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3D Movie Subtitling: Searching for the best viewing experience¹

Abstract

Subtitles these days have taken a new function beyond translating or transcribing dialogues. New technological development allows for placing subtitles, as texts, in any region of the screen, also for subtitles to become an integrated part of the narrative. Different terms have been used to label the new subtitles, their function and effect. Some authors use the term “dynamic subtitles” and they find through testing end users that subtitles have “the potential to make the overall viewing experience less disjointed and more immersive” (BROWN ET AL 2015). O’Sullivan comments on this on-screen text type of the play between the diegetic and extra-diegetic: subtitles function as an “extreme anti-naturalistic device” (O’SULLIVAN 2011: 166). Commenting on the limits and nature of subtitling itself Luis Pérez-González points at a higher audience attraction “that shapes audience engagement by commenting upon the diegetic action and disrupting conventional forms of semiotic representation, making viewers consciously work as co-creators of media content” (PÉREZ-GONZÁLEZ 2012: 18). Finally, Dwyer through eye-tracking methodology challenges “that screen media is made to be viewed, not read” (DWYER 2015). All these authors point at one issue: a change of viewing tradition and user involvement regarding subtitles.

Not only subtitles are more engaging, media content is trying to maintain audience and gain new audiences through higher emotional interaction. 3D has been for over a century a format aiming at offering a more real environment where action develops. This article looks at subtitles accompanying 3D media, again a new subtitle opportunity to play with the narrative and the viewer interaction and engagement. The first part of the article revises the different ways to create 3D images. This is important to understand the second part of the article, when some 3D subtitled movies and videogames are analysed from a descriptive approach. The article concludes with the need to research from a user-centric perspective subtitle production to achieve the best viewing experience.

Keywords: subtitle, subtitling, immersive environments, video games, films

1. Introduction

There is no 3D media content standard format or a standardised way to generate it. This multiplicity of 3D generation has a direct implication on how to create subtitles for 3D media content. Both creating content and creating subtitles depend on technology, which in turn is directly related on the 3D viewing possibilities. Immersive environments are nowadays where content developers are focusing in a big effort to increase market share. One of the most immersive technologies is that of 3D, but this format is not a very new proposal. The 3D process was brought to the movies in the 1920s, but became popular in the 1950s. Movies such as *Kiss Me Kate* (1953), *Hondo* (1954), *Dial M for Murder* (1954), *Creature from The Black Lagoon* (1954) are good

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example of popular 3D movies from last century. 3D was the Hollywood answer to TV, which started to gain audience share at that time, as it had been the addition to sound or colour earlier (JOCKENHÖVEL 2011). Film studios made a big effort to fight other forms of visual entertainment such as TV audience competition, or more recently video games.

The latest attempt to mainstream 3D media content - in movies, television and video games - is the responsibility of industries: hardware manufacturers, broadcasters, videogame producers or movie makers. This renewed challenge aims at improving the user experience, by adding vividness and realness in the images (BUSELLE & BILANDZIC 2009; GREEN, BROCK & KAUFMAN 2004). Film makers in the 21st century, with new technological aid, are trying again to enhance emotions and impact the user giving a second chance to the 3D format. Films like *Avatar* (CAMERON 2009) was a blockbuster and a huge success of the stereoscopic technology (BELTON 2009). The quality and realness of the image provokes more affective engagement, immersion and vividness (HUANG, ALEM & TECCHIA 2013). The user feels engaged in the reproduced situation (stimuli/environment content), the image seems real just in front of or around the user. Immersiveness can be conceptualized as involvement, presence, flow, transportation, narrative engagement, absorption, and entrancement (ROONG & HENNESY 2013, WEIBEL ET AL 2008). Immersiveness, and some other interaction markers such as presence or engagement, implies a different interaction with the image as a different visual perception by the user, which has a direct relationship with the language of interaction and translation (WISSMATH, WEIBEL & GROONES 2009).

On the one hand, we have the 3D media content, and regarding subtitling, it is the Audiovisual Translation modality which has monopolised attention in research and publications (FRANCO & ORERO 2004). Subtitling is also the audiovisual translation modality with higher number of guidelines, and experimental studies. Some research has been also performed for subtitles in video games (O'HARA & MANGIRON 2013) and subtitle reception (O'HARA & MANGIRON 2016). Still little is known for subtitling in 3D either in guidelines, their reception with end users, or enjoyment (VILARÓ 2011). Generating stereoscopy is complex, and the fact that 2 sets of data are produced makes any experiment double challenging. For any experimental research, special equipment is also needed to create, reproduce, receive and analyse 3D media content. The first part of the article will explain the different ways to generate 3D, giving rise to different 3D content, which affects its reception. The second part of the article will look at subtitles in 3D movies. From a descriptive approach, several 3D examples will be analysed.

2. Generating 3D content

Stereoscopy (also called stereoscopic or 3D imaging) refers to a technique to create or enhance the illusion of depth in an image by presenting two offset images separately to the left and right eye of the viewer. The two 2D offset images are then combined in the brain to give the perception of 3D depth. The visual cortex of the brain fuses the two images into the perception of a three-dimensional scene or composition. This is accomplished by:

1. The viewer wearing eyeglasses to combine separate images from two sources,
2. The viewer wearing eyeglasses to filter images from a single source separated to each

eye,

3. The light source split the images directionally into the viewer's eyes (no glasses required). In this third option, we also have the possibility of auto-stereoscopy. When the viewer's head is in a certain position, a different image is seen with each eye, giving a convincing illusion of 3D. Such displays can have multiple viewing zones allowing multiple users to view the image at the same time, though they may also exhibit dead zones where only a monoscopic, cross eyed, or no image at all can be seen.

3D creation with no glasses has other possibilities such as alioscopy and anaglyph. The former uses 8 interleaved images to produce the autostereoscopic 3D effect through purpose built 3DHD display units. The LCD screen equipped with lenticular lenses, allows for a reproduction of the same image from various perspectives depending on the viewer's changing position. As a result, the viewer perceives the 3D scenes and objects with simulated depth and distance, without wearing any special glasses. Anaglyph 3D images contain two differently filtered coloured images, one for each eye. When viewed through the "color-coded anaglyph glasses", each of the two images reaches the eye it's intended for, revealing an integrated stereoscopic image.

It is important to bear in mind the different possibilities when creating 3D because each system implies a different hardware for its reception: active or passive glasses, anaglyph glasses, etc. This has a direct impact on the subtitles that can be generated to accompany the 3D images.

3. Generating 3D movies

There are many ways to generate a movie, from recording real life actors with a camera or cameras, by stop motion, or any of the possibilities available with a computer to create animated films. The content created usually is in 2D, but there is an interest in new immersive environments such as Virtual Reality (VR), movies recorded with a 360 camera, or 3D. Stereoscopic content can be created from scratch, but there is also the possibility of converting 2D content into 3D. That is, you have the content in 2D and applying a computer programme it becomes 3D footage. Computer generation and two-camera recording are the two scenarios when generating native or original 3D content. A good example of native 3D content generated by the side by side two-camera recording is the movie *Pirates of The Caribbean: On Stranger Tides* (MARSHALL 2011) while to illustrate an example of a computer-generated content is the movie *The Adventures of Tintin* (SPIELBERG 2011). In her blog Katey Rich writes about this movie as "Animated films have always been better suited to 3D than live-action, since the colors tend to be brighter and the action more controlled, making it easier for everything to pop out in the third dimension. As it's directed by a master like Steven Spielberg, and uses motion capture to really take advantage of the 3D animated space, Tintin is even better suited for 3D than most animated films" (RICH 2012). A third possibility to generate 3D content not mentioned previously is the mix of both 3D generation technologies: computer generation and two-camera as in the movie *Tron: Legacy* (KOSINSKI 2010). In this movie, real world scenes are recorded in 2D while scene from a fiction world are in 3D. The content of this movie is sometimes generated by a computer and sometimes with two cameras, and in some scenes a mixture of both. We have given examples of three native

3D mainstream commercial movies. These will be analysed later in this article, but we should also focus on two other recent films, from expert film directors who have tried the 3D format: *Alice in Wonderland* (BURTON 2010) and *Avatar* (CAMERON 2009). The reason for this interest is for disparate 3D result from the sublime in the case of the latter to the ridiculous. Tim Burton's movie is now famous for the bad 3D quality while Cameron's *Avatar* will always be quoted for the spectacular production.

4. Subtitles in 3D

The title of this section is misleading, because the most common approach to generating subtitles for 3D content is the use of 2D subtitles. This fact shows the unawareness of film directors of the postproduction process of their movies, and the addition of translation modalities to distribute the movies in different languages. Taking into consideration all the transformations a film will endure for its distribution and exhibition is the claim being made from different constituencies in Media Accessibility (UDO & FELS 2009) and Audiovisual Translation (ROMERO FRESCO 2013). Understanding how the finished movie will be translated, or made accessible, from its creation would no doubt offer a higher quality product across languages, cultures, and audiences. This situation is even more pertinent for 3D movies since the stereoscopic experience is broken with the inclusion of subtitles, a two-dimension text over a 3D content. This generates a clash for the viewer experience since traditional 2D subtitles appear at screen depth level, and if a scene has some pop-out effects below the position of the subtitles there is trouble at getting the correct volume information. The same applies if the scene uses a lot of depth, again making it hard for the viewer to properly focus synchronically on the text and the image from the movie, the experience is anything but engaging, it is uncomfortable for the viewer.

Many issues are raised when having to subtitle 3D content. Some are related to the technology behind the 3D creation and the effects the superimposing of the text may have such as "ghosting" or "shadowing" as in Fig 1, when the image, in this case the subtitle, is repeated (GONZÁLEZ ZÚÑIGA ET AL 2013).



Fig 1. Ghosting 3D effect on subtitles

For this article, we shall focus on the overall creation of subtitles. For example, when the movie was created as a 2D and then is automatically converted as 3D. The letters for the subtitles are 2D, but should be 3D images? Where should be the subtitles located? Next to the action or varying according of the depth intended. Given the many issues which should be taken into consideration when subtitling in 3D, and the lack of guidelines on how to subtitle in 3D, an analysis of existing 3D subtitled movies has been performed. It is hoped that this bottom up descriptive research approach will shed some preliminary light on the current 3D subtitling style.

5. Analysis of 3D subtitled films

To understand the current subtitling solutions used in contemporary films, a corpus of five movies were chosen to match the different 3D production techniques already mentioned in section 2, and understand how subtitles work in each type of 3D. At this stage only a descriptive analysis has been performed. It is hoped that further analysis with experimental setup will be carried out in the future to assess user levels of engagement, justifying in this way the use of 3D technology and the preferred solutions. A corpus of six movies was chosen in a two-year span (2010-2011). The reason for this choice is to have a sample of the first solutions chosen by movie makers. This choice also adds a Spanish native 3D movie *Torrente* to find out the home subtitle options – solutions found in humble movie industry compared Hollywood.

5.1 *The Adventures of Tintin (SPIELBERG 2011)*

Checking for subtitles in a computer-animated movie the director Steven Spielberg is the first choice since it guarantees quality production. Since 3D is generated by a computer it should have a more natural treatment of depth. Its creation is completely controlled, and it doesn't have to rely in either technology or "about the language that 3D can speak" as film director Alan Taylor explained to Weintraub (2013). After analyzing the subtitles, we have noticed that they are always located in the perspective closest to the viewer. Therefore, they always remain ahead of the rest of the scene. The focus of the scene, if reading subtitles, is in a depth closest to the viewer. However, different shots with different frames and focal distances create different sensations of depth to the viewer barely noticed. The 3D effect, or over the shoulder, where the tunnel effect is very pronounced is reduced since the focus stays reading the subtitles. The different depths should be respected also with the parallax of the subtitles for each scene or shot. To be able to show the subtitles always in the closest perspective, they are created much separated from each other in the parallax of the shots hence the feeling of depth is greater. In more open shots such as those in the desert or the sea, subtitles are very close to each other or even with little separation. These changes of perspective are little appreciated by the viewer in this film, since the relative perspective between the shots and the subtitles is always the same -- always perceived ahead. However, changes in closeness can be seen if viewed without stereoscopic glasses or if several shots of different depths and their respective subtitles are contrasted, where some are perceived closer to the viewer in absolute terms. The conclusion for

this computer-generated film is that subtitles always appear before the rest of objects of the shot. When a high depth is created, subtitles are much closer to the audience compared with less 3D effect. No effort was made by Spielberg to generate an interplay between the subtitles and the 3D movie effects.

5.2 *Pirates of The Caribbean: On Stranger Tides* (MARSHALL 2011)

This film is recorded in native 3D. For this a side-by-side camera, or a camera with two lenses, is used to record a different parallax for each eye in order to achieve a greater and more natural depth and greater engagement. In this movie only one aerial scene is recorded in 2D and later converted to 3D without affecting the general perception of depth. In addition, unlike *The Adventures of Tintin*, this movie contains scenes of real images, scenes generated by computer and mixed 3D and 2D scenes, and for these reasons is a good example to analyze when subtitled. The subtitles in this film follow the same pattern as in *The Adventures of Tintin*. They are always shown in the perspective closest to the viewer and their depth varies depending on the 3D feeling that is perceived in each shot. However, unlike the previous film, in *Pirates of the Caribbean* the viewer perceives the changes of depth in alternating shots in a more pronounced way that is between panoramic and close-up. Likewise, there are many scenes with shot where some character speaks with voice over and then changes to a shot where that character appears before the camera, in this case subtitles are kept on screen in different regions. This adds one more difficulty, since there are two different perceptions of depth, and then subtitles should be adapted to it for easier reading. In this film, this problem has been solved by placing the subtitle at a depth corresponding to the scene with greater perception of tunnel effect, provided that, when making the change, this is not behind some object that may seem closer to the viewer. It can be said that dynamic and adjusted 3D subtitles have been created. However, this system can be tiring, since there are several cases where in the same scene appears subtitles at different depths, which means that we must change our focus to move from one subtitle to another. This can be quite annoying for a certain public and may aggravate the eye fatigue and produce headaches, as reported by some subjects when watching stereoscopic films.

5.3 *Tron: Legacy* (KOSINSKI 2010)

Although this film was generated like *Pirates of the Caribbean* it was interesting to study because it presents some differences. As with the previous movie it has mix 3D and 2D mixed scenes. For this movie, though, scenes that happen in the real world are filmed in 2D, while those that occur within the virtual world were filmed directly with stereoscopic cameras. In addition, five of these scenes are recorded in IMAX 3D format with a 1.7:1 aspect ratio, unlike the rest using the Cinemascope system at 2.35:1. This movie shows differences of filming and technologies, and how affects the presentation of the subtitles on the screen depending on which scene is involved. In scenes that are recorded with IMAX 3D cameras, a great sense of depth is perceived and, as a result, the subtitles change in depth, adapting to each scene in the same way as in *Pirates of the Caribbean*.

On the other hand, scenes that occur in the real world have no 3D effect, but their subtitles are displayed at a different depth, closer to the viewer on all shots. It is the same case with scenes recorded in 3D in the virtual world with the Cinemascope system in which, despite having a depth effect, this is not too obvious. Both types of scenes use a 2.35: 1 aspect ratio, which means that when viewing on a standard 3D HDTV (1.7: 1 aspect ratio) black bars appear at the top and bottom of the image. One line subtitles appear on the black box, while those of two lines are directly on the image. These changes have no effect on the depth at which the subtitles are displayed. However, unlike what happens in the films analyzed above and in the scenes shot in IMAX 3D format, we could not identify a fixed pattern when showing the depth of the subtitle with respect to the scene in which is located. There were cases where subtitles to different depths were shown in the same shot for no 3D depth changes.

5.4 *Alice in Wonderland* (BURTON 2010)

Alice in Wonderland is a film that may seem very similar to those discussed above as a mixed 3D production. It combines scenes of real images, computer-animation scenes and scenes that mix both, but this movie differs from the rest by being recorded in full with 2D cameras. So, in fact we are dealing with a 2D movie. To achieve a stereoscopic effect, during the postproduction the whole film was digitally adapted, but the results are rather poor if the real scenes are compared with the animated by computer or with other films shot directly in 3D. These peculiarities made this movie a good choice to be analysed. Subtitle production for this film is not far from what we have discussed in *Pirates of the Caribbean: On mysterious tides*. There are many scenes with large alternations of shots with different depths, and also follow the general pattern that we have observed with the subtitles, always showing in the perspective closest to the viewer and varying the depth depending on the sensation of 3D perceived for each scene. However, it presents two peculiarities that deserve to be commented and that justify the analysis of this film. First, the most interesting feature they present is that they are dynamic subtitles. That is, that a subtitle itself adapts to the different depths to which it must show when changing scenes. In other words, if in a single scene a subtitle covers several shots, it will modify its depth according to the ideal depth in which the subtitles must be displayed in each scene. These changes are imperceptible to the spectator when wearing 3D glasses. They avoid the main problem with the subtitles of *Pirates of the Caribbean: In mysterious tides*: there is no change of depth between subtitles in the same scene reducing visual fatigue.

The other feature is the presentation of subtitling in computer generated scenes, when in *wonderland*, which have a much more realistic and accentuated stereoscopic effect. This depth creation compares with real-world scenes, created through conversion to 3D, and hardly noticeable. Special attention has been paid to present subtitles in each of the two conditions. In the former, the subtitles are dynamically displayed with a creation of depth, while in the latter, the parallax between subtitles is much smaller, which makes the depth perception less pronounced, in tune with the rest of the scene.

5.5 *Avatar* (CAMERON 2010)

This movie was responsible for the 3D comeback and a surge in interest for stereoscopic content. The film combines different production techniques: real-life sequences, digital animation, and traditional animation. It was filmed entirely in native 3D with a recording system developed in part by the director himself, James Cameron, called Fusion Camera System which and has turned out to be quite popular ever since. In relation to subtitling, this is shown in a very similar way as it does in *The Adventures of Tintin: The Secret of the Unicorn*. The depth of the subtitles is adapted to the scene so that they always appear in a closer perspective, but in a gentle way and not so tiring for the viewer, without sudden changes of depth as they occur in *Pirates of the Caribbean: On tides Mysterious* or the dynamic changes of depth between scenes like *Alice in Wonderland*.

However, it presents a particular point that none of the previous films presents, despite being produced after *Avatar*. In this film, the location of the subtitles is dynamic, that is, they change their position regarding the location of the speaker on the screen and the type of scene to facilitate reading and improve the tracking of the action. Thus, if a character is placed to the right of the scene, the text is displaced to position itself close to it, instead of in the usual position or, in its absence, in a place where they do not interfere, as it happens in some shot where subtitles are located above since the action happens in the bottom part of the screen. In addition, it should be mentioned that the film already includes subtitles in the parts where the native inhabitants speak in their own language Na'vi. Subtitles for this language follow the same features as other subtitles with the exception of colour: yellow. The different subtitle features, and the positive reception is perhaps the fact that subtitles were part of the creation process –since they were used to translate Na'vi. These subtitle features aid reading and avoid distraction to both attention to action and significantly reduce visual fatigue. Also, being one of the first films released for the general public in 3D, the result obtained is highly satisfactory, which that does not happen with later films.

5.6 *Torrente 4: Lethal Crisis* (SEGURA 2011)

With the analysis of this film we wanted to check how Spanish cinema reacted to the 3D trend. For this we chose the first movie in Spain to be shot in 3D *Torrente 4: Lethal Crisis*. *Torrente* is a blockbuster, which may explain the financial risk taken for shooting in this expensive format. Santiago Segura was helped by James Cameron on how to go about 3D shooting, and it was his team - Vicen Toto and Dan Venti - who helped with the stereoscopy for *Torrente*, as they had previously done with *Avatar*. Though the stereoscopic effect is quite well achieved, with regard to subtitling it is far from being at the level of its US counterparts. The text is always flat, never enhanced to match depth, without any parallax difference as if it were a traditional 2D movie.

This presents great difficulties in reading subtitles, more so when higher depth as when a greater tunnel effect is appreciated, while subtitles are presented with no depth. Such inversion of perspective logic makes them difficult to follow for more than 5 or 10 minutes without producing a sensation of dizziness and great visual fatigue.

6. Conclusion

Subtitles for 3D content have not become 3D. That is, we have 2D texts superimposed on 3D content. While the superimposing may be more or less dynamic, the 2D image over 3D effect is always present. Except for *Avatar*, all other movies thought of subtitles as a postproduction feature, dealing with them as an alien film element. Much work is needed to generate adequate subtitles for 3D content. When producing feature movies in 3D the aim is to heighten viewer engagement. This ultimate purpose clashes when the 3D movie has to travel to different languages through subtitling, or when the movie is made accessible. As already mentioned by some authors for 2D is more poignant for 3D since "subtitles in a foreign language decrease feelings of spatial presence, transportation, and flow" (WISSMATH ET AL 2009: 115). The 2D subtitle text needs more work and thought to be integrated an artistic feature, and should be the responsibility of the artistic team, away from the postproduction department.

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