Information Management in Interactive and Non Interactive Suspenseful Storytelling

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ABSTRACT
Suspense is one key feature in modern storytelling. One of the mechanisms to deliver a suspenseful experience to an audience is by means of controlling the information provided. The media, however, has a very strong impact on what kind of information can be delivered and how. Moreover, modern storytelling is usually conveyed interactively, in such a way that the audience is also part of the story. In this paper we experiment and analyze the different impact of information management in interactive and non-interactive storytelling. We report on an experiment measuring the reported perceived amusement in interactive and non-interactive versions of a potentially suspenseful story, and we provide evidence that a passive, non-interactive audience usually prefers less information than an active interactive audience. The study provides informed insight on how these results could be used in real scenarios to deliver appropriate levels of information to enhance the perception of suspense.

KEYWORDS
suspense; interactive storytelling; computational creativity; information management

1. Introduction

Amusement is one of the most typical objectives of storytelling. This has been thoroughly studied in different fields: narratology Zillmann and Tannenbaum (1980), psychology Delatorre and Arfè (2015); Zachos and Maiden (2013) and learning Burton et al. (2004) among others. How to improve the feeling of amusement is fundamental in mastering valuable storytelling in humans. As such, good storytellers are generally assumed to master the skill of adjusting the level of different components along a story in such a way that the overall perceived level of fun is high.

Among the aspects influencing the quality and effectiveness of successful storytelling, suspense plays a crucial role in emotional gratifications. Reactions to suspense are known to be directly related to enjoyment (Oliver, 1993, p. 315), having a big impact on the audience's immersion and suspension of disbelief (Hsu, Conrad, & Jacobs, 2014, p. 1359). The impact of suspense is backed up by several studies showing that

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people enjoy not only positive, but also negative aspects in stories (Altmann, Bohrn, Lubrich, Menninghaus, & Jacobs, 2012, p. 2). Readers tend to be amused by suspenseful, coherent and complex narratives, accounting for roughly 54% of the variance in situational interest (Schraw, Flowerday, & Lehman, 2001, p. 445) –in that study, suspense made the most relevant contribution with 34% of the variation–. The same pattern has been evidenced to appear in videogames, in which suspenseful ones are rated as more enjoyable than non-suspenseful ones (Klimmt, Rizzo, Vorderer, Koch, & Fischer, 2009, p. 31).

This suggests that creating and properly adjusting suspense is a fundamental asset in storytelling. Among others, one of the ways of managing the delivered suspense is by means of controlling the information that is given to the audience, having them know about a threat, a resource to handle it or what the main character knows. This influence of information flow is not only applicable to passive, linear storytelling. Active audiences of an interactive fiction, effectively performing as actors, need to be able to take decisions –where to go, what to do...– based on what the spectator knows about the environment. A clear example of this effect can be found in video-games –taken as a form of interactive narrative (Ryan, 2009, p. 45)– where players feel bored when the challenge is too easy and stressed when it is too hard (Patsis, Sahli, Verhelst, & De Troyer, 2013, p. 137). This leads to think that giving full situational information in interactive scenarios usually produces boredom and giving very limited situational information generally provokes frustration, but this is probably not the case with passive audiences. We hypothesize that if the active subject's uncertainty is too high for taking informed decisions, she might feel unable to enjoy the story. It follows that a very uncertain outcome may exert a negative impact in an active audience's amusement. However, a passive audience could actually enjoy scenarios in which the degree of uncertainty is relatively higher becouse of their curiosity (Knobloch-Westerwick & Keplinger, 2006, p. 193). We hypothesize that experiencing a high degree of situationaly and contextual uncertainty –and, hence, suspense– can have a negative impact in player amusement.

It follows that, according to our hypothesis, suspense by uncertainty-outcome and information flow are tightly interconnected. Controlling contextualized information flow is a useful resource to control suspense. Interactive storytelling systems, when implemented as computer simulations or games, can take advantage of this to try to convey different levels of suspense to the user. In this kind of systems, controlling information does not only impact suspense, but also playability and believability –among others–, ultimately influencing the levels of amusement and engagement.

This paper hypothesizes that the effect of situational and contextual information flow varies between interactive and non-interactive stories. The underlying involved cognitive processes change the whole experience when the audience is active. Modelling the information flow requires a distinction between interactive and non-interactive storytelling. In particular, this work is based on the following hypotheses:

(1) The impact of suspense in overall amusement is, in general, lower in interactive fiction than in non-interactive fiction.
(2) Interactive storytelling requires more situational and contextual information than the equivalent non-interactive stories for producing an amusing experience.

These hypotheses imply that to maximize amusement in interactive storytelling, more situational and contextual information is required, even at the cost of jeopardizing the equilibrium between classical suspense delivery by hiding facts to the audience.

This arises from the observation that some classical assumptions in suspense cannot be applied to interactive fiction. One of the most relevant is that suspense can be influenced by managing the information provided to the audience. For instance, this happens when the audience knows the location of a murderer but the victim does not. Information about the vulnerability of the victim typically increases the suspense.

In case of interactive stories where the audience or player has full control over a character, providing information to the character is the same as giving this information to the player and vice versa. For this kind of interaction, there is one single information channel, instead of two –one for the characters and one for the players– which means that there is a loss of one degree of freedom for directly influencing audience's amusement.

It follows that, if the audience is omniscient, the character would be omniscient as well. This indicates that some classic suspense strategies are inappropriate to keep the interactive audience amused. Instead, we believe that the audience must have a certain feeling of control over the progression of the scene in order to keep the amusement and the engagement.

Ensuring amusement and engagement is fundamental in all kinds of narrative discourse. These kinds include game-like scenarios and many other forms of what is assumed to be interactive storytelling. In these environments, if no progress is possible, a player may try to continue playing for some time, getting increasingly frustrated before finally giving up (Livingstone & Charles, 2004, p. 7). When this happens, engagement may decrease.

With this idea in mind, Delatorre, León, Gervás, and Palomo-Duarte (2017) propose an architecture for a system that adapts the descriptive elements of a scene, in such a way that the amount of situational and contextual information of the scene output is adjusted to the required suspense intensity.

The system manages the structural components of the scene based on a *weighted corpus* consisting of a set of concepts, each one associated to a quantitative value that represents its level of suspense: a) features of characters influencing the expected outcome like character strength or distance between threat and victim; b) objects involved in the scene influencing the scene plot –as weapons or doors– or just decorative elements without direct participation in terms of emotional valence and dominance; and c) environments as spatial context, atmosphere or scenery, which are a verifiable generator of suspense and may affect the skills of the characters.

The development of such an architecture requires a careful analysis of how to adapt the parameters. According to the previously exposed ideas, it is necessary to quantify the actual differences and particularities of suspense in interactive storytelling as opposed to producing suspense in non-interactive settings.

To confirm the previously proposed hypotheses, an experiment has been designed and run. In this experiment, $N = 23$ human subjects experienced interactive or non-interactive versions of a suspenseful story. The amount of situational information they were given was different in each version.

No claims are made about what the underlying cognitive aspects are. The aim of this experiment is to provide evidence for this phenomenon, as it is considered influential in the design of suspenseful interactive stories. Other aspects influencing engagement and amusement (playability, context, plot) are not studied in this experiment.

The rest of the paper is organised as follows: Section 2 describes the related previous work on suspense and information used for designing the experiment. Section 3 describes the experiment, whose results are detailed in Section 4. Section 5 discusses these results. Finally, Section 6 suggests an approach to the problem along the func-

tionality of an automatic storytelling system, while Section 7 summarizes the results.

2. Related work

The experiment described in Section 3 tests the results of watching and playing non-interactive and interactive versions of short, suspenseful stories. In these stories, a murderer chases a victim which is controlled by a human. The information concerning the position of the murderer is a) not provided, or b) provided by sound, visual footsteps, or c) by full view of the setting, depending on the version of each story. This section reviews the literature related to this work and alike other systems based on suspense, information management and automatic storytelling.

2.1. Suspense, amusement and information

Suspense "has been conceived of as *pleasant excitement*" (Zillmann, 1991, p. 282). This evidences the relation between suspense and amusement. Likewise, suspense is defined as the pleasure experienced immediately prior to the anticipated resolution of uncertainty, and posit that it is positively related –up to a point– to the amount that is at stake on the outcome of an event (Caplin & Leahy, 2001, p. 73).

For instance, in Hitchcock movies –as well as classical thrillers–, suspense is delivered by providing the audience with information the characters in the story lack. This resource makes the spectators know more than the main characters and can make themselves the question "how can the situation be solved?" more intensely (Truffaut & Scott, 1998, p. 95). These data are key because they enforce active cooperation with the audience for coming up with a meaning (Calatrava, 2008, p. 154). Actually, in many classical suspenseful scenes in which the main character is threatened, suspense is generated as a function of the spectator's perception on the character escape options (Gerrig & Bernardo, 1994, p. 460), which can be inferred from the information provided by the story.

In fact, suspense can also be defined as the result of foreseeing a jeopardizing situation; "the activity that lies in equally calculating, expecting and evaluating a coming event" (Wulff, 1996, p. 1), foreseeing participates "in the constructive process by which a reader interprets details in a text and works towards an understanding of a text as a whole" (Miall, 1995, p. 277). It is not unusual that the anticipation of negative outcomes triggers the feeling of suspense in the audience (Comisky & Bryant, 1982, p. 51). From this perspective, suspense is an anticipation feeling (Miall, 2006, p. 54) that happens directing the course of the narrative (Iwata, 2009, p. 42).

To achieve this state of anticipation, it is required to provide the audience with: 1) information as the starting point for future developments; 2) a scenario of what is coming; 3) alternative possibilities which are more or less probable; and 4) finally, the individual possibilities and possible counteractions by the protagonist conceived (Wulff, 1996, p. 1). Therefore, controlling situational and contextual information seems fundamental to evoke suspense in the audience. It influences both non-interactive and interactive storytelling, in which the potential enjoyment is also influenced by outcome-uncertainty (Abuhamdeh, Csikszentmihalyi, & Jalal, 2015, p. 1).

2.2. Managing information in a suspenseful scene

According to Smith (1999), fear makes us notice dark shadows, mysterious noises and sudden movements and thus provides more possibly frightening cues. Van Vught & Gareth (2012) support this view. To them, it is more common for players to experience a startle suspense in response to games with fictional worlds because the atmosphere that triggers the anticipation is more easily created through fictional clues. Atmosphere effects as dark/foggy and the music/soundscape are continuously suspenseful (van Vught & Schott, 2012, p. 100). Perron (2012) has a similar opinion about the fog and darkness as used to hide what is not depicted. Players do not see very far, so they are always scared to run into something awful (Perron, 2012, p. 27). Since players with omniscient knowledge will use it for their own benefit (Calatrava, 2008, p. 214), controlling what they know is fundamental to keep the narrative and the corresponding suspense under the designer control.

As mentioned, sound is another useful component of suspenseful environments. Sounds can contribute to environment and spatial definition, providing leads on proximity and distance (Tanz, 1971, p. 222). If a character hears a subtle whisper, she will probably be far from the speaker. If she understands the words, she is nearer. A clock tower sound far away will increment the space (Bal, 1997, p. 101), and the sound can inform the character about the proximity of an enemy (Fernández Ruiz & Puente Bienvenido, 2015, p. 104). Therefore, sound is fundamental in interactive scenarios because it provides specific information about the environment and conveys emotional information like surprise or terror (Roux-Girard, 2011, p. 192). Mixing sound and visual information can provide useful redundancy for the player and enhances vividness (Steuer, 1992, p. 12).

Regardless of the strategy of information control to evoke suspense, interactive scenarios in which the audience takes the role of one of the characters have a particularity: the player has the same information as the main character. In this sense, information revealed to the spectator-controlled character is automatically revealed to the audience. In these cases, systems focus on the user's experience of the story and, therefore, choices made by the user influence the story development (Cheong & Young, 2006, p. 1907).

2.3. Related work in automatic storytelling and video-games

Video-games have been the discursive narrative space that has taken more advantage of this strategy, from interactive fiction textual games (Montfort, 2007, p. 7) to, recently, filmic interactive dramas (Wei, 2011, p. 338). Beyond the narratology versus ludology debate (Neitzel, 2005, p. 231), computer games may be considered as "interactive cinema" (Friedman, 1995, p. 78). Actually, current interactive narrative systems borrow the design of video-games (Klimmt, Roth, Vermeulen, Vorderer, & Roth, 2012, p. 189), particularly of genres as survival horror and RPG (Delmas, Champagnat, & Augeraud, 2009; Franco, Maia, Neto, & Gomes, 2015; Lindley, 2002; Peinado & Gervás, 2004).

In this new discourse denominated *transmedia storytelling* (Jenkins, 2006, p. 21) in which the player takes the role of the character, there is an emotional impact coming from such transference. This is different from the impact happening in classic discourses (Lara, 2014, p. 139). For instance, suspense decreases as the player control increases (Perron, 2012, p. 99). On the other hand, some suspense-generation techniques based on how to provide information are not possible, as players need a

different amount of information (Calatrava, 2008).

Taking this difference into account, quantitative and qualitative analyses are needed to approximate the impact of situational information and suspense between interactive and non-interactive storytelling.

With respect to automatic storytelling systems, while the treatment of suspense in the main narrative is supported by several prototypes –MEXICA (Pérez y Pérez, 2007), MINSTREL (Turner, 2014), Suspenser (Cheong & Young, 2006), Dramatis (O'Neill & Riedl, 2014) or IDtension (Szilas, 2007)–, most of them do not address interactivity. Attempting to undertake this feature, proposals as DEFACTO (Sgouros, 1999), Character-Based Interactive Storytelling (Cavazza, Charles, & Mead, 2002) or Façade (Mateas & Stern, 2003) are interesting initiatives, considering the difficulty and limitations of the matter. These limitations are mainly based on the "narrative paradox" or how to reconcile the needs of the user who is now potentially a participant rather than a spectator with the idea of narrative coherence (Aylett, 2000, p. 35).

Some other important challenges are implied. For instance, the order in which actions must be performed by the user and the system is often inflexible, it is usually hard to recover from mistakes, and each system has its own interaction conventions (Rich & Sidner, 1998, p. 315). Similarly, in connection with suspense, interactive narrative techniques do not provided mechanisms to ensure that particular narrative qualities – such mentioned suspense, as well as surprise or romance– will be produced in resulting plans (Thomas & Young, 2006, p. 21).

Along with this, the effect of suspense in experimental prototypes and practical narrative are often not the same. Stories developed through academic projects generally create much shorter and less intense narrative experience than films, novels or story-centered commercial games do (Wei, 2011, p. 338).

Against this background, an approaching threat comes out as a useful resource for experimenting with suspense. Given that most accounts of suspense assume foreseeing as a fundamental component, physical approximation has been used in the prototype system for the experiment, as described in Section 3.

3. Experiment

This section describes the experiment and the methodology that was applied to extract the information about what the differences between audiences of interactive and non-interactive stories are. Section 4 describes the results.

3.1. Participants

The experiment took place in the Computer Science Faculty of University of Cadiz (Spain). The experiment was announced to students and those wanting to take part in it voluntary enrolled. The objective and the process was explained to them and they all accepted the conditions. Twenty three undergraduate students ($N = 23$), 20 males (86.96%) and 3 females (13.04%) participated. All the participants were students of Computer Science degree. Their ages ranged from 20 to 41 years ($mean = 24.22$, $stdev = 5.08$). All participants were Spanish native speakers. There was no compensation for participating in the experiment.

An internal code (from 1 to 23) was assigned to each participant. This code was related to their corresponding age, genre and contact information. Their codes were used to anonymously distribute them among the groups. Variability of number of

Table 1. Experiment participant's distribution

gender	N	**ratio**	$mean_{age}$	SD_{age}
global	23		24.22	5.08
male	20	86.96%	24.35	5.21
female	3	13.04%	23.33	4.93
Group A	12		24.08	5.83
male	10	83.33%	23.09	6.19
female	2	16.66%	25.00	5.65
Group B	11		24.36	4.20
male	10	90.09%	24.80	4.32
female	1	9.91%	20.00	–

participants, age and genre were limited among both groups by manually distributing the participants by genre and age. Table 1 shows the distribution of the participants.

Participants were divided in two groups. Group A or *decision-makers* ($N_A = 12$) was formed by participants who performed the role of decision-makers during the interactive stories; and group B or *viewers* ($N_B = 11$), were the passive, non-interactive audience.

The low proportion of volunteer female subjects made the experiment unbalanced in terms of participants' gender. The appropriateness of the number of subjects is also discussed in Section 5.

3.2. Interactive environment

To test the hypotheses proposed in Section 1, a testing environment was built. It consisted on an interactive application that displayed a top-down, tile-based 2D closed environment in which a female character –the *victim*– had to find a key to get out of an apartment, as depicted in Figure 1. During the escape, the *victim* was chased by a male murderer –the *threat*–, who would kill her if he reached her. The choice of both genders concerning their respective roles have been taken from classical suspense movies (Sapolsky, Molitor, & Luque, 2003).

Figure 1. Screenshot of the 2D environment used for experimenting with the suspenseful story

The *victim* was initially located in the central corridor of an apartment with just one exit door, and the *threat* was initially located in a random side of the apartment. The location of the *threat* was initially unknown to the audience –whatever experimentation group they are–. Each participant in the group A took the role of the *victim*, and had to escape the apartment. To do that, the *decision-maker* needed a) to find the key

–randomly placed in any wardrobe of the apartment– and b) to get out through the door. If the murderer reached the victim, she would be killed and the *decision-maker* would lose the game.

The gameplay was turn-based and the victim moved first. On each turn, the *decision-maker* subject had to move the character with the keyboard cursor arrows –up-down-left-right– and search for the knife or the key with the space bar. The *victim* moved four tiles on each turn, and the *threat* could move up to five tiles. This advantage for the murderer avoids endless or very long matches and forces the victim to try not to face him –since otherwise the player would not be able to escape–.

The murderer was controlled by a simple AI –whose behaviour is unknown to the participants–. This AI systematically explored each one of the rooms of the apartment. The exploration would go on until the *victim* is within the sight area of the *threat* –less than four tiles away, in the direction the *threat* is facing– and there were no obstacles between them.

If the *threat* detected the *victim*, he would approach her until he reached her, or she was not within his sight area. When this happened, the *threat* would get back to his initial position and started the exploration over until he found the *victim* again.

The prototype was implemented with RPG Maker VX[1] and it is freely available[2].

3.3. Story

The structure and the decoration of the apartment were the same through the different executions. Conversely, the interactive experience had five versions:

(0) A *sandbox* version –not used for data acquisition– in which the subjects could move freely and get used to the controls, the environment and the basic interactive mechanics. This version had no *threat*. This version was used to train the participants before the experiment.
(1) An interactive session in which no information about the threat position was given. The *victim* had a flashlight that allowed her to see the very nearby area only. The rest of the scene remained in complete dark. No sound or other clues were revealed until *victim* is reached.
(2) An interactive session in which, for each turn of the murderer, there was an audible feedback of footsteps revealing approximately how far he was. The visibility was the same as in version 1.
(3) An interactive session in which, for each turn of the murderer, there was an audible feedback of footsteps revealing approximately how far he was. Additionally, footprints were displayed on the screen to inform the user about the relative part of the apartment the *threat* is. The visibility was the same as in versions 1 and 2
(4) An interactive session in which the *decision-maker* could see the whole scenario including the *threat* location, the footprints and the sound feedback.

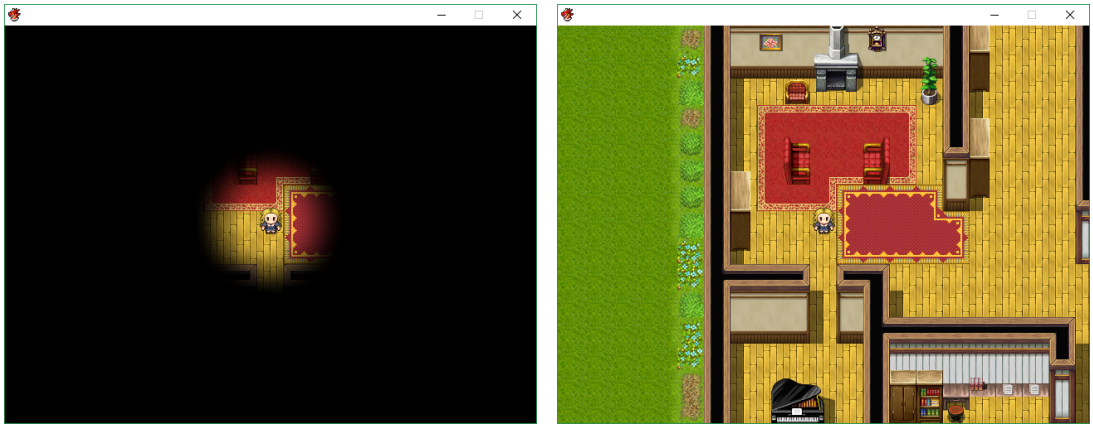
Table 2 shows the features of each version.

Additionally, Figure 2 shows the differences in term of visibility between the experimental versions one, two and three –Subfigure 2a– and the fourth version –Subfigure 2b–.

[1] http://www.rpgmakerweb.com/products/programs/rpg-maker-vx
[2] http://rodin.uca.es/xmlui/handle/10498/19962

Table 2. Story versions' features

version	threat in scene	complete visibility	footsteps sound	footsteps orientation
0	✗	✓	✗	✗
1	✓	✗	✗	✗
2	✓	✗	✓	✗
3	✓	✗	✓	✓
4	✓	✓	✓	✓



(a) Visibility in versions 1 to 3

(b) Visibility in version 4

Figure 2. Comparative between visibility in versions 1 to 3 with respect to version 4

3.4. Method

Participants were divided randomly in two groups. Group A or *decision-makers* ($N_A = 12$) is formed by participants who performed the role of decision-makers during the interactive stories; and group B or *viewers* ($N_B = 11$), who were the passive audience –spectators–.

The experiment was run in two sessions in one single laboratory. Subjects from groups A and B were matched randomly in pairs and interleaved –subjects from group A would be surrounded by members of group B and vice versa–. The screen of the *decision-makers* –the interactive version– was shared through Adobe Connect so that the corresponding *viewer* –group B– could see the interaction in real time. Viewport, tile size and other rendering aspects were identical between systems: all of them had the same specifications and configuration –Toshiba Satellite Pro S500-10D laptops–.

Before the sessions started, participant were asked about their age, gender and experience in video-games –*low*, *medium* or *high*–. After that, group B was presented with version 0 of the environment –see Section 3.3– for five minutes, in order for them to familiarize with the context, characters and controls.

Then, each *decision-maker* –group A– and, passively, every viewer –group B– played or watched two rounds of the 4 versions in random order each. Two rounds were played in order to analyse the effect of training in the results.

After each *threat* turn and before the *decision-maker* made a decision for the *victim*'s next move, the participants had to fill in a line in a questionnaire consisting of five questions:

- *How much suspense does the situation generate?*
- *What hope do you think the character has to escape?*[3]

[3]Both questions based on Gerrig & Bernardo's (1994) experiment Gerrig and Bernardo (1994), aforementioned

Table 3. Correlations between *suspense*, *hope* and *amusement*

	decision-makers		***viewers***	
	hope	***amusement***	***hope***	***amusement***
suspense	-0.412***	0.022	-0.527***	0.315***
hope		-0.045		-0.197***

*: p-value <0.05, **: p-value <0.01, ***: p-value <0.005

- *What degree of enjoyment are you experiencing?* –the responses to questions are given in a 4-likert scale with the following values: *none*, *low*, *high* and *very high*, corresponding to values ranging from 1 to 4, respectively–
- *Do you think it makes sense to go on with the story?* (*yes*/*no*)
- *How much information do you feel you have about the current situation?* –4-likert scale with the following values: *too little*, *little*, *enough* and *too much*–.

4. Results

After running the previously described experiment, demographic information for all participants and a total of 1811 report lines were collected. Each one of this report lines included answers for the five questions made on each step. 48 entries had to be discarded because they were partially missing or erroneous.

Globally, results show a moderate downhill correlation between *suspense* and *hope* ($\rho = -0.470$, $p < 0.000$) and a weak uphill correlation between *suspense* and *amusement* ($\rho = 0.179$, $p < 0.000$). The correlation is slightly stronger in the group B (*viewers*), both between *suspense* and *hope* ($\rho = -0.527$, $p < 0.000$) as, noticeably, between *suspense* and *amusement* ($\rho = 0.315$, $p < 0.000$). However, no significant linear correlation was found between *suspense* and *amusement* nor *hope* and *amusement* in the case of *decision-makers*. This evidences that *amusement* for both active and passive audience is also influenced by other aspects beyond suspense, having more impact in the case of *decision-makers*. These correlations are shown in Table 3.

Additionally, as expected, a significant moderate high correlation has been found between revealed *information* and *suspense* ($\rho = -0.603$, $p < 0.000$).

The value of this perceived *information* depends on the version of the scenario that is being experienced ($\chi^2 = 1533.6$, $p < 0.000$), without significant differences between roles. Consequently, the differences between the scenarios influence all of the reported variables: *suspense* ($\chi^2 = 358.56$, $p < 0.000$), *hope* ($\chi^2 = 105.34$, $p < 0.000$) and *amusement* ($\chi^2 = 100.72$, $p < 0.000$), although it affects the variables in a different way depending on the role. In fact, Duncan's test reports no significant differences in *suspense* between version 2 and 3 for *viewers* and *decision-makers*. In addition, no significant differences were found in *amusement* between version 1 and 4 for *decision-makers*, or in versions 2 and 3 for *viewers*. Specifically, the report by *decision-makers* ($\chi^2 = 24.606$, $p < 0.000$) rated as *high* the *amusement* in stories 2 and 3 –versions with *little* and *enough* information–; too much information –version 4– yielded *low amusement* and *too little information* –version 1– made the participants report a *none/low amusement*, being the second, non-training round even lower, as will be detailed below. However, although with a less intense effect ($\chi^2 = 10.584$, $p < 0.02$), *viewers* reported more *amusement* in versions 1 and 2 in that order –*low/high* to *high*– and then 3 and 4 –*low/high* to *low*–, which is inverse to the amount of given information. The reported *amusement* is significantly different in versions 3 ($\chi^2 =$

in Section 2.

Table 4. Local groups and means for each reported variable

	viewers		*decision-makers*	
version	**mean (stdev)**	**group**	**mean (stdev)**	**group**
suspense				
1	2.913 (1.024)	a	3.066 (0.899)	a
2	2.529 (0.819)	b	2.662 (0.807)	b
3	2.612 (0.699)	b	2.525 (0.772)	b
4	1.831 (0.822)	c	1.874 (0.832)	c
hope				
1	2.206 (0.919)	a	2.317 (0.899)	a
2	2.511 (0.714)	b	2.088 (0.807)	b
3	2.459 (0.740)	b	2.348 (0.837)	b
4	2.277 (0.927)	c	2.765 (0.908)	c
amusement				
1	3.016 (0.958)	a	2.221 (1.122)	a
2	2.609 (0.673)	b	2.725 (0.763)	b
3	2.507 (0.687)	b	2.963 (0.781)	c
4	2.140 (0.709)	c	2.345 (0.811)	c
information				
1	1.006 (0.079)	a	1.018 (0.133)	a
2	1.418 (0.494)	b	1.851 (0.401)	b
3	2.602 (0.528)	c	2.783 (0.413)	c
4	3.651 (0.485)	d	3.816 (0.388)	d

-6.686, $p < 0.000$) and 1 ($\chi^2 = 6.156$, $p < 0.000$), weaker in version 4 ($\chi^2 = -2.920$, $p < 0.004$) and not significant in version 2, where both roles refer similar ratings ($\chi^2 = -0.292$, $p < 0.8$). On the other hand, reported *hope* and perceived *information* is not affected by the role. Table 4 shows groups and means for each variable, and Figure 3 shows graphically this difference between both groups for the four reported variables.

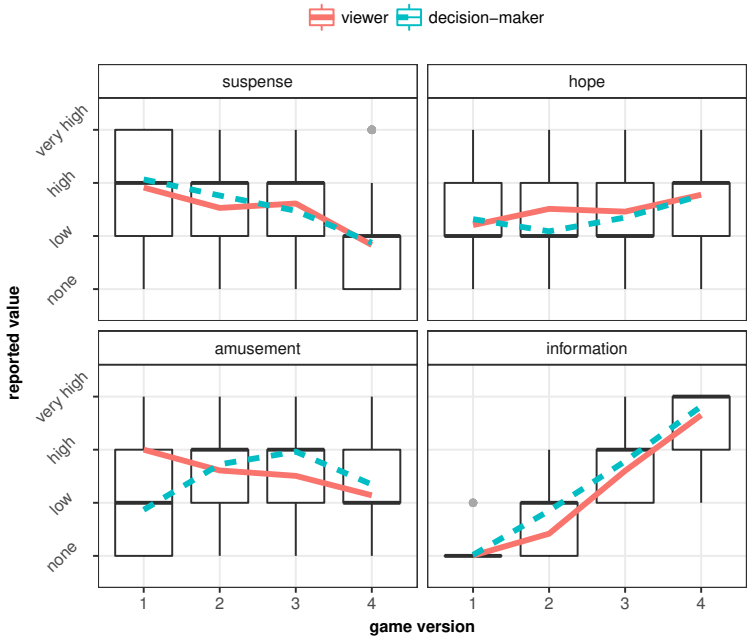


Figure 3. Values reported by *decision-makers* and *viewers* (grey dots represent outliers)

As depicted by Figure 3, the higher the amount of information, the lower the reported *suspense*. This relation seems not to be affected by the group. The amount of information given in the experiment influences *hope* at a lower level.

In order to confirm this, a multivariate analysis of variance (MANOVA) was conducted to determine whether there were differences in the impact in each of these variables due to the version and the role. Results evidence that both group *A* –*decision-makers*– and group *B* –*viewers*– answered similarly about reported *suspense* ($F_{7,1800} = 0.184$, $p = 0.801$). In contrast, behaviour of *hope* presents a significant variations between versions and roles ($F_{7,1800} = 7.625$, $p < 0.001$). Reported *amusement* seems to be also clearly affected by the group ($F_{7,1800} = 39.838$, $p < 0.000$): version 3 yields a *high* value, *low/high* in version 2 and *low* in versions 1 and 4. Moreover, although the game version is the significant factor ($F_{3,1800} = 3857.31$, $p < 0.000$), the role of the audience also seems to influence this difference by itself ($F_{3,1800} = 118.70$, $p < 0.000$) and in conjunction ($F_{7,1800} = 18.68$, $p < 0.000$).

As trivially expected, the differences in provided information also influence the interaction ($F_{3,1800} = 4.967$, $p < 0.01$), making less disclosed scenarios faster to play –10 turns in average– than fully disclosed ones –14.78 turns on average, version 4–. There was no significant difference between versions 2 –12.21 turns– and 3 –11.35 turns–. Therefore and as aforementioned, the amount of information seems to affect the participants' opinion about going on with the story.

On the other hand, experience in video-games seems not to have a relevant effect on the number of turns ($\chi^2 = 1.872$, $p = 0.242$), *suspense* ($\chi^2 = 0.489$, $p = 0.632$), *hope* ($\chi^2 = 0.722$, $p = 0.570$) or *amusement* ($\chi^2 = 0.243$, $p = 0.721$). However, least experienced *decision-makers* exceptionally reported a higher *suspense* in training round ($\chi^2 = 12.99$, $p < 0.002$). This difference in *suspense* was not reflected in the second round ($\chi^2 = 3.433$, $p < 0.114$) nor the least experienced gamers when they perform as *viewers* ($\chi^2 = 2.237$, $p = 0.191$), who moreover reported a slightly higher global *hope* –*low/high* versus *low*– ($\chi^2 = 6.774$, $p < 0.04$).

Remarkable differences were found between rounds (training-first and second, as explained in Section 3.4). Participants from both groups report higher *suspense* in the first round ($Z = 3.635$, $p < 0.001$). Likewise, *hope* to escape mostly raises in the second try ($Z = -3.611$, $p < 0.001$). Despite these variables did not evidence significant differences in terms of rounds, reported *amusement* did so. Specifically, the effect of "boredom", when *decision-maker* is omniscient –last version–, is more pronounced than in the second round ($Z = 5.874$, $p < 0.000$); moreover, *amusement* is higher in version 1 ($Z = -2.118$, $p < 0.034$) and, clearly, in version 3 ($Z = -4.210$, $p < 0.000$). This is consistent with gamification and engagement effects due to the experience factor (Deterding, Dixon, Khaled, & Nacke, 2011). The difference was not found in *viewers* ($Z = 0.69611$, $p = 0.486$). Figure 4 shows graphically this differences.

Results obtained from the non-training round evidence that similar *suspense* evokes different *amusement* depending on the role of the audience. While *viewers*' *amusement* decreases as *suspense* does from *high* at the first version to *low* at the second ($\rho = 0.602, p < 0.000$), *decision-makers*' *amusement* reaches it peak in version 3, showing a significant but weak linear correlation with *suspense* ($\rho = 0.180$, $p < 0.001$). No other correlations were found between both variables (and, consequently, the amount of *information*) for *decision-makers*. It means that *suspense* has less influence in *amusement* for *decision-makers*, as much as they need more *information* to engage. In addition with the rest of the analysis, this fact supports our initial hypotheses.

Finally, no significant differences were found with respect to the participant gender. Nevertheless, the low number of female subjects (3) makes it impossible to draw strong conclusions about this.

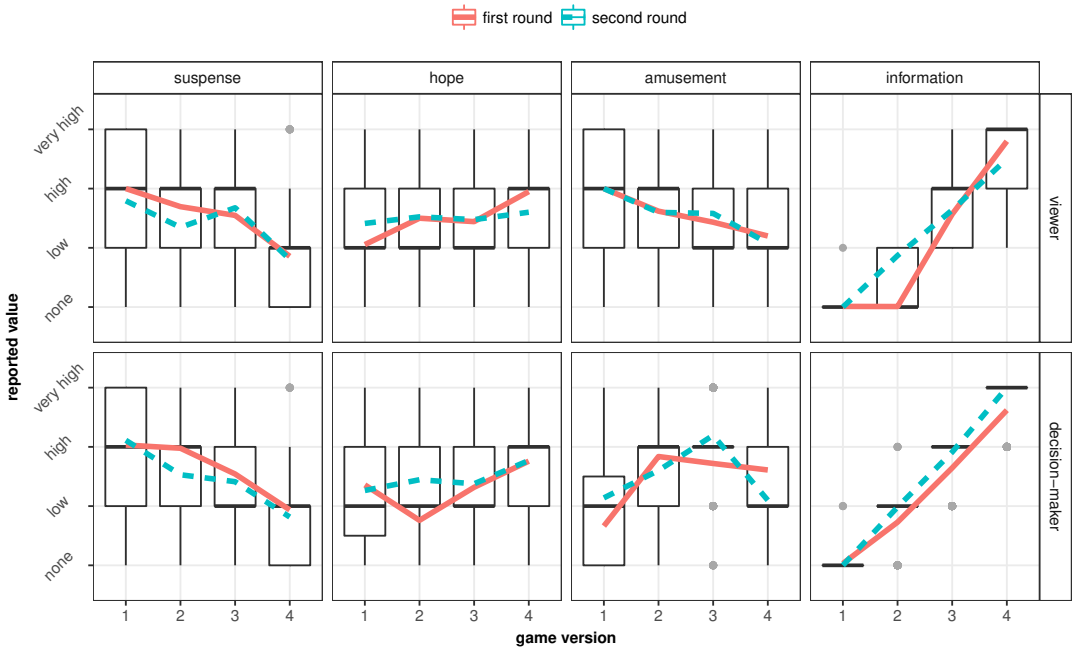


Figure 4. Values reported by *decision-makers* and *viewers* in first or second rounds (grey dots represent outliers)

5. Discussion

The experiment results suggest differences between the impact of suspense in interactive versus non-interactive stories. However, there are some aspects that must be reviewed in order to extract a working conclusion.

Suspense, hope for escaping, amusement and situational and contextual information are all part of a general cognitive process experienced when playing or watching a story. As such, the influence of several aspects in the experimenting environment –hard or out of control– is not negligible. First, the platform used in this experiment was intentionally modelled as an *easy-to-play* video-game for the participants to be able to play the interactive story with a low entry barrier. This may have influenced the participants since they promptly detect the story occurs in a fixed-rule scenario, with probably no surprises. The same applies to the simplicity of the plot, explained to the participants beforehand. The validity of the working hypothesis in more elaborated, real contexts would require more in-depth experimentation.

Suspense in this experiment is not based on providing additional information to the audience, as proposed by several authors (Allen, 2007; Burget, 2014; Calatrava, 2008; Iwata, 2009; Truffaut & Scott, 1998). This is anyway impossible in interactive stories because the audience, as *decision-maker*, takes the role of the main character, and that implies that any information provided to the character is automatically provided to the player and vice versa. This fact is evidenced in version 4 –see Section 3–, where, even when the murderer is in another room that would not be visible for the *victim* as fictional character, the *decision-maker* reacts by avoiding that place. Hence, the suspense in this case is produced even when the fictional character and the player have the same information. In this way, given information corresponds to the amount of resources provided to the victim, which has more chances of escaping because she

knows where the murderer comes from. The reported suspense is similar in both roles –*decision-maker* and *viewer*–, supporting that there is an inverse relation between the victim's resources and the perceived suspense. If the resources are clearly insufficient to counteract the threat, *decision-makers* get frustrated.

Although information flow is an important constituent of suspense, anticipation seems to be restricted to situations where escaping or being about to be killed is perceived as certain for the audience (Comisky & Bryant, 1982; Hoffmann, 2006; Miall, 1995; Wulff, 1996). Nevertheless, taking suspense as an "anticipation feeling" (Miall, 2006), it can be observed that it happens in versions 1, 2 and 3, being noticeably lower in version 4, when the participant knows the location of the murderer.

The experiment has only been run with a single pair of characters: a prototypical female victim and a prototypical male murderer. This has been taken from classical suspense movies (Sapolsky et al., 2003). The literature, however, reports on emotional differences when the gender and the aspect of characters vary (Belmi & Neale, 2014; Clover, 1987; Fischoff, Antonio, & Lewis, 1998). Additionally, more differences could be expected between *decision-makers* and *viewers*. This limit is aggravated by the fact that the percentage of female participants is significantly low, which does not yield sufficient data to discard the influence of genre. Alongside this is the circumstance that the number of participant is fairly small –23 in total, 11 vs. 12 by condition–, where t-test power analysis reaches an estimated factor for false negative finding of 0.46 in terms of the relation between suspense, hope and amusement. This clearly points that the sample should be higher to ensure that results are not incorrectly retaining a false null hypothesis for contrasts. However, from the perspective of how the experiment was designed, each *decision-maker* and *viewer* experience various games –in two rounds, two games per version–, the reported previous factor for ANOVA analysis drops to 0.17, and observable physical and *in-response-to-events* reactions of participants were quite similar in their respective roles. Therefore, while we conclude that adding more subjects would be need, we consider that the general results are convincing enough as a first experimental evidence and easily reproducible.

All these aspects suggest the need for a more refined experiment to draw stronger conclusions. While the results evidence the differences between interactive and non-interactive storytelling in terms of the needed information, concluding definitive facts needs further experimental support.

6. Towards the Application of the Results in Automated Storytelling

The results of the study suggest that interactive suspenseful storytelling requires more situational and contextual information than their non-interactive counterparts in order to maximize the experienced amusement. In the context of automated storytelling systems, these results can be used to inform a generative algorithm so that the produced output approximates the correct amount of information, either in real-time for interactive scenarios or offline for non-interactive story generation.

Story generation systems are very heterogeneous and providing a general model of the information that should be given to the audience is not only outside scope of this proposal, but also probably unreachable at the moment (Bringsjord & Ferrucci, 1999; León & Gervás, 2014; Li & Riedl, 2015; Pérez y Pérez, 1999; Swartjes & Theune, 2006). However, all storytelling systems –interactive or not– tell stories by conveying chunks of information in the form of text or graphics. Several of them, additionally, follow a generative process in which there is procedural distinction between plot and

discourse (Chatman, 1978). That is, a two-stage process in which the plot is first generated and then told or shown to the audience, possibly omitting or reordering these chunks of information. This hypothesis is assumed to be valid even in those systems that just tell all of the created material.

In non-interactive storytelling, the amount of information for a valid level of suspense must be relatively low. In order to implement this in non-interactive storytelling systems, this idea can be used as a metric in a generative algorithm for yielding a discourse that hides a relatively high number of details to the audience. An automatic storytelling system can hide details that are related to suspense, like the position of the threat, the weapon that a murderer might have, and other. That is, classifying some information as suspenseful and then hiding part of them should be, according to our results, a way to improve the discourse in terms of its suspense.

Interactive storytelling could use an analogous approach, but this kind of systems are more complex to design because they have to take the player's behavior into account. The results suggest that hiding part of the information related to the threat can maximize the perception of suspense, but hiding too much of it can produce a non-pleasant experience. For this to be possible, not only suspenseful aspects should be explicitly identified in the generative process, but also those aspects that are important for the player to be able to go on with the experience without losing relevant details. For instance, the position of the murderer and the weapon he might be carrying are information related to suspense. Hiding both could work for non-interactive fiction, but the results suggest that interactive storytelling would require to give, at least, part of that information while hiding some other.

While identifying these two families of information –suspenseful and needed for playing– are considered key, providing a general model for an actual implementation is a challenging tasks because current storytelling systems are too heterogeneous. The results of this research are not a straightforward solution to maximizing amusement in terms of suspense in storytelling, but can serve as an additional metric for automatic systems. How this metric is implemented is left to the specific models and implementations.

7. Conclusions and future work

This work is based on the hypothesis that interactive stories need more situational and contextual information than non-interactive ones to be amusing to the audience, even at the expense of less suspense. Suspense seems not to be as influential in interactive storytelling, at least not as much as a correct information flow. While an exact quantification of how much information is needed depends on the context, it seems clear that too much information is boring and too little information can be frustrating in interactive storytelling.

Along with the hypothesis, this paper has described an experiment in which human participants were matched in pairs of *decision-makers* –active– and *viewers* –passive–, both experiencing the same story from two different perspectives. The analysis of the results indicates that the hypothesis is plausible in the context of the experiment and the found correlations indicate that the predicted effect seems to be true. However, due to the nature of the experiment –a 2D, tile-based, turn-based game– and its limitations, it is still soon to make a general conclusion. Nevertheless, we consider the results to be relevant since the story generation system we have used to test the hypotheses is quite similar to several interactive systems and popular games.

In all versions of the narrative, suspense is produced even when the audience has the same information as the main character in the scene. Against this background, the experiment has evidenced that giving too little information to the *decision-maker* reduces the amusement, just in the same way that too much information is counterproductive. In this sense, an omniscient audience, in contrast with non-interactive stories, needs a different amount of information.

We observed that amusement and engagement are influenced by the perception of escape chances. As the hope of winning decreases, the passive audience loses interest. It seems that, whereas the passive spectator desires a quick resolution when the chances of the protagonist are low, the active audience wants to have an advantage to help the character to generate opportunities that can make the story longer.

More generally, we also conclude that interactive storytelling requires challenge, but offering enough opportunities. In this way, it is important to avoid this form of "learned helplessness" in which the audience experiencing a negative outcome which cannot be controlled loses interest. Besides, simply triggering the feeling of suspense is not enough to consolidate engagement. This does not seem to be the case for passive audience, which seems to be more affected by classic suspenseful settings, some of which are replicated in interactive drama as discussed in Section 1.

Finally, based on the evidences found, we are currently working on a broader study that relates these observations with the effect of other features of suspense –use of tools and resources, distance between the threat and the victim, and other particular characters' features–. The overall objective is to provide a model serving not only to predict suspense, but to be able to do it within interactive storytelling.

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Notes

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