning.

9. *The flow.* Another concept of great importance within the anti-frustration features is *Cognitive Flow* [4]. When the skill required to perform a task is too high, the person becomes frustrated. On the contrary, if the task is too easy for the skill the person has, he or she gets bored. When the required skill and difficulty are in accordance, the person is in a state of flow. A video game, and especially his tutorial, should keep the player within the flow zone as long as possible, because boredom or frustration will lead him to leave the game.

10. *Reward the observant player.* Organic tutorials teach while playing so it is indispensable that the player pays attention to every detail in the scenario left by the developers. For instance, to avoid the frustration of a player the obstacles do not necessarily have to be easy: they can be difficult but fair. That is to say, an observant player should have the possibility to overcome it thanks to the tracks previously left. This type of support is a reward for the most attentive players. It is common to reward the good explorer, through improvement items, to encourage him to go all the corners of the stage in search of more objects, shortcuts, argument pieces, Easter Eggs or secret areas.

3.3 Comparative analysis of organic tutorials

The theoretical basis to understand the design of organic tutorials introduced in section 2, the sample of games defined in section 3.1, and the items to properly analyse levels identified in section 3.2, provide the elements to perform the study of video games to obtain design patterns. The process to perform this analysis for each video game is made of the following steps:

1. Play the tutorial.
2. Read the studies and essays about design concepts made by other authors,.

3. Replay the tutorial, considering the design concepts.
4. Match the elements of the game with design concepts.

After analysing all the video games in the sample, we made the last step of this research: a comparative analysis of the two best examples of organic tutorials in the sample. Specifically, the organic tutorials to be compared are those belonging to *Super Mario Bros.* (SMB) and *Dark Souls* (DS) video games, two completely different games (see table 1 with the main features of the games) whose organic tutorials are recognized for their quality. Each analysis element has been studied, checking whether they are fulfilled by both games. The results will help to demonstrate that these elements of design give rise to exceptional tutorials, regardless of the genre and the time of the game, if they are well implemented.

Table 1. Main features of *Super Mario Bros.* and *Dark Souls*

	Super Mario Bros.	*Dark Souls*
Genre	Platforms	Action-Role
View	2D	3D
Year	1985	2011
PEGI	+3	+16
Actions	3	12

The review of the ten analysis elements for organic tutorial design (section 3.2) is presented in tables 2 and 3. The tabled include one example of use for every analysis element and game, as well as screenshots. The order in which each video game uses these techniques is not relevant so it is not considered in the study.

This comparative analysis corroborates the idea that the principles of organic tutorial design obtained in the present study are applicable to a great variety of video games. Organic tutorials make the players feel capable to learn from their mistakes, consider the options and overcome the challenge, instead of being treated with condescension. The direct help of the developer is not needed: he or she learns in the best possible way, by playing the game.

4   Design guide for organic tutorials
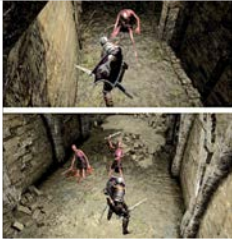
Organic tutorials, if well designed, are the best choice for teaching players in skill-based video games. Their greatest advantage, their effectiveness as a tool to teach the player, is also their greatest weakness: an improperly designed organic tutorial will leave the player disoriented, without having correctly learned the mechanics of the game. The high implementation difficulty, the risk of an improper design and the limited information available on organic tutorials, make it

Table 2. Review of the ten elements for *Super Mario Bros.* and *Dark Souls* (I)

Element	*Super Mario Bros.*	*Dark Souls*
1. Guidance and direct navigation	The path to the left is blocked, only movement to the right is allowed	The whole area is full of corridors, the movement is always forward.
2. Guidance and indirect navigation	The interrogation blocks blink to draw attention: the player unconsciously moves towards them.	The souls are whitish and blurring to draw attention: the player unconsciously moves towards them.
3. Teach through contextual practice	After learning to throw fireballs, the player must used them to kill two consecutive Goombas.	After learning to block with the shield, block the arrows from an enemy.
4. Antepiece, Setpiece and Conveyance	First, practice the jump with no risk of death by fall; then make another jump, now with risk of death.	First practice the combat techniques with unarmed enemies; then fight against an enemy with a sword.
5. Teaching through failing	The first Goomba forces the player to learn the basic jumping ability.	The first boss is impossible to defeat without equipment; it forces the player to escape and to become armed before the fight.

Table 3. Review of the ten elements for *Super Mario Bros.* and *Dark Souls* (II)

Element	Super Mario Bros.	Dark Souls
6. Teaching through accident	When jumping over the red mushroom, the top block is touched, and Mario turns into Super Mario.	When falling from the balcony on the boss, the normal attack turns into a powerful fall attack.
7. Safe areas	The game starts in an area with no enemies, with space to test the controls.	The game starts in a cell with no enemies, with little but sufficient space to test the camera and movement controls.
8. Short iteration cycles	There are two control points: one in the beginning (where it is most likely to die), and another in the middle of the level.	There are three save points: one in the beginning, one in front of the boss and one at the last third of the level.
9. The flow	The first enemies, the Goombas, are the weakest. They are first defeated one by one and then in pairs.	The first enemies, the ones with the sword, are the weakest. They are first defeated one by one and then in pairs.
10. Reward the observant player	The goal flag, which gives extra points, can be seen at the end of the level.	When opening the big door, the boss can be seen on the roof, avoiding the ambush.

necessary to propose a document that gathers, condenses, explains and exemplifies the entire process and common techniques for designing this particular type of tutorials.

After analysing the organic tutorials of the sample using the knowledge acquired during the study of the theoretical framework, it is possible to identify three fundamental objectives of a well-designed organic tutorial:

- Be a subliminal guidance for the player
- Address the indirect teaching of the player
- Do not frustrate the player

Each of these objectives is carried out using various techniques of level design and gameplay. A relationship between the fundamental objectives of the organic tutorials and the associated design techniques can be established:

- Get a subliminal guidance for the player, by:
  - Direct guidance
  - Indirect guidance
- Get the indirect teaching of the player, by:
  - Contextual practice
  - The use of antepieces and setpieces
  - The use of failure
  - The use of accidental events
- Do not frustrate the player, by:
  - The use of safe areas
  - Short iteration cycles
  - Maintain the flow of the game
  - The use of the reward for being observant

Once established this relationship, a brief guide can be proposed, made of a list of principles or patterns, aimed at developers interested in designing good organic tutorials (see table 4). A tutorial meeting most points of the guide would be of organic type, but whether it is a good or a bad ultimately depends on the designer. This guide is not infallible; it is only a tool for the developer to clearly understand the fundamentals and needs of the organic tutorials. It is the designer who decides how to design and structure his own tutorial level to meet the three basic objectives of organic design. Designing around these principles, in an intelligent way and with numerous iterations for testing the results, you can create a quality organic tutorial.

5 Conclusions and further work

In their origins, video games did not need to explain the controls or the mechanics to the player due to their simplicity: the novice players were able to learn in few minutes how to advance in the game. As technical and playability complexity increased, the need of instruction manuals to explain controls and mechanics arose. These manuals, in their printed form, were a viable option during the 80's

Table 4. Design principles for organic design

	Techniques	Description	Examples
Subliminal guidance	Direct guidance	The tutorial must be linear, to prevent disorientation, but not so obvious that the player realizes that there is a single route.	Corridors, rooms with single entrance and exit but with small side rooms, turns, several floors, backtracking, closed doors, blocking enemies, no return points ...
	Indirect guidance	In wide areas or with several possible paths, the use of various stimuli to attract the attention of the player allows to place and direct him towards the desired area.	Focal points, composition, views, landmarks, illumination, color contrast, movement, detail, audio, sillhouettes, shape language, tactical zones, guide lines ...
Indirect teaching	Contextual practice	After learning a new skill, the player must put it into practice immediately to memorize it. How and when to use it is up to the player.	An obstacle near the place where the new skill was learned, which can only be overcome by using it.
	Antepiece and setpiece	During the game the player must practice simple challenges, antepieces, to be able to overcome later, on his own, more complex challenges, setpieces.	An obstacle that does not penalize the player when he fails, followed by a similar one in which the error does penalize.
	Failure	It is common for the player to fail in a tutorial in which there are no direct explanations. Make sure that the player learns something new from each mistake to make progress.	An obstacle in which the player fails in a first attempt, so that he learns to put it into practice in the following attempts.
	Accidental events	Make the player perform an action that triggers the accidental discovery of a new playable mechanic. These accidents do not penalize.	An enemy near a destructible element of the stage. By attacking the enemy and failing, the element is destroyed.
Avoid frustration	Safe areas	The tutorial is the first contact of the player with the video game, so it is necessary to use safe areas in which he can put into practice what he have learned.	The beginning of the game must be in a safe area, without enemies, so that the player can freely test the basic controls of the movement and the camera.
	Short iterations	Learning through failure requires trial-error. To prevent the player from getting frustrated, these repeat cycles should be short.	In the tutorial, the control and save points must be close to each other and to the biggest challenges, such as the fight with bosses.
	Flow	The difficulty of the tutorial should initially be minimal, to compensate for the player's low level of skill. It should increase gradually to adjust to the increasing ability.	The tutorial should present the most basic and easy enemies and obstacles. As the player progresses, the difficulty can be increased with several simultaneous enemies.
	Reward for the observant	Since the level itself guides and teaches the player, it should encourage attention to the scenario.	Give clues about traps to players who, instead of running, are attentive to the scene. Place upgrade objects to reward the exploration.

and 90's because, despite being more complex, it was still possible to condense all the learning about a video game in a short document. The problem appeared when video games progressed so that a printed manual was not an economically viable option since dozens of pages were required. Moreover, the immediacy that characterizes the digital world, made players not want to read long manuals to start playing. Therefore, an option that began to arise was the use of tutorials integrated in the beginning of the video game. One of the most interesting types of tutorial from this point of view is the organic or indirect tutorial, which teaches the player without the need for text, but by means of an adequate level design, that is, they indirectly teach the player while he plays the tutorial level. These tutorials become key aspects to the success of the video game. After high investment in the development of a video game, designers cannot afford the game to be abandoned by players that are not able to learn how to play it.

In the first place a selection of the games with organic tutorials has been made. They make up the sample for this research work. Eight video games have been analysed as representatives of a broad set of generations, genres and technologies. After analysing the organic tutorials of the sample, three fundamental objectives of a well-designed organic tutorial have been identified: subliminal guidance for the player, indirect teaching and not to frustrate the player. Each one of these objectives are carried out using various techniques of level design and gameplay, and a list of ten techniques are established: direct guidance, indirect guidance, contextual practice, the use of antepieces and setpieces, failure management, the use of accidental events, safe areas, short iteration cycles, flow channel and the use of the reward for being observant. The relationship between the fundamental objectives of the organic tutorials and the associated design techniques has allowed us to write a brief guide. It is made of a list of principles or patterns to implement organic tutorial, aimed at developers interested in designing a good organic tutorial for their video game.

In addition to help video game designers, this guide can be easily transferable to the design of interactive educational materials. This is an advantage if you consider that video games are an excellent learning tool, by complying with all the laws of classical learning in an environment where failure is not seriously penalized. The design of organic tutorials in the world of education opens a door to natural and fluid learning, what we can call subliminal learning. It is not applicable to all types of learning, just as organic tutorials are not used in all types of video games. They are especially suitable in instruction for skills development. They will even be more useful if they are part of a gamified learning proposal. Therefore, this guide can also be used to help teachers to design gamified learning proposals.

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