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The Influence of 3D Screenings on Presence and Perceived Entertainment

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Abstract

More and more, 3D effects become a part of our daily life, e.g. a lot of people get in contact with 3D technology in the cinema. Taking into account the increasing relevance of this technology, it is important to explore its effects on the viewers and consider its influence on entertainment. To do so, we conducted a field study comparing experiences of 2D and 3D audiences' of the same movie regarding entertainment, feelings after the reception as well as feelings of presence and immersion in a between subjects design (N=53). Results revealed that 3D screenings do neither increase entertainment experience nor positive emotions. Instead, entertainment is best predicted by cognitive immersion which itself is not related to 3D versus 2D presentation. We conclude that joining a 3D screening does not guarantee an entertaining cinema visit.

Keywords---**Presence, Immersion, Entertainment Cinema, 3D- 2D**

1. Introduction

In the beginning of 2010, as an answer to the very successful 3D movies which had aired in cinemas, the first televisions with 3D capabilities hit the market. This is the third wave of 3D movies after the first in 1953-1955 and the rediscovery of this technology in the 1980s. Particularly against the background of rising numbers of 3D movies and new 3D televisions, the question if 3D screenings are more preferable than 2D screenings arises again. What remains to be answered is whether 3D is capable of improving people's daily television experience in the future in the sense of experiencing more enjoyment, as this is the essential characteristic of media entertainment [1]. With new 3D televisions launched, it gets more and more important to determine whether it really enhances our television experience, and therefore represents enrichment in entertainment, or whether it can just be regarded as moneymaking, caused by a temporary fascination of 3D images.

Vorderer et al. [1] postulate that the experience of enjoyment/entertainment is influenced by several variables. On the one hand characteristics of the medium are important: the technology and the content, both which can induce entertainment. Technology refers to technological components of the media presentation, for example screen sizes [2]. Content describes that the presented topic should be meaningful to the recipient. On the other hand Vorderer et al. [1] propose five prerequisites of equal importance from the user's perspective. To experience entertainment, at least one prerequisite has to be fulfilled. The first prerequisite is the media user"s willingness to suffer disbelief. This means, that because narrative stories rarely base on true stories, the user temporarily has to accept the unreal narrative as real. The second factor concerns the user's ability or motivation to feel empathy with the protagonists, determining user's liking or disliking of a character. Related to the concept of empathy, the ability to interrelate with the characters in the sense of parasocial interaction [3] can increase media enjoyment. Further, the user's interest is of importance, because if a user is not interested, it will be hard to entertain him. It is assumed that a specific kind of presentation (2D or 3D) will not be able to compensate missing interest from the user's side. The last factor stated by Vorderer et al. [1] is the "sense of being there" (p.396). According to the authors, this concept has been conceptualized in many ways, e.g. as being involved, immersed, transported, absorbed or present. "Again, without the user's capability and willingness to be present somewhere else and with somebody else, the occurrence of enjoyment or entertainment, or both, is highly unlikely, if not impossible." [1, p.396].

In sum, Vorderer et al. argue that "[t]he media, the technology, and particularly the interaction between the media and its user also determine whether the response will be more or less entertaining." [1, p.398]. This assumption also applies for the sense of being there which is of special interest in the context of 3D screenings. This predisposition may be dependent on different aspects,

such as the user‟s willingness to be present on the one hand and of technological determinants on the other hand.

In this context, Steuer [4] postulates that the feeling of being there is influenced by two technological determinants: interactivity and vividness. Interactivity refers to the possibility to interchange with the medium whereas vividness refers to the amount of sensual information given by the medium.

For instance Bracken [5] found that high definition television compared to standard television increases feelings of being there. Lombard et al. [2] even showed that feelings of enjoyment and involvement grow with greater screen sizes. Also in line with these results, Botta and Bracken [6] found increased feelings of being there in response to greater screen sizes. Furthermore, a result that is most likely to match the technical determinant of 3D screening, is reported by IJsselsteijn et al. [7] who found increased feelings of being there in response to short stereoscopic presentations of a fast rally car ride.

Assuming that 3D screenings provide the opportunity to experience a new or rediscovered way of entertainment, we examine whether 3D screenings increase the feeling of being there and whether this feeling fosters the experience of enjoyment/entertainment [1].

2. Theoretical background

As mentioned earlier, the feeling of being there is conceptualized in manifold ways, for instance as presence, immersion and transportation. All of these conceptualizations try to explain users‟ experiences caused by different media. Nowadays, media like cinema, television and most recent game consoles employ the technology of 3D presentation. Especially in cinema, 3D presentations are suggested to transport recipients into another world, making them forget about reality. This global idea is related to the concepts of transportation, presence and immersion. Transportation is an established concept in the context of narratives; it describes which kinds of narrative structures lead to the "feeling of being „lost‟ in a story [...]" [8, p.312]. Research on transportation focuses on the narrative story rather than on technological circumstances that can increase the feeling of being in the story. In contrast to transportation, presence and immersion take technical determinants like screen sizes into account. We understand recent 3D screenings first and foremost as a revised technological development that provides a good opportunity for research on presence and immersion. Both concepts are widely used and overlap in their psychological definitions. However, since researchers do not yet agree on whether

presence and immersion eventually refer to the same phenomenon, we here use the concepts as different operationalizations of the feeling of being there. To reach at a more detailed understanding, both concepts are outlined in the following.

3. Presence

By now, many definitions of presence have been given that differ in focus. As one of the first researchers, Steuer [4] conceptualized presence "[...] *as the sense of being in an environment*"(p.6). Many perceptual factors contribute to generating this sense, including input from some or all sensory channels, as well as more mindful attentional, perceptual, and other mental processes that assimilate incoming sensory data with current concerns and past experiences [...]." [4, p. 6]. After taking a broad body of literature into account, Lombard and Ditton [2] differentiate six distinct forms of presence. Apart from describing presence as a multi-dimensional concept they conclude that in order to experience presence, the illusion of non-mediation is necessary.

Non-mediation comprises viewers' inability to distinguish between the real (physical) world and the world created by the medium. Lombard and Ditton argue that non- mediation can be achieved when "the medium can appear to be invisible or transparent and function as would a large open window, with the medium user and the medium content (objects and entities) sharing the same physical environment" [9, presence explicated]. In the context of 3D screenings non- mediation is suggested to be obtained by the 3D technology. The technology might create the illusion of a shared physical environment.

Further, Steuer specifies that the experience of presence induced by media depends on its technical characteristics, specifically on the dimensions of vividness and interactivity. Vividness refers to the sensual information richness provided by media, whereas interactivity describes the possibility of interacting with the mediated environment. Furthermore, each dimension is assumed to interact with several others factors. Interactivity is influenced by speed, range and mapping: Speed describes the "[ ] rate at which input can be assimilated into the mediated environment" [4, p.15], while range comprises the number of possibilities to interact with the system/environment. Finally, mapping describes the capability of a system / environment to implement/integrate those actions into a natural manner. But according to Steuer, who states that film screenings in cinemas are technically characterized by low interactivity and high vividness, the latter seems to be more important.

Vividness is predicted by breadth and depth. Breadth refers to the amount of sensual channels which are appealed by the technology, like the visual system, auditory system or haptic systems, whereas depth implies the intensity of appeal in each channel. 2D screenings and 3D screenings neither differ with regard to the interactivity dimension nor to breadth within the vividness dimension. However, the depth of sensory appeal is intensified, because of the stereoscopic information that is additionally provided by the 3D technology [10].

Moreover, IJsselsteijn et al. [11] state that apart from technological determinants user characteristics can influence the experience of presence. They suggest that not only users' age and gender could be of relevance but that the capability of perceiving things in a stereoscopic way or the feeling of getting sick by an environment can alter the experience as well. User characteristics are assumed to be important in the context of 3D screenings, because of the increased amount of sensual information produced by stereoscopy. Further, this increase could provide sickness, for instance eyestrain, caused by a sensory overload or by the 3D glasses.

3.1. Immersion

Similar to the concept of presence, the concept of immersion is widely used and research produced a lot of definitions that focus either on technical or psychological aspects. Slater, Linakis, Usoh, and Kooper [12] state that "[i]mmersion, [...] is therefore an objective description of what any particular system does provide" (p. 3) it "[...] refers to what is, in principle, a quantifiable description of a technology." (p. 3). Lombard and Ditton [9] describe that to measure immersion the number of appealing senses has to be counted first followed by measuring the amount of information which are provided. "Not only immersive virtual reality systems but also simulation rides, IMAX theaters, and even standard movie theaters can be said to immerse the senses of media users" [9, presence as immersion]. We assume that by providing more sensual information in the context of 3D screenings via stereoscopy the level of immersion should increase. Lombard and Ditton's [9] suggestion is very similar to Steuer's vividness dimension. The difference is that Steuer's dimension is related to the feeling of presence whereas Lombard and Ditton's notion refers to an objective characteristic of a system/medium. We suggest that in this case immersion can influence the experience of presence.

Apart from technological definitions of immersion, psychological definitions similar to those of presence are available: "[i]mmersion involves a lack of awareness of time, a loss of awareness of the real world, involvement and a sense of being in the task environment" [13, p.32]. This is in line with the psychological description that the feeling of immersion is accompanied by absorption, involvement, engagement and engrossment [9]. Bente, Krämer, and Petersen [14] add that immersion concerns affective, cognitive and behavioural mechanisms.

The relationship between the concepts of presence and immersion is still subject to debate until today. Referring to immersion, it can be critized that that "[...] sometimes they have been used erroneously to describe the experience of presence" [15, p.374]. Further, immersion is suggested to be one of six distinct forms of immersion [9]. Witmer and Singer [16] define immersion as "[...] a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli experiences" [16, p.227] and continue that experiencing immersion is a necessary precondition for presence. Other research groups use both terms a priori interchangeably, like [17]. Due to this manifold use and comprehension McMahan [18] concludes that "[t]he terms immersion and presence are seen together more and more often, although both have been so loosely defined as to be interchangeable -which they often are." [18, p.68].

3.2. Presence and immersion in the context of 3D screenings

Showing films via 3D is a rediscovered mode of presentation that strives to enhance user's entertainment experience. It is suggested that "[...] each new development in the history of visual media can be viewed as a gradual build up of perceptual cues that simulate natural perception and enhance the experience of presence [...]! [19, p.4]. With the advent of 3D TV research group wondered whether 3D TV, due to its greater depth, which is a sub-dimension of Steuer's vividness, induces feelings of presence, perception of depth and naturalness of depth and whether those aspects correlate [20]. In an experiment by IJsselsteijn et al. [20] participants saw three repetitions of a film clip (each lasting 8 minutes) to assess their experiences separately on each dimension. Experiences were captured continuously by means of a slider. Results revealed that the feelings of depth, realism and presence varied due to the specific condition. Also, presence and perceived depth as well as naturalness of depth and presence were strongly positively correlated. This indicates that indeed the medium's vividness or more specifically depth [4] is related to the feeling of presence.

However, those results do not give evidence for the assumption that 3D screenings will lead to increased presence and increased enjoyment. A more recent study focused on the gratifications provided through 3D screenings in cinema [21]. Participants were asked to rate their expectations and experiences before and after the screening; for instance users" emotions (before and after the screening) and feelings of presence (after the screening) were assessed. Results revealed that participants experienced presence during the screening. Moreover, the effect was moderated by gender, that way that women in general experienced more presence than men (e.g. women had a greater feeling of being in the movie). However, as the study was merely designed to examine the person-specific determinants of presence experience, it did not compare 3D and 2D screenings.

Therefore, it is not clear which aspects in detail evoked feelings of presence. In line with Lombard et al. [2] the feelings of presence in the study by Sobieraj et al. [21] could also have been evoked by the large screen size in the cinema. Lombard et al. [2] found that participants reported a greater sense of enjoyment, involvement and physical movement when watching scenes on a greater screen than compared to a small TV screen. Accordingly, Botta and Bracken [6] showed that participants experienced more presence while watching action movies on a greater screen size.

However, it is also reported that the enhanced feelings of presence are predominantly caused by the emotional content of the stimulus material [15]. The research group demonstrated that when watching neutral stimulus material feelings of presence strongly depend on technological circumstances (e.g., larger screen sizes), but when stimulus material is emotional the technical determinants do not have an influence on presence any longer.

In the present study, we want to investigate whether 3D screenings can increase feelings of being there compared to 2D screenings, an aspect not covered in previous research. In doing so, we will use questionnaires originally developed to measure feelings of presence. Additionally, we will use a questionnaire developed to assess perceived immersion. As a result, we can give further indication whether the concepts are distinct dimensions of the feeling of being there. Furthermore, referring to Vorderer et al. [1], we want to examine whether the experience of entertainment in 3D screenings is mediated by the feeling of being there and which variables determine a) the feelings of presence and immersion and b) the experience of entertainment/enjoyment.

4. Method

4.1. Independent variables

To investigate effects of 3D screenings, we decided to interview moviegoers who watched the same film in either a 2D or 3D screening.

4.2. Measurements

To assess whether 3D screenings increase the experience of entertainment, we assessed answers to the following four self-constructed items: "How much did the movie meet your expectations?", "How much did you enjoy the story?", "How much did you enjoy seeing the movie?", "How much would you like to see the movie again?". Participants indicated their answers on a 5-point Likert scale (1= not at all the case; 5= very much the case) and the entertainment scale obtained good reliability (α=.805, N = 53).

Moreover, we used the PANAS Scale [23] to measure emotional states during the movie in a retrospective way. This allowed us to investigate whether viewers felt more positive or even more negative after the 3D screening.

To examine whether the experience of entertainment and the report of positive feelings are moderated by the feelings of being there, we decided to assess the feeling by using a questionnaire developed to measure the concept of presence. Additionally, we used a second questionnaire constructed to capture the psychological concept of immersion. Due to the fact that there is a huge amount of presence questionnaires, we adapted the questionnaire most appropriate to measure presence in the context of 3D screenings and consequently used the items provided by Kim and Biocca [24]. These were originally developed to measure presence in the context of broadcastings. Example items we used are: "When the screening ended, I felt like I came back to the „real world" after a journey", "The movie came to me and created a new world for me, and the world suddenly disappeared when the movie ended". Additionally, we included one adapted item of the Hendrix and Barfield [25] questionnaire: "Did you feel you could reach into the virtual environment and grasp an object?". Those nine items obtained a good scale reliability (α=.845, N= 53).

To capture the feeling of immersion we used a very recent questionnaire on immersion developed by Jennett et al. [13] to assess the feeling in the context of gaming. We adapted 14 items of the questionnaire and added the following two items: "How much were you aware of wearing 3D glasses during the movie?" and "How much

did you enjoy graphics and pictures created by the movie". In a factor analysis we found a three factor solution based on nine items. According to the constituting items, we labelled the first factor "affective immersion" (α=.796), the second "cognitive immersion" (α=.700) and the third "real-world-connectivity" (α=.713; for factor loadings see Table 1).

To capture a (potentially) negative effect of the 3D screening, we formed three additional self-constructed items: "How strenuous was the screening for you?", "How much did the screening strain your eyes?" and "How much did the screening tire you?". Due to the small number of items, the scale labeled as strenuousness scale obtained a reliability of α=.600 (N= 52).

In line with earlier studies and former findings [e.g.

Table1

Factor Loadings Based on a Principal Components Analysis with Varimax Rotation for 10 Items Regarding Immersion (N=53)

	Affective Immersion	Cognitive Immersion	Real-world-connectivity
To what extent did you feel that the movie was something you were experiencing, rather than something you were just doing?	**.792**	.018	-.184
To what extent did you feel emotionally attached to the movie?	**.790**	.158	.123
To what extent did you feel emotionally attached to the actor?	.754	.083	-0.1
To what extent did you feel you were focused on the movie?	-0.20	**.755**	.264
To what extent did the movie hold your attention?	**.043**	**.742**	-.229
To what extent did you forget about everyday concerns?	.196	**.742**	.264
To what extent did you lose track of time?	.301	**.651**	-.214
To what extent were you aware of yourself in your surroundings?	.242	-.145	.876
To what extent were you aware of being in the real world during the movie?	-.220	.163	**.806**

Note. Factor loadings > .40 are in boldface.

11, 9, 21] we additionally assessed the following user characteristics: frequency of movie visits, frequency of movie watching, gender and age. Additionally, we collected several facts about the specific viewing situation: (1) seating position, because in 3D screenings, effects are constructed to obtain best appeal in a seat in the cinema centre, (2) the number of accompanying people, and (3) how much participants paid for their ticket. Additionally, we asked the participants joining the 3D screening whether this was their first time watching a 3D movie and how many 3D screenings participants had already joined.

4.3. Participants

53 participants aged between 12 and 50 years (M= 26.23; SD= 10.74) completed the questionnaires. 23 of them were in the 2D condition, 30 filled out the 3D questionnaire. 20 (35%) male and 33 (65%) female participants took part. Participants visit movies quite often per year (M= 9.34; SD= 9.16) and watch movies either in cinema or at home nearly 7 times a month (M = 6.53; SD= 7.74). 2D and 3D viewers do not significantly differ in their movie watching behavior.

On average, they paid M= 8.59 Euro (SD= 4.50) for their ticket and would maximally pay M= 8.73 (SD= 3.29). Participants in the 3D condition have already seen M= 3.60 (SD= 2.51) 3D screenings on average. However, 5 participants stated that they visited a 3D screening for the first time. None of the participants visited the movies alone, 16 persons answered to be accompanied by their partner, 23 by their friends and 21 by family members (multiple answers were possible). Most moviegoers were seated in the centre of the cinema hall (45.3 %), followed by a slightly off-centred position (43.4%) and just a few sat heavily off-centred (11.3%). 3D viewers mostly were seated in the centre (53.3%), followed by a slightly off centred seating (40.0%) and a heavily off-centre seat (6.7%).

4.4. Procedure

The participants filled in the questionnaire of their condition after the screening of either the 2D or 3D version of Shrek Forever After. Filling out the questionnaire was voluntary and there was no incentive. Volunteers provided information on all moderator and dependent variables.

5. Results

The statistical analyses were realized with PASW Statistics 18. In order to test whether 3D screenings alter the extent did you feeling of being there we conducted a MANOVA viewing condition as independent variable and presence, affective immersion, cognitive immersion and real-world- connectivity as dependent variables. The results show a significant main effect for cognitive immersion (F(1, 47) = 6.39, p < .050, η2p = .120). Counter-intuitively, 3D viewers were less cognitively immersed (M= -0.25, SD= 1.02) than the 2D viewers (M= 0.42, SD= 0.77). Furthermore we tested whether the feeling of being there depends of individual user characteristics (gender, age, frequency of movie watching, frequency of cinema visits), but did not find any significant effects.

To analyze whether the 3D screening evoke eyestrain a one-way ANOVA with viewing condition as independent variable and the strenuous scale as dependent variable was conducted. The analysis showed a marginal significant effect (F(1, 52) = 3.79, p < .10, η2p = .070): 3D viewers were more stressed (M= 5.97; SD= 2.85) than 2D viewers (M= 4.65; SD= 1.72). To exclude the possibility that strenuousness inhibits increased feelings of presence and immersion, we repeated the former MANOVA and added the strenuousness scale as a covariate, but the covariate did not significantly influence the dependent variables.

Finally, we wanted to find out whether the overall entertainment experience was enriched by the 3D screening. Thus, we calculated a one-way ANOVA with the entertainment scale as dependent variable and viewing condition as independent variable. Contrary to expectations we found that the 3D viewers were less entertained (F(1, 51) = 5.39, p < .024, η2p = .096, M= 16.40; SD= 2.87) than the 2D viewers (M= 4.65; SD= 1.72). Referring to Vorderer et al. [1] who state that the experience of enjoyment depends on the feelings of being there we conducted an ANCOVA by adding presence scale, affective immersion, cognitive immersion and real-world-connectivity as covariates. But none of the covariates had a significant effect on the entertaining experience. Including the strenuousness scale, age, the amount of watched movies per month, frequency of cinema visits and the paid ticket price exploratory as covariates did not alter entertainment, too. Additionally we explored whether gender has an impact on entertainment by calculating a one-way ANOVA with gender and viewing condition as independent variables

and the entertainment scale as dependent variable. Results did not reveal significant effects.

To examine which variables can predict entertainment experience as well as positive and negative feelings we conducted multiple regression analyses. Therefore we employed the stepwise method and used entertainment as independent variable and viewing condition, presence scale, cognitive immersion, affective immersion, real-world- connectivity and the seriousness scale as predictors. Regression analysis excluded all predictors of the model except cognitive immersion. Therefore cognitive immersion can moderately predict the experience of entertainment (R2 = .13, F(1,47) = 6.98, p<.05, 95% CI [.24, 1.74]). The more viewers felt cognitively immersed the more did the experience entertainment (β = .36, p= .01).

To determine whether at least 3D screenings provide gratification by enhanced positive feelings compared to the usual 2D screenings, a MANOVA with viewing condition as independent variable and both PANAS Subscales (positive affect and negative affect) was conducted. The results did not show any significant effect; 3D viewers did not feel better or worse due to the 3D screening.

In order to determine which variables influence the emotional experience we conducted MANOVAs by adding the former used covariates into the analysis. Analyze did not reveal a simple effect of viewing condition, but revealed a marginal significant influence of affective immersion on the Positive Affect Subscale (F(1, 36) = 3.66, p < .10, η2p = .092) as well as cognitive immersion (F(1, 36) = 3.13, p < .10, η2p= .080). Moreover the covariates the amount of watched movies per month, frequency of cinema visits and the paid ticket price did not influenced emotions, but age did. So age influenced the Negative Affect Subscale (F(1, 36) = 5.11, p<.05, η2 = .124) and the Positive Affect Subscale (F(1, 36) = 3.93, p < .10, η p = .098) marginally.

Conducting a MANOVA with both PANAS Subscales as dependent variables and gender and viewing condition as independent variables ruled out that gender did not have an influence on emotions, too.

Furthermore, we investigated whether emotional states after the screening are predicted by viewing condition, presence scale, cognitive immersion, affective immersion, real-world-connectivity and the seriousness scale. Thus we conducted a stepwise multiple regression analysis with the Positive Affect Subscale as dependent variable and viewing condition, presence scale, cognitive immersion, affective immersion, real-world-connectivity, the strenuousness scale and additionally age as predictors.

Age was included because it turned significant as a covariate. We found that age (β = - .34, p= .05) and affective immersion can moderately predict positive feelings (β = .33, p= .05, see table 2). So the younger viewers are the more positive will they feel after the screening. Additionally, the more viewers are affectively immersed the more positive feelings will be evoked. None of the other predictors fit in the model.

Accordingly, we realized a stepwise multiple regression analysis to examine which variables predict negative emotions best, by using the same predictors. Analyzes showed that age (β = -.37, p= .05) and cognitive immersion can moderately predict negative emotions (β = -.30, p= .05, see table 3) - all other potential predictors were excluded. The younger viewers are the more negative emotions are experienced. Further the less viewers are cognitively immersed the more negative emotions will be experienced.

6. Discussion

In the current study we wanted to examine whether 3D screenings enhance the experience of entertainment by increasing feelings of presence and immersion. Therefore we compared the impression 2D and 3D audiences formed of the same movie. Analyses did not show any indication that the 3D screening enriches entertainment.

Table 2 Predictors of the PANAS Subscale Positive Affect

Variable	Model 1 B	Model 2 B	95% CI
		Positive Feelings	
Constant	34.84**	35.44**	[29.84, 41.03]
Age	-.14*	-.25*	[-.45, .03]
Affective Immersion		2.37*	[.30, 4.45]
R²	.11*	.22*	
F	5.09*	5.50*	
ΔR²		.11	
ΔF		5.35*	

Note. N= 47. CI= confidence interval. *p<.05. ** p<.01

Table 3
Predictors of the PANAS Subscale Negative Affect

Variable	Model 1 B	Model 2 B	95% CI
		Negative Feelings	
Constant	16.33**	16.98**	[13.50, 20.47]
Age	-.24*	-.16*	[-.29, -.03]
Affective Immersion		-1.48*	[-2.93, -.04]
R²	.10*	.18*	
F	4.58*	4.61*	
ΔR²		.09	
ΔF		4.28	

Note. N= 47. CI= confidence interval. *p<.05. ** p<.01

Alternatively we investigated whether at least positive feelings were enhanced due to the 3D screening. Again, the screening did not influence whether positive feelings occurred.

Instead, analyses revealed that 3D viewers felt less entertained compared to 2D viewers. One explanation for this as dependent variables and gender and viewing condition as independent variables ruled out that gender did not have an influence on emotions, too.
might be that viewers felt less present and immersed in the movie as this is an important aspect of entertainment experiences (see [1]). And indeed, the results indicate that at least cognitive immersion is influenced by the screening form. Here, 2D viewers report to be more cognitively immersed than 3D viewers. They paid more attention to the movie, forgot about their everyday concerns and lost track of time. However, this is, again, contrary to our original assumptions, since we expected, based on the work of Steuer [4] that 3D screenings might increase the feelings of presence and immersion because of its enhanced depth of provided sensory information. Furthermore, the results of IJsselsteijn et al. [20] and Sobieraj et al. [21] suggest that 3D TV and 3D cinema might be beneficial for presence and immersion. The current data, on the contrary, may lead to the conclusion that the provided depth cues in 3D are not necessarily and automatically more successful in creating the illusion of non- mediation. This might be explained by the notion that the 3D technology shifts attention from the movie to other factors. Viewers might concentrate on the 3D effects so much that it inhibits the process of immersion. So viewing movies in a classical mode of presentation facilitates the process of immersion due to the fact that this is a well-known mode of reception. Thus the familiarity might lead to a relaxation, which provides the opportunity to immerse into the movie in a better way. Only future studies will be able to test this assumption since the novelty effect of 3D movies has to wear off before this can be demonstrated. However, the result that number of previously viewed 3D movies did not influence results as a covariate makes it seem unlikely that this is the crucial point (although more viewings than currently possible might be necessary to sufficiently habituate to the technology).

While MANOVAS with presence and immersion factors as covariates do not confirm our interpretation that a lack of immersion might have led to less entertainment, regression analyses clearly do. To explore which variables predict the experience of entertainment, we conducted a regression analysis and found that the only variable which predicts entertainment is cognitive immersion, which is in

line with assumptions by Vorderer et al. [1]. The more viewers shift attention to the movie and lose track of time, the more they will be entertained.

Similar to the results concerning 3D and entertainment, analyses revealed that emotions were not affected by viewing condition. Watching a movie in 3D does not provide benefits by facilitating positive emotions. By conducting a regression analyses we neither found that 3D screenings predicted whether viewers will experience positive feelings nor negative feelings. Again immersion is the most important influencing variable. Positive emotions were predicted by affective immersion and viewer‟s age. So the more viewers are emotionally attached by the movie and the actor, the more positive emotions will be experienced. Negative emotions instead are predicted by cognitive immersion. The less viewers are focused on the movie, the more negative emotion will be triggered.

The findings that 2D screenings enrich the feeling of being there and entertainment rather than 3D screening might lead to the assumption that due to the 3D glasses eyestrain was caused. The increased eyestrain in turn might inhibit feelings of entertainment and being there. Although analyses showed a marginally effect of being more strained in the 3D condition than in the 2D condition, covariance and regression analyses showed that it did not influence the feeling of being there as well as entertainment. Therefore it can be concluded that wearing 3D glasses and perceiving stereoscopic information is more stressful than watching movies in the classical way, but the strain does not change the feeling of being there and entertainment in a negative direction. Generally our finding of higher stress is in line with the idea that media form can evoke negative effects, for instance eyestrain induced by a stereoscopic perspective or the weight of a head-mounted display [11]. However, it has to be acknowledged that in this specific situation the report of the viewers might have been affected by demand characteristics. As a moderating variable in future studies we plan to include a question on whether participants wear spectacles in order to check what aspects influence the experience of stress.

Unexpectedly we found that viewer's age predicted positive as well as negative emotions. This indicates that independent of feelings‟ valence; younger viewers were emotionally more affected than older viewers. This can be due to the fact that the movie in this study was a funny animated movie foremost created to appeal to families.

This interpretation is related to one of the limitations of this study. The specific movie we selected might have influenced results in two ways, first it might not have addressed the whole audience in a similar way and second the movie might not have provided appropriate 3D effects. The film Shrek Forever After leads to higher intensities of emotions in younger viewers, which can be caused by higher levels of interest and empathy with the specific movie characters. Empathy for instance is more easily experienced to the characters like Shrek or Princess Fiona by the younger audiences. Furthermore the content of the movie - the story- can alter experience of entertainment. It seems also possible that the content was too banal, because it was first of all a funny animation movie and thus did not address all viewers in general. Another sample of viewers for instance fans of action movies might provide other results concerning emotions, entertainment as well as presence and immersion. Upcoming studies should consider more than one movie - at best different genres- to ensure that the content addresses most of the viewers. In future studies, viewers should also be randomly distributed into viewing conditions to achieve a higher internal validity. In our design expectations as well as mechanisms of cognitive dissonance might have led to the lack of significant results.

Additionally the interest of watching the movie should be assessed, because although adults were joining the movie we suggest that they rather accompanied their children to the movie [27]. When parents choose a movie independently of their children they might show a different movie preference. Not watching a first choice movie might inhibit feelings of being there, entertainment and emotions in general. Another possibility is that parents paid so much attention to their children during the screening that they were not capable of experiencing entertainment. This, however, cannot explain why 2D screenings were experienced as more entertaining than 3D screenings but can only account for non-significant results that might have been caused by bottom effects.

It can be argued that due to the emotional content of the movie the technology of 3D screening did not have a beneficial impact on the feelings of presence [15]. In their study Baños et al. [15] did not find any increase of presence caused by a bigger screen size when stimulus material was emotional, but when stimulus material was neutral the large screen enhanced feelings of presence. Employing different levels of emotional content can help to examine whether presence and immersion in the context of 3D screening do just depend on the emotional content of the movie or at which point 3D screenings can alter the feeling.

The second point concerning the selected movies is the quality [26] and quantity of the presented 3D effects.

3D movies differ considerably in their 3D effects. Some movies present numerous 3D effects like Tron Legacy whereas others present fewer effects like Clash of the Titan. Also, there are qualitative differences in the effects that are due to the mode of cinematography. There are several ways to create 3D movies: Some like Shrek-Forever After are developed by constructing 3D animations, some were shot from the beginning with 3D cameras like Avatar and others were filmed with normal cameras like Clash of the Titans and afterwards revised to show 3D effects. Probably the mode of producing 3D effects can also have an effect on entertainment, emotion and feelings of being there. To conclude there are limiting points due to the content to the movie as well as the technical realization of given 3D effects which can influence the cinema experience.

Another limitation refers to the sample of the study: Participants were not randomly distributed to one viewing condition but rather made a conscious decision previously. For instance Jurnet, Beciu, and Maldonado [22] found that feelings of presence vary across individuals in the context of virtual environments depending on their level of introversion. Transferring this result to the current study it is possible that participants in both viewing conditions differ in several variables which impact the feeling of being there, entertainment and emotions. Furthermore the small sample size makes it hard to form assumptions resulting from the regression analyses with statistical power. To conduct a more powerful regression analysis in the future, a larger sample is necessary. For each included predictor the sample size enhances by ten to 15 participants [28]. Thus to make valid assumptions with several predictors sample size should span 100 to 150 participants. Although sample size concerning regression analyses was critical it was sufficient to conduct powerful analyses of variance.

By focusing on the 3D technology, we found in summary that this new mode of presentation is not a warranty for an entertaining cinema visit as might be suggested by the intensified depth cues or just the higher ticket price. We conclude that 3D screenings give the opportunity to conduct more research on presence and immersion as well as on entertainment and emotions, although it seems that 2D screening currently provide more benefits to the audience. Referring to the familiarity of reception it can be fruitful to investigate entertainment when 3D TV comes to the market and viewers get used to this form of reception.

Conclusions

We conducted a study to investigate whether 3D screenings enrich the feeling of being there, entertainment and emotional experience. We found that consistently 2D screenings provide better experience than 3D screenings. A possible explanation for the benefits of 2D screening is the familiarity of viewing condition. Familiarity might go along with higher relaxation what leaves enough cognitive resources to concentrate on the movie. To manifest this assumption further research on familiarity and viewing condition should be conducted. Another suggestion is that the current 3D movies do not provide quantitatively as well as qualitatively sufficient 3D effects. In sum we found that 3D screenings do not predict the feeling of being there, nor entertainment or emotions. We conclude that 3D screening underachieve viewers" expectations.

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