COLOR AND EMOTION IN MOVIES

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Abstract

Colors are known to spark strong emotions by way of their symbolism. This connection between color and emotion exists across cultures and in multiple forms of visual communication. Movie directors and cinematographers oftentimes conform to known color and emotion conventions to affect the audience's emotional experience. At the same time, others intentionally overlook these conventions by associating particular colors to scenes in an unconventional (cinematographic) way. 8 movie clips (4 with conventional colors and 4 with cinematographic colors) evenly spread out across emotion valence were shown to 42 participants. An emotion questionnaire (PANAS-SF) was administered to measure the emotional impact of each clip. The results of this experiment showed that conventional colors spark more intense emotions than cinematographic colors. Conventional colors spark more intense negative emotions and more intense positive emotions as opposed to cinematographic colors. The findings of this research experiment underscore three vital points: emotions are situational (i.e. they are dependent on the emotional context); emotions arise from the brain processing conscious experiences and translating them into feelings; and conscious and unconscious color symbolism plays an important role in the type of emotion that arises.

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Table of Contents

Introduction

Colors are universally known to affect the emotional and ensuing physical attitudes of humans, owing to the fact that they represent a source of information. This emotional attitude encompasses a wide range of positive and negative emotions. Alternatively stated, colors can be mapped to emotions considering that they consciously or unconsciously influence how visual experiences are interpreted (Kaya & Epps, 2004; 2015; Nijdam, 2005).

The connection between color and emotion is situational and dependent on the context. There are cultural elements that come into play and affect and change the meanings associated with a color, including color preferences and symbolism. Despite these cultural differences, there are plenty of colors that have similar emotional resonances across populations (Nijdam, 2005; Kaya & Epps, 2004). These are known as conventional colors.

As affirmed by Baker (2016) in a journalistic, opinionated internet magazine that centers on examining every aspect of movie making, including color psychology, movie directors and cinematographers have been conforming to these known color and emotion conventions to create the intended emotional experience within a diverse and ever-growing audience.

An essential part of an engaging movie experience is cinematic reality: the creation of a reality that is more purposeful, engaging, and thrilling than every-day life. Details like color are exaggerated and given meaning to make the movie emotionally riveting. Directors create cinematic reality throughout a broad spectrum of genres and sub-genres, going from comedy, thriller, romance, all the way to science fiction. On top of that, every culture has a distinctive approach at creating cinematic reality and affecting the audience's emotional attitudes: Bollywood's kaleidoscopic musicals and Japan's grainy, folklore-based horror movies are perfect examples (Benovsky, 2017).

The universal appeal of movies also stems from the audience's cognitive ability to emotionally connect with the characters. This is known as the theory of mind and consists of the audience taking on the characters' perspectives and understanding their mental states: their desires, beliefs, intentions, and objectives. The emotional pull of movies can thereby be ascribed to empathy (Gallagher & Frith, 2003).

An array of subtle cues needs to come into play in order to spark an emotional stimulation, to foster empathy, and to create an engaging cinematic reality. Color is a crucial one of those cues. Widely accepted conventions somewhat regulate the way directors and cinematographers use color in movies, given the knowledge that there is a connection between particular colors and particular emotions. At the same time, other directors have intentionally overlooked these conventions by associating specific emotions to unconventional (cinematographic) colors. The question is, what effect does this cinematographic use of color have on the emotional experience of the audience? This question is the topic of this thesis. Does the conventional use of colors create stronger emotions in the audience than the cinematographic use of colors?

In order to answer that question, this study will measure the difference in emotional intensity and consistency between the conventional use and the cinematographic use of color in movies. Below, the relevant literature on this topic is discussed.

Literature Review

Emotions

Emotions are intense sensations that are sparked by real or imagined experiences. They are cognitive processes that happen in response to a situation and that are followed by bodily reactions. The brain identifies and interprets a visual experience and subsequently releases stress hormones like cortisol and adrenaline if the experience is negative, and oxytocin, dopamine, and serotonin if the experience is positive. These brain signals are followed by a physical response or an impulse to react (Frijda, 1986; Wei, Dimitrova & Chang, 2004).

An infinite number of emotions exist but they all originate from and are associated with eight primary mood types (i.e., basic emotions): anger, fear, joy, sorrow, acceptance, rejection, surprise, and expectancy (Thanopulos, 2009; Wei, Dimitrova & Chang, 2004). Complex emotions like euphoria, love, melancholy, and tranquility are a combination of these basic emotions, along with simple or more intricate cognitive processes. By way of illustration, a negative emotion like dissatisfaction can be defined as a combination of anger and the assumption that no resolution to a problem exists (Burton, 2016).

An additional theoretical approach affirms that emotional experiences are scattered on a three-dimensional model that consists of three axes (also known as intensity dimensions): arousal, valence, and approach/avoidance motivations (Feltman & Elliot, 2012; Mauss & Robinson, 2009). Arousal indicates how calm (low) or exciting (high) an emotion is, valence distinguishes between the emotion's positive and negative affectivity, and approach-avoidance underscores whether there is a wish to come closer or to move away (i.e. the directionality of the behavior). Emotions that motivate approach have a tendency to pull the subject towards the emotion-sparking stimuli. Love is an approach-motivating emotion. By contrast, emotions that motivate avoidance either push the

subject away or keep them at a distance from the emotion-sparking stimuli. Fear is an avoidance-motivating emotion. Put differently, emotions are distributed on a continuum that goes from calmness all the way to excitement, in a positive or a negative way, and diverge in their inherent attraction or aversion. For instance, serenity is an emotion with low arousal, positive valence, and an approach motivation, as opposed to fear, which is an emotion with a high arousal, negative valence, and an avoidance motivation. This underscores how emotions with a positive valence tend to provoke an approaching behavior, while emotions with a negative valence commonly prompt an avoiding behavior, highlighting the consequentiality of valence in this whole paradigm.

Emotions are multi-layered and nuanced phenomena comprising a wide range of measurable reactions: behavioral, expressive, physiological, and subjective feelings (Mauss & Robinson, 2009). There are numerous methods used to measure these reactions, including pupillometry (pupil dilation), electrodermal activity (changes in sweat gland activity), electrocardiography (the electrical activity of the heartbeat), electroencephalography (the electrical activity of the brain), and facial expressions (for instance, smiling).

Other classifications of emotions, in addition to the eight basic types along with the three intensity dimensions, are that emotions can be primary and secondary (Christensen, 2010), or innate and learned (Simon-Thomas, 2017). Primary emotions are reactions to an experience, while secondary emotions are sentiments about the emotion itself. Serenity is a primary emotion, but serenity about being in love (in other words feeling at peace as a result of being in love with someone) is a secondary emotion. This goes to show that secondary emotions complexify and intensify primary emotions. Innate emotions are embedded into the brain's subcortical circuits, making them automatic and comparable across populations. They consist of anger, fear, sadness, anticipation, surprise, joy, and trust. Conversely, learned emotions are the product of the social environment an individual is raised in: his/her past experiences, expectations, and reasoning. As a

result, the way these learned emotions are expressed diverges from person to person. They include, inter alia, emotions like shame, pride, and relief (Becker-Asano & Wachsmuth, 2008).

Emotions are a complex phenomena as shown by new research conducted by New York University professor Joseph LeDoux and City University of New York professor Richard Brown in 2017 who concluded that emotions are thought processes and states of mind resulting from conscious experiences and the ensuing gathering of information (LeDoux & Brown, 2017). Emotions arise from the brain processing conscious experiences and translating them into feelings, as opposed to just being innately programmed or embedded in the brain.

In addition, according to Taylor (2009), an emotional reaction lasts for only 90 seconds. These 90 seconds correspond to a chemical process taking place inside the body following a conscious experience. Emotions that exceed 90 seconds enter an emotional loop as a consequence of the brain deciding to prolong them.

Colors

Light is composed of different colored wavelengths that are absorbed by objects and reflected back to the eyes. The color of the wavelength comes down to its actual length: violet has the shortest wavelength, while red has the longest. The specific color of an object depends on which wavelengths it absorbs and which wavelengths it reflects. Black-colored objects appear black owing to the fact that they absorb all wavelengths and reflect none, while white-colored objects appear white given the fact that they reflect all wavelengths (What is Color, 2004[1]).

Color is a combination of three interdependent chromatic components: hue, saturation, and value. Hue is the dominant wavelength (expressed as a number from 0 to 360 degrees), saturation is its brilliance and intensity (the purity of the hue), and value is its intensity in terms of lightness

[1] https://www.nasa.gov/audience/forstudents/k-4/home/F_What_is_Color.html

or darkness. Changing one or all three of these elements creates a new color. For instance, lowering the saturation of red can move it into the pink areas of the color spectrum (Bear, 2019).

The consequentiality of color is applicable to everyday life and to multiple forms of visual communications like branding and moviemaking. This arises from the fact that specific colors are intentionally chosen to communicate a message and to spark the desired emotional experience. Color selection in media goes far beyond aesthetics, considering that it influences the way in which humans interpret and respond to a visual experience. It has the power to affect emotional and physical attitudes. Considering that there are plenty of colors with similar emotional resonances across cultures and societies, it is possible to affirm that there are universally accepted color and emotion conventions (Kennedy, 2014; Elliot & Maier, 2014; Nijdam, 2005).

Aligning the use of color with these universal conventions is also highly desirable since purchase decisions, customer perceptions, and 90% of snap judgements are based on color and its appropriateness to the product. Positive emotional experiences are sparked when the color fits the product (Ciotti, 2018).

Color and Emotion

Strong emotions originate from visual experiences (Baumgartner, Esslen, & Jäncke, 2006; Suk & Irtel, 2009). A connection exists between what is seen and the ensuing emotion that is felt, and color plays a paramount role, considering that it brings certain emotions to the surface, as opposed to its being used solely for aesthetic purposes. This visible connection is supported by prior neurophysiological research revealing the strong link between affective images and the emotional experience that follows.

Kaya and Epps (2004) studied the relationship between colors and emotions. They showed that colors convey emotions on account of the fact that they are associated with objects, things, and physical spaces. These associations seem conventionalized. By way of illustration, yellow is associated with the sun and thereby sparks optimism and euphoria. Blue is linked to the vast ocean and to the night sky, and communicates serenity, solitude, and sadness. The positive valence of blue (i.e., serenity) explains why hospital walls are commonly painted in blue to soothe patients. Red draws a parallel with blood, fire, and romance, resulting in emotions like fear, love, and desire. This is apparent with the universality of stop signs in red and with red being the color of Valentine's Day. White sparks emotions like hope and innocence, and is therefore associated with weddings and doves. And since black is related to power and death, it is commonly known to impart emotions like comfort and sorrow. The foregoing color and emotion associations are undoubtedly just a few examples among many.

A perfect and contemporary example that illustrates how colors are used to sway perceptions and emotions is McDonald's recent logo change. The American fast food company's decision to change the color of its logo from red to green was intentional, considering that green's association with nature sparks feelings of healthiness and portrays the company as eco-friendly (Inskeep, 2009).

A single color can be associated with both positive and negative emotions (Ferreira, 2019; Saito, 1996). It can act on varying levels of a continuum of emotional states and may as a result not be attached to one distinct emotion. A case in point: blue is known to communicate positive emotions like purity and youth, but it can also spark negative emotions like solitude and sadness. Grey sparks serenity, but also sadness and depression. The same is true with red as it communicates contrasting emotions like love and fear. Conversely, a single emotion can be

sparked by a multitude of colors. Serenity can be sparked by both blue and green, love can be expressed by both pink and red, and happiness can be elicited by both yellow and orange.

The Conventional Use of Color in Movies. The strong connection between color and emotion is also applicable to movies. Movie directors and cinematographers choose specific colors based on the emotions they want to spark within their audience (Baker, 2016). Colors have known ideas and meanings associated with them that allow directors to set the mood and create an atmosphere (e.g. melancholic, romantic, idyllic, dreamy). These associations provide subtext and additional information about the scene and about the characters without an actor having to say a single word. Considering that it adds additional layers of meaning to a scene and can accentuate key details (e.g. plot devices), colors are a subtle way to affect the emotional resonance of a scene (Landau, 2014). For these reasons, much like other forms of visual communications, colors are not solely intended to create visual pleasure but are also used to manipulate emotions, both consciously and unconsciously.

The following examples underscore the consequential role of conventional colors in movies. They highlight how colors allow movie directors and cinematographers to manipulate the audience's emotions and as a result to create a cinematic reality and a memorable movie experience (Mascelli, 1965). This goes to show that the universal appeal of movies stems not only from the quality and strength of the screenplay and its cinematic interpretation (from script to screen), but also from its purposeful use of color.

The intentional use of specific colors is evident and consistent throughout the movie Moonlight (2016). Pink represents maternal love, blue conveys youth, and black imparts feelings of power and responsibility (Moakley, 2017). Even though this color examination comes from

journalistic analysis and opinion, they were selected to illustrate this point owing to the fact that they are all consistent with scientific insights that show how these colors are widely known to elicit similar emotions. See Figures 1 and 2 for examples.

Figure 1 A still from Moonlight directed by Barry Jenkins (2017). Pink represents Paula's maternal love (Moakley, 2017).

Figure 2 A still from Moonlight (2017). Red sparks love, while the protagonist's black colored durag and darker clothes indicate power and responsibility (Moakley, 2017).

Colors in movies also act on varying levels of a continuum of emotional states. Depending on the emotional context, a single color can spark both a positive or a negative emotion. Positive emotions like youth and innocence are communicated in the coming-of-age movie Moonlight via the color blue. In contrast, negative emotions like isolation and danger are evoked by using blue in the crime movie Only God Forgives (see Figures 3 and 4). This goes to show how context (i.e. what is actually going on in the scene) affects how particular colors exert an influence on behaviors and emotions. Nonetheless, on account of the fact that an infinite number of emotions exist, just because a single color can spark both a positive and a negative emotion does not imply that it is mapped (i.e. connected) to every negative and every positive emotion. By way of illustration, just because blue can elicit a negative emotion like danger does not automatically mean that it also sparks another negative emotion like vertigo (Kaya & Epps, 2004; Baker, 2016; Zhang, Liu, An, Yang, & Wang, 2015).

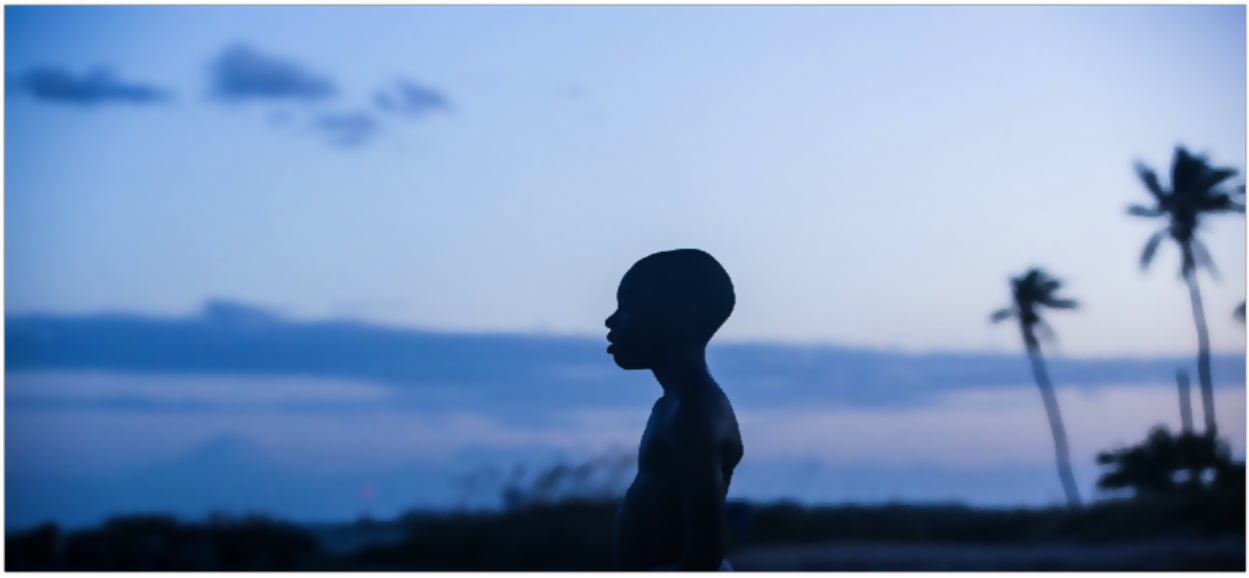

Figure 3 A still from Moonlight (2017). Blue communicates positive emotions like youth and innocence (Moakley, 2017).

Figure 4 A still from Only God Forgives, directed by Nicolas Winding Refn (2013). Blue conveys negative emotions like isolation and danger (Baker, 2016).

Positive emotions like love, compassion and optimism are conveyed by the color red in the romance movie Her, while negative emotions like hostility and imminent death are sparked by the same color in the epic science fiction movie 2001: A Space Odyssey (Baker, 2016). See Figures 5 and 6.

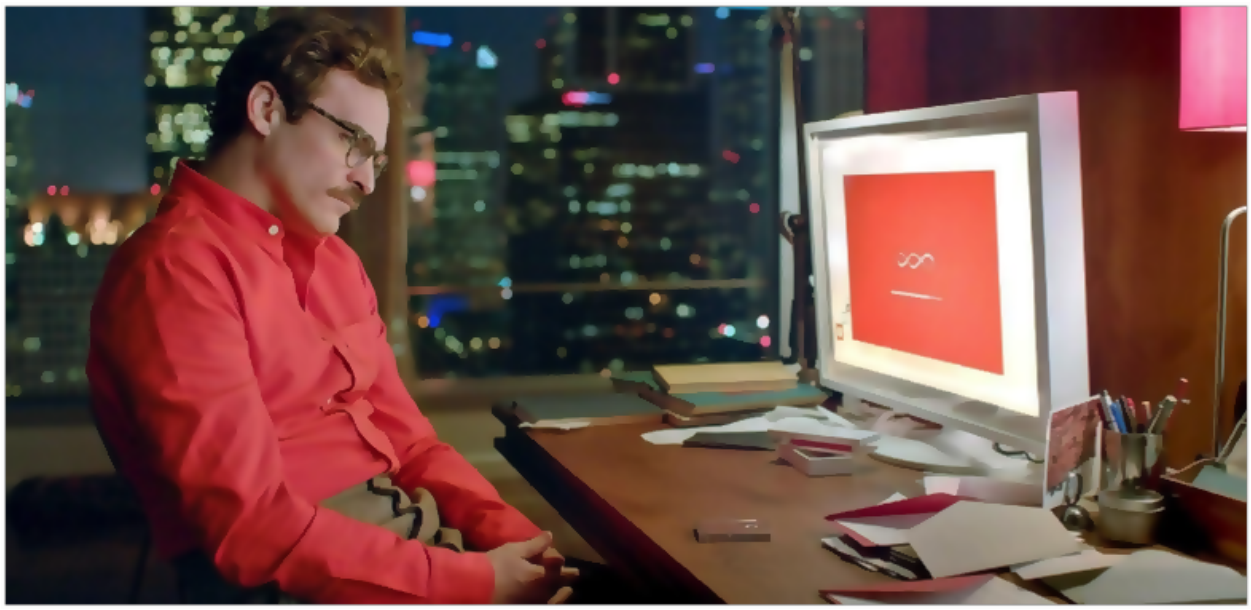

Figure 5 A still from Her, directed by Spike Jonze (2013). Red colored motifs are intentionally placed in each shot to elicit positive emotions like the protagonist's love, compassion and optimism (Baker, 2016).

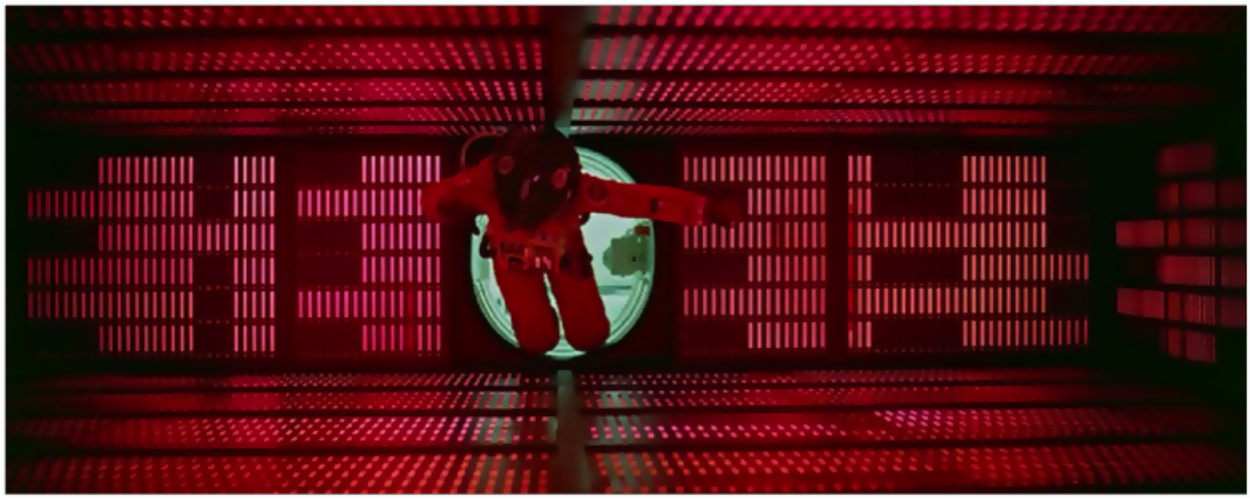

Figure 6 A still from 2001: A Space Odyssey, directed by Stanley Kubrick (1968). Hal's processor core is in red to appeal to negative emotions, like hostility and imminent death (Baker, 2016).

The Cinematographic Use of Color in Movies. At the same time, other movie directors and cinematographers have intentionally ignored these conventions by associating specific emotions to unconventional (cinematographic) colors. Even though these cinematographic colors are aimed at communicating a particular emotion, they do not conform to widely known color associations. The conventions that do exist are the ones established by the director within a specific movie or across his entire filmography. By way of example, given that Wes Anderson oftentimes overlooks conventions and elicits negative emotions like danger via bright colors, he creates his own distinct color and emotion conventions within his filmography (Vaughn Vreeland, 2015). See Figure 7.

Figure 7 A still from The Grand Hotel Budapest, directed by Wes Anderson (2014). Bright colors like pink are often used in Wes Anderson's movies to elicit danger (Vaughn Vreeland, 2015).

The emotions sparked by conventional colors differ from those sparked by cinematographic colors. Given its association with the sun and with summertime, yellow sparked positive emotions for 98% of respondents in an experiment conducted by Kaya and Epps (2004) that aimed at finding out which colors evoked which emotions. Nonetheless, yellow conveys negative emotions like anxiety and danger in the movie Birdman (2014). 95.9% of respondents reported positive emotions like hope and serenity when exposed to the color green. At the same time, green sparks negative emotions like worry and unease in The Matrix (1999). Orange is mostly known to impart positive emotions like enthusiasm and optimism, but symbolizes endangerment in The Darjeeling Limited (2007). And even though blue is known to communicate both positive emotions like purity and negative emotions like sadness, it is associated with love in Eternal Sunshine of the Spotless Mind (2004) (Kaya & Epps, 2004; Baker, 2016).

The audience's level of familiarity with a director's distinct visual style (e.g., his unique color palette) can affect its emotional experience (Shimamura, 2013). If a director always uses the same cinematographic color to spark the same emotion in all of his movies, a familiar audience may also always associate that color with that emotion. Knowing that a director's cinematographic color associations are consistent creates a schema of what to expect. For instance, fans of Wes Anderson will know how to properly experience his movies given the fact that they know he commonly associates negative emotions like sadness and danger with bright colors like pink and yellow (Vaughn Vreeland, 2015).

On the premise that both conventional colors and cinematographic colors can spark the emotions intended by the cinematographer, the following research question is proposed:

'What is the influence of the cinematographic use of color in movies on the emotions of viewers?'

Given the fact that the use of conventional colors is based on widely known color and emotion associations and are ubiquitous in everyday life, the following hypotheses are proposed:

H1: Cinematographic colors have a weaker influence on positive emotions than conventional colors, and will spark less intense positive emotions.

H2: Cinematographic colors have a weaker influence on negative emotions than conventional colors, and will spark less intense negative emotions.

Method

Participants

Participants were recruited in the city of Tilburg in the Netherlands by way of a convenience sampling and a snowball sampling. All in all, 42 participants signed up for this experiment. The sample consisted of 20 males and 22 females, aged between 20 and 30 (*M = 25.36, SD = 3.02*). All participants were of Dutch nationality, with the exception of 2, who were Thai and Taiwanese. The sample encompassed an amalgam of undergraduates and graduates. 20 of the participants (47.6 %) had bachelor's degrees, while 22 of them (52.3%) had master's degrees.

Materials

Eight movie clips with an aspect ratio of 16:9, a resolution of 1080p, and lasting 53.8 seconds on average were shown in full screen to each participant. Four of these clips conveyed an emotion with a positive valence, while the other four communicated an emotion with a negative valence.

Given the fact that the audience's level of familiarity can affect their emotional experience and to prevent as best as possible the creation of a schema of what to expect, the clips were selected from known and lesser known movies that span 26 years. They include: The Darjeeling Limited (2007), Drive (2011), Slumdog Millionaire (2008), The Grand Budapest Hotel (2014), As Tears Go By (1988), Garden State (2004), and a short film directed by the researcher: And I Love Her (2008). On account of the fact that it could exert an influence on the emotional experience of participants, the sound (i.e., the dialogue and the background music) was removed from each of these clips.

The clips were chosen for their clear depiction of a positive or a negative emotion and for their cinematographic use of color, as indicated in the literature. The positive emotions were related to love and romance, and the negative emotions to death, fear, pain, and danger. For instance, the

clip of the movie The Darjeeling Limited (2007) depicts the moment three American brothers spring into action when they spot three Indian boys drowning in a river, as they attempt to cross it on a raft. Despite their efforts, the protagonists are only able to save two boys, one boy dies. As opposed to conforming with conventions and using blue to communicate negative emotions like sadness or red to spark emotions like danger, Wes Anderson composed this scene with a predominantly yellow color (Kaya & Epps, 2004). See Appendix A for a more elaborate description of the other clips.

The color of each clip was manipulated by way of the *Color Correction* feature in Adobe Premiere Pro CS6. In order for the clip to look natural, color grading was subtle and never extreme. An example of the color manipulation is shown in Figure 7. Figure 7 A's color is the original one, while Figure 7 B's color has been manipulated.

A B

Figure 8 Drive directed by Nicolas Winding Refn (2011) in cinematographic yellow (A) and conventional blue (B).

Table 1 Overview of the Eight Clips and Their Characteristics

Movies	**Year**	**Director**	**Duration**	**Valence**	**Emotion**	**Cine Color**	**Conv Color**
The Darjeeling Limited	2007	Wes Anderson	71s	Negative	Danger	Pink	Blue
Drive	2011	Nicolas Winding Refn	46s	Negative	Hostility Danger Uncertainty	Yellow	Blue
Slumdog Millionaire	2008	Danny Boyle	65s	Negative	Solitude Despair	Orange	Blue
The Grand Budapest Hotel	2014	Wes Anderson	30s	Negative	Sadness Danger Isolation	Pink	Blue
As Tears Go By	1988	Wong Kar-Wai	45s	Positive	Desire Passion	Blue	Red
Garden State	2004	Zach Braff	50s	Positive	Warmth Optimism	Grey	Yellow
Eternal Sunshine	2004	Michel Gondry	60s	Positive	Warmth Optimism Love	Blue	Orange
And I Love Her	2008	Yoshanka Samarawira	64s	Positive	Love Fantasy	Blue	Pink

Design

A within-subject factorial design was used with two independent variables: emotion (positive vs. negative) and color (cinematographic vs. conventional). This study design was selected considering that it reduces the likelihood that real differences between each condition goes undetected. Participants bring with them their own experiences, knowledge, and context, thereby influencing their responses. As opposed to having a between-subject study design, where participants only interact with a limited set of variables, a within-subject design allows for each participant to be presented with all levels of a variable and to affect them similarly (Budiu, 2018).

The four conditions: positive/cinematographic, positive/conventional, negative/ cinematographic, negative/conventional, were distributed semi-randomly over a list of eight movie clips, of which four were positive and four were negative. On account of the fact that participants were not allowed to watch a scene more than once, there were two lists of scenes in the experiment that are balanced with respect to the use of color. If a clip had conventional color on the first list, it would have cinematographic color on the second, and vice versa. The eight clips were shown in a random order to each participant and participants were randomly assigned to a list.

Instruments

The evaluation and comprehension of each scene were asked in three questions:

- Do you like the scene? (yes / no)
- Do you think the scene sparked a positive or a negative emotion? (Positive / Negative)
- What happened in this scene? (text box)

To determine the intensity of their emotional experience, participants were required to fill in a psychometric scale known as a Positive Affect and Negative Affect Schedule Short-Form (PANAS -SF) (Karim, Weisz, & Rehman, 2011) after each clip. This self-report questionnaire was divided into two distinct mood scales that can be interpreted in a consistent way across populations: one measured positive emotions, while the other centered around negative affectivity. Each scale consisted of 10 items (affects) that were rated on a scale of 1-5 and included the following terms: interested, distressed, excited, upset, strong, guilty, scared, hostile, enthusiastic, proud, irritable, alert, ashamed, inspired, nervous, determined, attentive, jittery, active, and afraid.

In order to check for PANAS structure on this sample, a principal components analysis (PCA) was performed on the 20 PANAS items. In the first step, the extraction was applied by Eigen values greater than 1, with Promax rotation. The analysis yielded a 4-factor solution, with the factors explaining 70% of variance. However, correlations between the first and the second two factors were high, the first one being $r = .87$, and the one between the third and the fourth factor being $r = .86$. Since the correlations were so high, a two-factor solution was chosen. Kaiser-Meyer-Olkin Measure of sampling adequacy equaled .89, and Bartlett's test of sphericity was significant ($\chi^2(190) = 4471.73$, $p < .001$). The two factors explained 55.80% of variance and the correlation between the two scales is $r = .00$. The structure of the factors is presented in Table 2. All but one item grouped in the same way as the original scale proposes: negative emotions on one factor and positive ones onto the other. Only one emotion, 'alert', has higher saturation on the first factor, indicating that this emotion was maybe perceived as negative by our respondents, so it was removed from further analyses. The dependent variables Positive emotions and Negative emotions are calculated as average scores for items pertaining to each of the factors in Table 2, with Positive emotions having 9 items and Negative emotions 10.

Table 2

Structure matrix for PANAS

Item	Component 1	Component 2
Afraid	.893	
Scared	.867	
Distressed	.864	
Nervous	.852	
Upset	.761	
Jittery	.737	.149
Hostile	.707	
Irritable	.561	-.177
Guilty	.558	
Alert	.522	.339
Ashamed	.425	
Active		.788
Enthusiastic	-.312	.771

Excited		.770
Strong	.273	.764
Attentive	.198	.757
Determined	-.161	.747
Inspired	-.242	.699
Proud		.667
Interested	.353	.601

In order to check for internal consistency, Cronbach's Alpha was calculated. It was .891 for the Positive emotions scale, and .908 for the Negative emotions scale. This indicates that the scales had an excellent reliability. The data analysis resulted in two dependent measures one for positive emotions and one for negative emotions. They were subjected to further statistical analyses.

Procedure

The experiment that was conducted consisted of participants having to watch 8 pre-selected clips. Four of the clips had emotions with a positive valence (*And I loved her, As Tears Go By, Eternal Sunshine of the Spotless Mind, and Garden State*), and four other clips had emotions with a negative valence (*Slumdog Millionaire, The Grand Budapest Hotel, Darjeeling Limited, and*

Drive). The color was manipulated in a manner that for the negative scene, a positive cinematographic color is used instead of the original (conventional) negative color, and vice versa. That way, there were 4 different conditions (positive clip in conventional color, positive clip in cinematographic color, negative clip in conventional color, negative clip in cinematographic color). Participants filled in the PANAS-SF questionnaire after watching each clip. Each participant saw eight movie clips, 4 positive and 4 negative, and 4 in conventional and 4 in cinematographic color.

Participants attended a controlled environment (namely a soundproof booth) at the research lab of the Tilburg University School of Humanities and Digital Sciences. The experiment was conducted within the span of two weeks.

Participants watched each clip in full screen on a 15" Apple Macbook Pro Retina.

Prior to initiating the experiment, participants were asked to read an informed consent form, comprising of a short introduction to the study. If they consented to participating in the experiment, they received a set of demographic questions about age, gender, nationality, and academic background.

After this, each participant watched a movie clip that used color in either a cinematographic way or in a conventional way. They were subsequently asked to specify their level of comprehension of each clip. Specifically, participants were asked to describe the content of each clip and specify if it sparked a positive emotion or a negative emotion.

Participants were debriefed upon completion of the questionnaire. The objective of this research experiment was reiterated (that is, determining if conventional colors sparked more intense and consistent emotions as opposed to cinematographic colors in movies), they were thanked for their attendance, and certified that all the data had been saved.

Data Analysis

The analyses were performed in IBM SPSS and they included descriptive statistics, repeated measures t-tests and repeated measures GLM.

Results

Means and standard deviations across experimental conditions are presented in Table 3.

Table 3

Means and standard deviations across experimental conditions

	Positive emotions M *(SD)*		Negative emotions M *(SD)*	
	Conventional	Cinematographic	Conventional	Cinematographic
Positive clip	2.69 *(.73)*	1.62 *(.49)*	1.05 *(.14)*	1.21 *(.22)*
Negative clip	1.99 *(.49)*	1.71 *(.48)*	2.48 *(.49)*	1.49 *(.26)*

A set of paired t-tests was conducted in order to test the hypotheses. The results show that there are significant differences in provoking both positive and negative emotions based on the clip valence and the use of color: positive emotions x positive clip $t(41) = 10.089$, $p < .001$, positive emotions x negative clip $t(41) = 3.044$ $p < .01$, negative emotions x positive clip $t(41) = -3.672$, $p < .01$, negative emotions x negative clip $t(41) = 12.741$, $p < .001$. Looking at Table 3 shows that clips with a positive valence spark more intense positive emotions in conventional color compared to cinematographic color (2.69 vs 1.62). This is in accordance with the first hypothesis (H1). Table 3 also shows that clips with a negative valence elicited more intense negative emotions in

conventional color compared to cinematographic color (2.48 vs 1.49). Furthermore, positive clips in cinematographic color sparked more negative emotions, while negative clips in cinematographic color provoked less negative emotions. This also supports the second hypothesis (H2). However, it should be noted that conventional colors provoked more positive emotions irrespective of the clip compared to cinematographic colors.

In order to check for interaction effect of clip valence and color, two repeated measures GLM were conducted, one for positive and one for negative emotions. When it comes to positive emotions, there is a significant main effect of valence ($F(1, 41) = 21.440$, $p < .001$, $\eta^2 = .343$), indicating that positive emotion scores were higher for positive clips ($M = 2.16$, $SE = .079$) than for negative clips ($M = 1.85$, $SE = .060$). The main effect of color was also significant ($F(1, 41) = 62.803$, $p < .001$, $\eta^2 = .605$), indicating that positive emotion scores are higher when the clips are presented in conventional ($M = 2.34$, $SE = .081$) than in cinematographic color ($M = 1.67$, $SE = .069$). The interaction effect of these two variables is also significant ($F(1, 41) = 60.799$, $p < .001$, $\eta^2 = .597$; Figure 9). The difference in scores between positive and negative clips was larger for conventional than for cinematographic color. Positive emotions score decreases significantly more in the cinematographic color condition than in conventional color. The score on positive emotions is higher in conditions when the color is conventional compared to cinematographic.

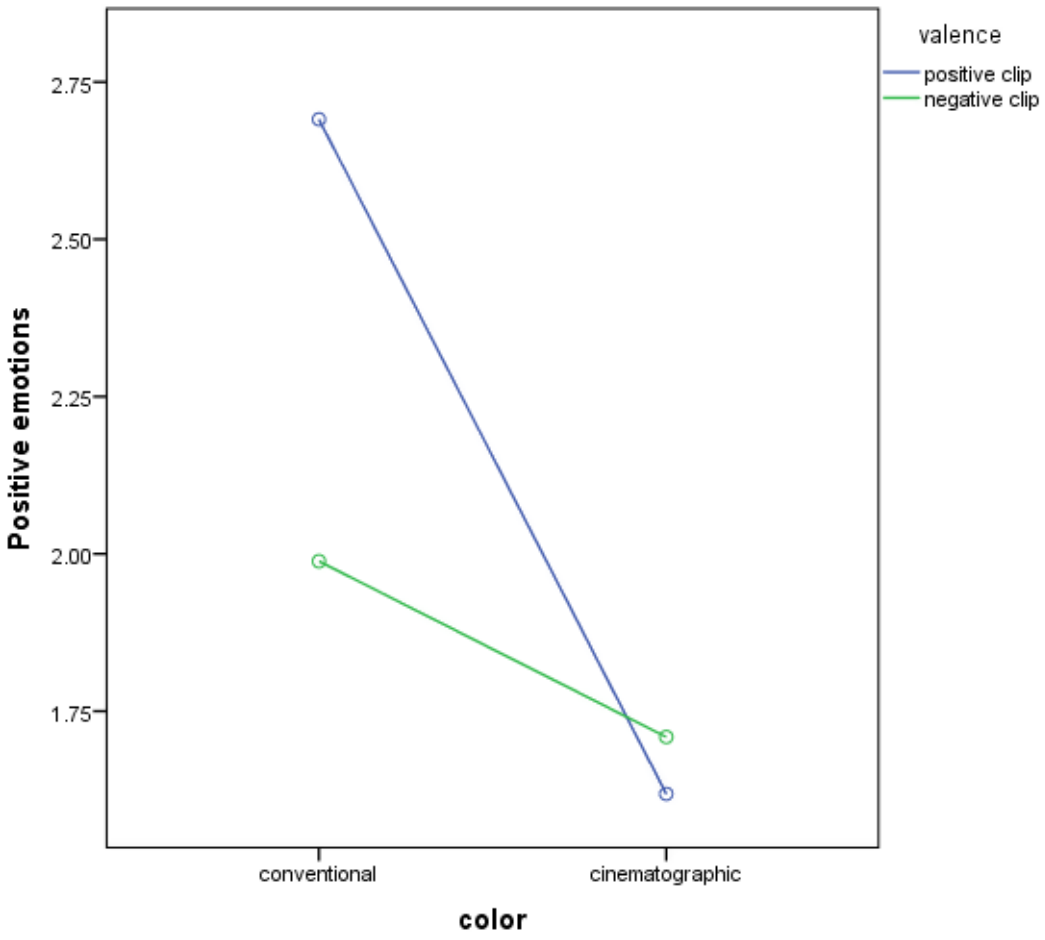

Figure 9. The interaction effect of clip valence and color on positive emotions

The main effects of valence ($F(1, 41) = 304.905$, $p < .001$, $\eta^2 = .881$) is also significant when it comes to negative emotions. The score on Negative emotions scale is higher for negative clips ($M = 1.99$, $SE = .047$) than for positive clips ($M = 1.13$, $SE = .020$). There is also a significant main effect of color ($F(1, 41) = 120.905$, $p < .001$, $\eta^2 = .747$), indicating that negative emotions score is higher for conventional ($M = 1.77$, $SE = .038$) than for cinematographic clips ($M = 1.35$, $SE = .026$). The interaction effect is also significant ($F(1, 41) = 134.375$, $p < .001$, $\eta^2 = .766$; Figure 10). Again, the difference in scores between positive and negative clips was larger for conventional than for cinematographic color. When positive clips are played in cinematographic color, the score on negative emotions increases. However, when negative clips are presented in cinematographic color, the score on negative emotions decreases largely.

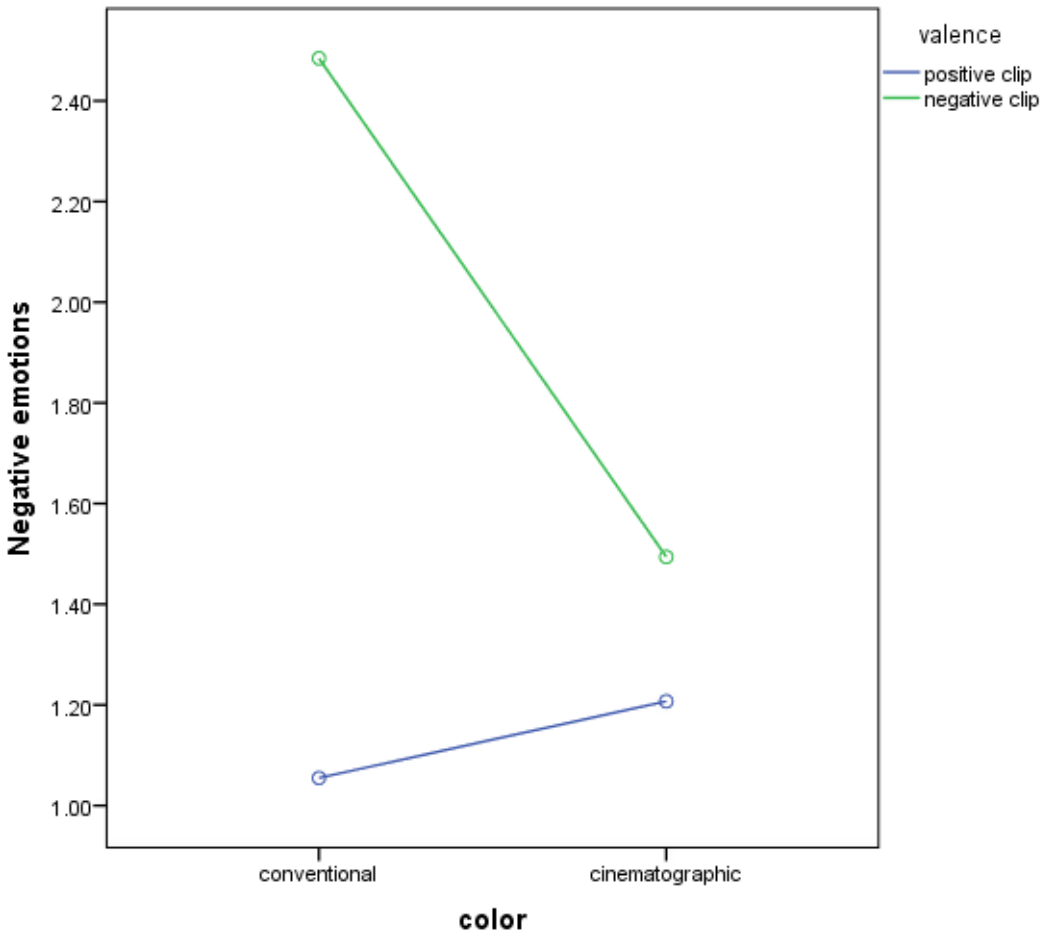

Figure 10. The interaction effect of clip valence and color on negative emotions

Discussion

Colors have the power to spark a wide array of positive and negative emotions. Cinematographers choose their colors intentionally, knowing that colors can affect the emotional experience of the audience. Some directors conform to color and emotion conventions to spark the intended emotions, while others deliberately ignore these conventions by associating specific emotions to unconventional and cinematographic colors.

The present study was designed to determine what the influence was of the cinematographic use of colors in movies on the viewers' emotions. The results of this research experiment supported both hypotheses that conventional colors spark more intense emotions than cinematographic colors.

The results of multiple analysis confirmed that, in this sample, positive emotion scores for positive clips were higher than for negative clips and negative emotion scores for negative clips were higher than for positive clips. Also, positive emotion scores for conventional color were higher than for cinematographic color, and negative emotion scores for conventional color were higher than for cinematographic color. On top of that, the difference in scores between positive and negative clips was larger for conventional color than for cinematographic. This underscores how conventional color yields a greater emotional intensity than cinematographic color and therefore confirms both hypotheses.

When the clips were presented in cinematographic color, the emotions were provoked as expected, meaning that negative emotions were provoked when that was intended. However, when movie clips were displayed in conventional color, they would provoke much stronger negative emotions, if they were intended to be negative, and less negative emotions when they were intended to be positive. These findings align with the previously mentioned neurophysiological

research by Baumgartner, Esslen & Jäncke (2006) that underscores the strong correlation between looking at affective images and the emotions that follow. It also validates that strong emotions arise from visual experiences as pointed out earlier in this study. A visual experience such as watching a short clip that lasts less than a minute is enough to spark strong emotions. Depending on the clip, these emotions can be mapped to ten positive emotions or ten negative emotions. The findings of this experiment add to and work together with the conclusions of Baumgartner, Esslen & Jäncke (2006) by showing that even short visual experiences can still elicit strong emotions. These conclusions have a significant implication on movie making since it shows that directors and cinematographers can use conventional colors to quickly and effectively manipulate the emotional experience of their audience without the need to increase the duration of a scene. Meanings and subsequent emotions arise rapidly when a scene contains strategically placed conventional colors. This explains why a well-known idiom in the movie industry has always been "less is more": it expresses the effectivity of minimalism, which in this case is a succinct visual experience that uses color in a conventional way, in producing more intense emotions.

Although conventional colors provoked stronger positive emotions irrespective of the clip's valence, compared to cinematographic colors they sparked more intense positive emotions when the clip was positive and more intense negative emotions when the clip was negative. As aforementioned, Suk & Irtel (2009) affirmed that numerous forms of visual communications like movies and branding oftentimes conform to color and emotion conventions given that certain colors are widely known to evoke certain emotions. The omnipresence of this type of color usage explains why participants may have intentionally or unintentionally registered and associated a particular color with the emotion it is known to convey, and why they subsequently experienced it more intensely. So by just watching a movie clip without providing any exposition (i.e. backstory), participants felt more intense emotions when colors conformed to known conventions. The

experiment conducted in this study validates the aforementioned findings of Suk & Irtel (2009) and of Nijdam (2005) by underscoring the fact that colors can be mapped to emotions given their known associations. These results show that in order to intensify the emotional experience of a scene through the use of colors and to thereby create an effective cinematic reality, directors and cinematographers need to take into account the fact that colors have corresponding emotions and that people consciously or unconsciously make these associations given their omnipresence in everyday life. They confirm that in movie making, colors are not a secondary feature but rather a pivotal one and that they need to be treated as such.

The findings of this research experiment also support what was discussed earlier: that emotions are situational. The type of emotions that arises depends on what is actually happening. As explained previously, the brain processes conscious experiences, collects information, and translates it into emotions (Nijdam, 2005; LeDoux & Brown, 2017). The conscious experiences here are visual. As a result, positive emotions are sparked when positive actions take place in the clip, and negative emotions are sparked when negative actions take place in the clip. This implies that for movie directors to elicit the intended emotions through colors, they must take heath of what is actually going on. The colors must match and be appropriate to the situation. As mentioned previously, positive emotional experiences are felt when the color fits the product (Ciotti, 2018). This theory seems to also be applicable to emotional experiences that are sparked while watching affective visuals like movie clips, although the term 'positive emotional experience' would refer here to a more intense emotional experience. The reason why cinematographic colors spark less intense emotions compared to conventional colors may be attributed to the fact that they just do not fit the context. In other words, cinematographic colors may seem out of place with regards to what is going on and as a result the brain translates this information differently. This explains why cinematographic colors sparked more positive emotions when the clip was intended to be negative.

This study, along with the theories discussed here make it clear that on account of the fact that the brain translates experiences and information into emotions and that emotions are situational, directors should align their choice of color with what is actually going on in the scene if they want the brain to provoke the appropriate level of emotional intensity. This is not to say that cinematographic colors do not provoke appropriate emotions, but rather that they do not elicit emotions that are as intense as those sparked by conventional colors.

This highlights the consequentiality of emotional contexts (i.e. the events that take place) when it comes to the connection between color and emotion. This is consistent with the aforementioned research conducted by Zhang et al. (2015) that demonstrates how emotional contexts play a significant role in affecting emotions. The experiment conducted as part of this study supports Zhang et al's (2015) findings since it shows that for a clip to spark positive emotions the events that take place in the scene should be positive and that conversely, for a clip to impart negative emotions the context should be negative. This highlights the pivotal role played by context when it comes to which emotional valence a color can elicit. This research experiment has shown that both conventional colors and cinematographic colors can spark negative emotions if the events of the scene are negative and that they can spark positive emotions if the events of the scene are positive, although the emotions are not as intense when cinematographic colors are used and that they can even be positive when the scene has a negative valence. However, compared to the findings of Zhang et al. (2015) which also highlighted how emotional contexts exert an influence on behaviors, the present study only focused on emotions. For this reason, further research should also be carried out to determine if colors used in a conventional way can also affect the behavior of participants and not solely their emotions. This would shed some light on the potential effect of conventional colors and cinematographic colors on the audience's behaviors.

Compared to cinematographic colors, conventional colors sparked more intense negative emotions when the clip was negative and more intense positive emotions when the clip was positive. Given that colors are consciously and unconsciously associated with objects, things, and physical spaces, a likely explanation may be that a color has a negative valence when it is in a negative context, and a positive valence when it is in a positive context. This is in agreement with the findings of Kaya & Epps (2004) mentioned earlier whose experiment showed that color associations have an influence on emotional attitudes. In other words, the valence of an emotion (i.e. its positive or negative affectivity) owes to what a particular color is associated with. The findings of this experiment validate the conclusions of Kaya & Epps (2004) given that it also underlines how color plays a pivotal role on the valence of an emotion. However, compared to their findings, which mainly focused on broad emotions such as happiness and sadness, this study was able to map colors to more specific positive and negative emotions by using a PANAS scale. This study also extends their research by distinguishing between the emotional intensity elicited by conventional colors compared to the emotional intensity elicited by cinematographic colors: it puts colors in unconventional contexts to assess their ability to spark intense emotions.

However, an interesting result of this experiment is that cinematographic colors sparked more positive emotions when the clip was intended to be negative than when it was intended to be positive. This is not to say that they did not elicit the intended emotions, but just that there was more positive affectivity compared to negative affectivity when the clip was negative. This owes to the fact that colors like pink, yellow, and orange are mostly known for their positive associations and positive valence since they are mainly used in a positive emotional context rather than in a negative emotional context. From this perspective, it can be assumed that this is exactly what movie directors and cinematographers intended to achieve. Their use of cinematographic colors may be aimed at creating a positive mood and atmosphere despite the prevailing negative

context. This underscores that even though the aforementioned studies have shown that emotions are situational and context dependent, this present study highlights that using colors in a cinematographic way can alter this. This is not to say that emotions are not sparked, but simply that they do not necessarily align with what is happening in the scene; they do not reflect the content of the clip. So compared to previously discussed studies, this study adds cinematographic colors into the whole mix and points towards the fact that they can provoke emotions that run counter to what is actually going on, which may or may not be intentional on the director's part. These findings imply that directors must be careful when selecting colors that run counter to conventions as they may not elicit the emotions of the scene as intensely as conventional colors. Nonetheless, they may be used to intentionally spark emotions that don't conform to color and emotion conventions. By looking at the aforementioned findings of Shimamura (2013) as well as the results of this experiment, it seems evident that doing so requires familiarity and prior knowledge, along with a clear exposition that establishes what colors are associated with in a particular movie. Simply jumping into a scene as did this experiment will cause the audience to not feel what they are suppose to feel when cinematographic colors are used. Having said that, this experiment has shown that emotions are still more intense when conventional colors are used in their corresponding context compared to when cinematographic colors are used and this can be attributed to their omnipresence in everyday life as well as in numerous forms of visual communications as have pointed out the theories of Suk & Irtel (2009) that were mentioned previously. Based on all of these findings, it is paramount that directors take into account the fact that both cinematographic colors and conventional colors can change the emotional valence of a scene and that since people are used to seeing colors used in a conventional way, they will react more intensely to them compared to with cinematographic colors.

As explained earlier, an emotional reaction is said to last for only 90 seconds. These 90 seconds correspond to a chemical process taking place inside the body following a conscious experience. An emotion that exceeds 90 seconds is the result of the brain deciding to prolong it: this type of emotion enters an emotional loop. This study showed that watching movie clips that use colors in a conventional way and movie clips that use colors in a cinematographic way both elicit an emotional reaction, even if this emotional reaction is more intense when conventional colors are used. However, do conventional colors provoke emotions that can enter an emotional loop? With this new question in mind, further research consisting of longer clips and additional time between a clip and its corresponding PANAS-SF should be conducted to determine if conventional colors spark intense and brief emotions or intense and lasting emotions. This would shed some light on whether the emotional experience that results from conventional colors endures. If the brain collects information and translates it into an emotion and then decides to prolong it passed 90 seconds, it would show that conventional colors elicit not only intense emotions but also lasting emotions, thereby making the whole movie experience truly riveting and poignant, which is the ultimate goal for directors.

There are additional reasons that may explain the results of this experiment. For one thing, it is important to highlight that this experiment was conducted within a short time span (two weeks) and for this reason, data was collected for only 42 participants. From this perspective, it is possible that additional and more diverse participants can sway the results of this experiment. Secondly, familiarity and prior knowledge may have affected emotional attitudes. Despite the fact that some clips were intentionally chosen from lesser known movies in order not to sway the results in one particular direction, it is possible that some participants may have rated a movie clip as more emotionally intense than another given their knowledge of that movie (i.e. they may have watched that movie before). As mentioned earlier, Shimamura (2013) states that familiarity and

prior knowledge can create a cognitive schema of what to expect, which can as a result affect emotional experiences. In this scenario, prior exposure to and knowledge of these movies may have made certain participants familiar with the cinematic style (i.e. the color palette) of these directors. This familiarity would have made them aware of what to expect and how to feel, which then validates the conclusions made by Shimamura (2013). Even though this research experiment showed that conventional colors sparked more intense positive emotions for positive clips and more intense negative emotions for negative clips compared to cinematographic colors, familiarity and prior knowledge seem to play a consequential role in this whole paradigm as they also intensify what are already intense emotions. The present study is able to add to the findings of Shimamura (2013) as it shows that intense emotions can be sparked not only by one's familiarity with the affective visual, but also when the use of colors conforms to well-known conventions. This combination seems to be how directors and cinematographers can elicit the intended emotional valence and intensity within their audience.

Lastly, cultural and attitudinal similarities of the participants may have shaped the results of this experiment. With the exception of two participants, this research experiment was limited to participants of Dutch nationality and in the 20 to 30 age range. As mentioned earlier, color and emotion conventions do exist, but color preferences and color symbolism may differ from culture to culture and from religion to religion, and this can sometimes come into play in affecting emotional attitudes. On that premise, cross-cultural research should be conducted to ascertain if these results can also be applicable to other nationalities, religious groups, and to participants over the age of 30.

Conclusion

Emotions are a complex and a multi-layered phenomena.

Color plays a consequential role in everyday life and in multiple forms of visual communications like branding and advertising. This is by virtue of the fact that colors are oftentimes intentionally chosen to consciously or unconsciously communicate a message and to spark a particular emotion.

This applies to movies as well. Movie directors and cinematographers oftentimes conform to color and emotion conventions to spark the intended emotions and to create an engaging movie experience. At the same time, others have intentionally ignored these conventions by associating specific emotions to unconventional (cinematographic) colors.

The results of this experiment support both hypotheses that conventional colors spark more intense negative emotions and more intense positive emotions than cinematographic colors. It also sheds some light on the fact that despite both conditions of color eliciting the intended emotions, cinematographic colors sparked more positive emotions when the clip had a negative valence than when it had a positive valence and that conventional colors sparked more intense positive emotions irrespective of the clip's valence. This shows the consequential role played by color in movies (both when it conforms to conventions and when it does not) and that directors, along with cinematographers need to take these findings into account when composing their scenes in order to more effectively communicate the right emotional valence and intensity, and to create an engaging movie experience.

Colors are widely known to affect the emotional and ensuing physical attitudes of humans, owing to the fact that they represent a source of information. Even though the findings of this research experiment are conclusive, cross-cultural research should be conducted to ascertain if the

emotional intensity of conventional colors compared to cinematographic colors can be applicable to other nationalities, religions, and cultures.

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Appendix

Appendix A: Elaborate Description of Each Clip

Clip 1: The Darjeeling Limited, directed by Wes Anderson (2007). Duration: 1 minute 11 seconds.

Emotional Valence: Negative

Cinematographic Color: Yellow

Conventional Color: Blue

This movie clip depicts the moment three American brothers spring into action when they spot three Indian boys drowning in a river, as they attempt to cross it on a raft. Despite their efforts, the protagonists are only able to save two boys; the third boy dies.

As opposed to conforming with conventions and using blue to communicate negative emotions like sadness or red to spark emotions like danger, Wes Anderson composed this scene with a predominantly yellow color (Kaya & Epps, 2004).

Clip 2: Drive, directed by Nicolas Winding Refn (2011). Duration: 46 seconds.

Emotional Valence: Negative

Cinematographic Color: Yellow

Conventional Color: Blue

This rapid and intense car chase involves Ryan Gosling and Christina Hendricks pursued by an unknown adversary.

This scene was strategically shot between morning and late afternoon in Los Angeles to give it its distinct yellow tone. Nonetheless, color and emotion conventions underscore that darker colors like blue are better at communicating negativity, danger, intensity, and uncertainty, while red sparks hostility and imminent death (Baker, 2016). Taking this into account, the manipulated version of this clip has a blue tint to it.

Clip 3: Slumdog Millionaire, directed by Danny Boyle (2008). Duration: 1 minute 05 seconds.

Emotional Valence: Negative

Cinematographic Color: Orange

Conventional Color: Blue

Considering his impoverished upbringing, Mumbai police suspect Dev Patel's character Jamal Malik of cheating on the game show 'Who Wants to be a Millionaire?' and consequently question and torture him by electric shock.

Despite the fact that a color like blue is known to spark negative emotions like solitude and despair, which aligns with what is going on here, Danny Boyle composed this scene with an orange color (Kaya & Epps, 2004).

Clip 4: The Grand Budapest Hotel, directed by Wes Anderson (2014). Duration: 30 seconds.

Emotional Valence: Negative

Cinematographic Color: Pink

Conventional Color: Blue

An eccentric shootout between every resident of the pink-colored, dilapidated, and isolated Grand Budapest Hotel takes place after Adrien Brody's character Dmitri discharges his gun at Zero and M. Gustave.

Considering that pink is mostly known to spark positive emotions like cheerfulness and love, blue was applied on the manipulated version of this clip in order to conform with conventions and to spark negative emotions associated with this color, including sadness, isolation, and danger (Kaya & Epps, 2004).

Clip 5: As Tears Go By, directed by Wong Kar-wai (1988). Duration: 45 seconds.

Emotional Valence: Positive

Cinematographic Color: Blue

Conventional Color: Red

Maggy Cheung and Andy Lau's characters are lovers who share an impassioned kiss inside a phone booth in 1988's Hong Kong.

As opposed to using a conventional color like red to spark positive emotions like desire and passion, director Wong Kar-wai composed this scene with blue to trigger the same emotions (Kaya & Epps, 2004).

Clip 6: Garden State, directed by Zach Braff (2005). Duration 50 seconds.

Emotional Valence: Positive

Cinematographic Color: Grey

Conventional Color: Yellow

While waiting in a doctor's lobby in New Jersey, a romantic attraction is created when Natalie Portman's character Sam introduces Zach Braff's character Andrew Largeman to a song that she is listening to.

This clip captures their chemistry with the color grey, although grey is known to spark negative emotions like sorrow. Orange is applied to the manipulated version by virtue of the fact that it is mostly known to impart positive emotions like warmth and optimism (Kaya & Epps, 2004).

Clip 7: Eternal Sunshine of the Spotless Mind, directed by Michel Gondry (2004). Duration: 1 minute.

Emotional Valence: Positive

Cinematographic Color: Blue

Conventional Color: Orange

Jim Carrey and Kate Winslet are two lovers lying down on a lake covered in ice and looking at and naming the different constellations together.

Michel Gondry uses blue to spark positivity and love. Although blue is a soothing color, it does not commonly spark love. The manipulated version is in yellow, considering that it is known to spark warmth, optimism, and love (Kaya & Epps, 2004).

Clip 8: And I Love Her, directed by Yoshanka Samarawira (2007). Duration: 1 minute 4 seconds.

Emotional Valence: Positive

Cinematographic Color: Blue

Conventional Color: Pink

Antoine enters a dreamlike emotional state after falling in love with Zoe, a girl he crossed paths with. His mind transports him to a life in which he has a romantic and euphoric affair with her.

Blue sparks love and fantasy in this short film. The manipulated version is more in line with conventions, since pink is known to spark love and euphoria.