

# Color signification in digital multimodal compositions: A descriptive analysis of undergraduates' digital videos

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*Modern digital technology allows users to compose multimodal ensembles that combine aural and visual modes. Video editors allow users to manipulate the color of visual imagery through effects. While effects unlock an extra layer of semiotic potential, empirical research has not examined how novice users utilize color-related effects to communicate meanings when creating digital artifacts. The present study analyzed 46 digital videos created by a cohort of undergraduates who attended a digital media course. The examination of the digital videos showed that only one in three video projects involved the use of effects for changing the color of the original image and video resources. A closer analysis of these video projects indicated three main patterns of color-related effects: defective, inconsistent, and consistent. Two video projects from each category are analyzed in detail, examining how the students utilized the semiotic potential of effects for manipulating color. The study is concluded with a discussion of the main findings and directions of future research.*

KEYWORDS          digital video, video effects, color, multimodal composing

## 1. Introduction: New Literacy Requirements

The digital revolution of the second part of the 20<sup>th</sup> century led to the emergence of new media that, in turn, led to the creation of new communicative practices (Manovich, 2001; Ito et al., 2010). On the one hand, current communicative practices are inherently multimodal. Digital technologies allow the combination of different modes such as static and moving images, and sounds. Consequently, multimodal communication has become the new de facto standard in the new textual landscapes. On the other hand, as contemporary communicative practices are screen-based, they rely heavily on visual elements (Kress, 2003; Kress and van

Leeuwen, 2006). Hence, the overwhelming majority of the multimodal texts that students get to create are to be viewed on screens (e.g. Instagram stories).

There are two main requirements for participation in these new communicative practices. First, students need to master the semiotic potential of modes and resources hitherto unexplored in traditional educational settings. This entails familiarizing with new modes (such as image, video, and audio) as well as appropriating new ways of combining these modes to communicate meanings. To create multimodal compositions students need to understand the semiotic potential of the aforementioned modes. As it has been pointed out, digital media offer new semiotic resources as well as new ways of using these resources, thereby expanding the meaning-making potential (Kress, 2003; Hull and Nelson, 2005; Ranker, 2008). Considering the dominance of the visual imagery in these new multimodal practices, an essential component of multimodality is familiarization with the visual mode. After all, educational practice is largely monomodal, being primarily concerned with written speech. The students will need to learn a new language, vocabulary, and grammar, which are not typically taught at school. This involves telling a story visually using devices such as frame, lens, light, color, and movement. Cinematography is the field that provides a visual language and the devices for visual storytelling (e.g. Keating, 2014; Brown, 2016).

Second, students need to familiarize themselves with the tools that enable the creation of multimodal messages. As Manovich (2011; 2013) points out, to understand contemporary media, we basically need to understand the software through which media is created, edited, mixed, viewed, and shared. Creating multimodal messages requires mastering the requisite hardware and software tools. Hardware tools, such as image and video cameras, allow the creation and capture of all types of media (images, videos, sounds). Software tools enable students to view, manipulate, mix, and share media. Digital technology is what enables students to craft multimodal ensembles the most common form of which is digital video (DV). Nowadays, DV has become the dominant text as it allows media creators to freely combine various modes: speech (written language), visual (static images, moving images), and aural (spoken language, ambient sounds, and music). While there is a broad range of software applications that are of potential interest, in this study we will focus on the most expedient software program for creating multimodal compositions, the video editor.

### *1.1. Video Editing Software*

Video editing software applications, commonly referred to as Non-Linear Editors (NLE) (Jackson, 2016; Smith and AGI Creative Team, 2014; Hughes, 2012; Wohl, Van Hurkman and Spencer, 2012) provide two main layers of functionality. First, a NLE allows users to combine different modalities to compose a message. This is accomplished by assembling the various visual and aural semiotic resources in a sequence (i.e. montage). In school settings students

typically learn to compose written texts using paper and pencil. Comparatively less attention is given to the visual or aural modes and message composing through word processing or presentation software applications. With the aid of a NLE users can employ new semiotic resources to compose messages and communicate meanings.

Second, a NLE allows users to sculpt the original semiotic resources, polishing them to reach the desired form. Effects, commonly known as video filters, are tools that implement algorithms for modifying the source visuals (Manovich, 2013). As it has been argued (author, 2019), the significance of effects lies in that, by changing the form of a shot, essentially they facilitate the changing of the meaning of the shot content itself. Using effects affords the luxury of starting out with a specific shot and molding it into something else (e.g. desaturate the shot and apply old film effects such as flicker, scratches etc to give the impression of archival footage). Therefore, the same shot can take on different meanings depending on the effect (or combination of effects) that are applied to it (for a brief overview of effects and their semiotic properties see author, 2019). Thus, in addition to allowing the mixing of different modes, NLEs also unlock an additional layer of semiotic potential through effects. One sub-set of effects that are typically provided by NLEs are related to modifications to luminance and chrominance.

## 1.2. Digital Alchemy

A print advertisement by Mosanto Chemical Company that featured in Fortune magazine in 1946 posed the following question: *“Can chemists sell dresses?”*. It went on to provide the answer: *“...yes and no. Few chemists would be any great shakes behind the counter of a retail store. But when it comes to adding such sales appeal to a fabric that it almost sells itself...then our chemists may soon be rated by the textile industry as rattling good salesmen”* (Blaszczyk, 2012, p. 17). The advertisement made clear that - while Chemists might obviously not be the best salesmen - they possess knowledge that can be used to make fabrics that are so colorful that, essentially, no selling skill is required. This type of color chemistry has many parallels with digital color, as NLEs enable media creators to act as “digital chemists”, altering the colors of the visual elements at will.

Digital technology has pushed the envelop in terms of color use. In particular, the advent of Digital Intermediate (DI) circa 2000 (Belton, 2008) revolutionized color manipulation to such an extent that it practically enabled painting with digital light (Prince, 2011). For instance, Jean-Pierre Jeunet and Bruno Delbonnel (director and cinematographer respectively) relied on digital technology to render the fantasy world of *Amélie* (2001). They used an explosion of color to create a ‘fake Paris’, a bright and colorful city, striped off all bad things (Vander-schelden,2007).

The possibilities of manipulating color in the process of post-production are unlimited. For about a century, if something was to appear green when projected to a screen, it had to appear

green before the camera lens. Digital technology has drastically transformed this, empowering media creators to change an image after it has been captured and stored. In fact, many color-related decisions are now made entirely in post-production. For example, the color of *300* (2006) was completely determined in post-production by the director Zack Snyder and cinematographer Larry Fong (Misek, 2010b), that is after principal photography.

Using video editing software users can adjust the chrominance of visual elements to an unprecedented extent. The user is no longer bound to the color properties of the raw source materials at the time of capturing. Color has simply become another independent variable that can be freely changed. NLE tools provide great affordances for manipulating color, such as the balancing of the primary colors, the isolation of specific colors and their adjustment, the isolation of specific areas of the frame and subsequent color adjustments exclusively to this area, and changes within the frame in the course of time. Effects facilitate continuity grading, color retouching (e.g. when parts of a shot are not properly exposed), day for night changes, relighting (portions of a shot), enhancement (digital make up such as brightening the eyes), color suppression (desaturation), lab process emulation, and colorization (adding color to black and white imagery) (for more details see James, 2014). Overall, color-correction (aka color grading) constitutes an essential part of post-production (Jackson, 2016; Smith and Team, 2014; Hughes, 2012; Wohl, Van Hurkman and Spencer, 2012; Hullfish, 2008; Hullfish and Fowler, 2009; van Hurkman, 2014).

## 2. On the Semiotic uses of color effects

As digital color and its semiotic properties in the context of multimodal composing is a largely uncharted area, we draw mainly on what we see as the two most pertinent traditions, multiliteracies and cinematography.

As far as multiliteracies are concerned, Kress and van Leeuwen (2002) provided an overview of the grammar of color in communicative processes. They described color in terms of Halliday's metafunctions (ideational, interpersonal, and textual), noting that it fulfills all three simultaneously. They introduced two semiotic affordances of color, *association* (i.e. where color originates) and *distinctive features* (e.g. scales running from light to dark color, saturated color to desaturated color). The authors addressed certain such features of color in detail (value, saturation, purity hue, modulation, differentiation, and hue), outlining their main semiotic uses.

On the other hand, cinematography is the field that has primarily defined visual storytelling in the 20<sup>th</sup> century. Color is one of the essential devices for telling a story through visual imagery (Brown, 2016; Keating, 2014). Block (2008) provides a thorough treatment of color, outlining its major properties and semiotic functions for communicating meanings. In addition

to Block, (2008), researchers such as Bellantoni (2005) and Misek (2010a) provide comprehensive accounts of color as a signifier in film. Based on the aforementioned sources, we provide the following rough categorization of the primary semiotic functions of color.

### 2.1. *Visual coherence | Affinity*

The main function is chromatic consistency whereby the visual resources (still and moving images) are homogenized. If the shots do not match in terms of luminance and chrominance, the resulting video will be visually incoherent and the viewer will be distracted – even if only at a subliminal level. Color allows visual consistency across frames and shots (Block, 2008). For example, to portray a sequence of six shots as a nostalgic flashback, the message composer might first desaturate the shots (to denote that old memories are vague, hence somewhat faded), then slightly blur them (memories are distant and fuzzy, hence unclear), and finally colorize them using a warm color hue such as red (redness suggests warmth). The viewer will be able to interpret these shots as a flashback only if they all share the same visual properties, namely faded colors, blur, and reddish tint. It is the visual affinity of this six shot sequence that will enable the viewers to understand the intended meanings.

### 2.2. *Visual distinction | Contrast*

Color's main function is to differentiate between events, times, places, subjects, states etc. A common convention is to use black and white to represent the past and color to represent the present (Block, 2008; Misek, 2010). This requires to subject large sequences of image and video clips to a similar color treatment (e.g. tinting and colorization). Different tints are commonly used to signify different worlds. For instance, in the *Wizard of Oz* (1939) Kansas is in black and white while the Land of Oz is in color (Bellantoni, 2005). Similarly, green is used in *The Matrix* (1999) to denote the computer simulated world while blue is used to signify the 'real' world (Misek, 2010).

### 2.3. *Visual punctuation*

In this case color is used to make elements stand out within the frame, namely drawing attention to a point of interest. Color properties (hue, saturation, and value) can be manipulated so as to emphasize a particular element relative to the other elements present on the frame. Although the final visual outcome is always the result of synergy (e.g. composition and framing play fundamental roles), the contribution of color can also be very decisive for emphasizing an element in the frame (Block, 2008).

### 3. Sculpting Visuals Through Effects

The bulk of former research on how students compose multimodal messages has mainly focused on the combination of the various modes to communicate meanings (see e.g. Hull and Nelson, 2005; Ranker, 2008; Bruce, 2009; 2015; Bruce and Chiu, 2015; DePalma and Alexander, 2015; Fulwiler and Middleton, 2012; Miller, 2013).

However, in recent years some researchers have explored how participants have employed video and audio effects in crafting multimodal messages (Doerr-Stevens, 2016; Smith, 2016; Burn, 2003; Hafner and Miller, 2011; Adsanatham, 2012; Hafner, 2014; Öman and Sofkova Hashemi, 2015; Yeh, 2018; author, 2019). While these studies do report the use of effects, the interest is emergent and largely tangential: the authors examine effects only because the participants who were crafting the digital messages used them. Even though the effects the participants used in the projects are listed, there is no detailed analysis of the semiotic properties of effects. The discussion is typically limited to the contribution effects made to the digital message. Thus, in this body of research a systematic, in-depth exploration of the semiotic function of effects is missing.

A comprehensive literature search located only a small sub-set of studies that had explicitly focused on effects targeting color adjustments. In the remainder of this section we will take a closer look at these studies.

Bruce (2009) reports findings from a longitudinal classroom-based study in which he followed three groups of high school students. He explored both the processes of multimodal production and the digital artifacts that the students made. The author relied on ethnographic methods to analyze various sources of data such as student protocols, interviews, teacher journal, and video recordings of the groups when they were editing their digital videos. Bruce (2009) details how the student groups experimented with different effects until they reached the specific visual or aural goals set. Of particular interest is the removal of color from a shot by one of the student groups. This group desaturated a shot fully, converting it to black and white. As the author explains, the reason behind this choice was mostly aesthetic: the scene was improperly lit during shooting the footage, which resulted in poor exposure. The student group took all the color away from the shot so as to cosmetically improve its appearance.

Baepler and Reynolds (2014) incorporated a video assignment in two writing courses. The students were asked to write an essay and then create the corresponding video so as to render the written essay in visual language. To convey the meaning of a negative influence of computer technology, one of the participants reported using many color effects. However, given the focus of the study, the authors did not explore further the semiotic dimensions of using such color-related effects.

Ranker (2017) conducted a study in which an 8<sup>th</sup> grader composed a digital video. The study was a longitudinal one spanning 10 weeks and involved participant observation by the

author. The digital artifact the student produced involved the application of effects to some of the shots. While the student utilized several different video effects (such as distortion and outlines), of particular interest for our purposes in this study was the use of effects that changed the image colors. Ranker (2017) described how the modality of the source video was altered due to the combined application of effects. As he pointed out, the use of color effects (in conjunction with the other effects used) allowed the student to create a very bizarre video, casting her message in a specific form.

In an exploratory study involving how undergraduates used effects in composing multimodal messages in the form of digital videos, author (2019) concluded that the majority of effects used pertained to transitions between shots. Only about 20% of the effects used were related to luminance and chrominance changes of the original image and video resources. The study indicated massive differences in terms of how effects were used in high and low rated DV projects. In the case of highly rated projects, the effects that were used had substantially changed the underlying visuals. Color-related effects were amongst the ones that made significant contributions to the subtle meanings that were communicated.

The sample is too small to allow drawing any conclusions as to the semiotic dimensions of color-related effects use. In the study by Baepler and Reynolds (2014) the issue is practically not taken up. The students in the study reported by Bruce (2009) utilized color effects to perform *cosmetic changes* to visuals, which amounts to fixing a shot in post-production. The color modifications reported by Ranker (2017) were clearly aimed at *changing* the source visuals., that is they served specific communicative purposes. It should be noted, however, that none of these studies was primarily targeting the use of effects and their semiotic properties. On the other hand, the findings reported by author (2019) were based on an examination of effects at large and showed that in certain DV projects the effects used *modified* the original visual elements, helping to get the message across with color.

### 3.1. Focus of the study

Considering that a systematic examination of color-related effects is missing, there is hardly any knowledge of how students appropriate the semiotic functions of color and apply them through effects in their digital multimodal compositions. While the semiotic potential that the effects make available to message creators in multimodal composing is significant, there is a knowledge gap concerning how novices use color-related effects in crafting multimodal messages. To address this, the present study attempts to map out how color-related effects are applied in multimodal compositions. In this paper we examine the DV projects made by a cohort of undergraduates who attended a semester-long course on digital media. The participants were introduced to the semiotic functions of color and were taught how to use a video editing program to compose multimodal messages. The main task involved the

creation of a multimodal message in the form of DV. The study focuses on these digital artifacts and addresses the following research questions:

**RQ1:** *What is the rate of use of color effects in the DV projects?*

**RQ2:** *How do the students apply the color effects in composing their DV projects?*

## 4. Method

### 4.1. Context of the Study

Seventy-six female students from a pre-school education department in Greece participated in the study. The participants enrolled in a compulsory, first-semester course on Digital Media. This 13-week course involved both lectures (3 hrs per week) and lab sessions (2 hrs per week). While most students reported some familiarity with media editing using popular social media services and tools (e.g. applying filters to images on Instagram), they reported that they had received no previous formal training in digital media processing.

The objective of the course was to introduce students to digital media concepts and processes, particularly image, audio, and video editing for educational purposes. More specifically, the course constituted a lightweight introduction to digital media creation and editing and included the following modules: (a) the *grammar of static and moving images* (Bordwell and Thompson, 2008; Thomson and Bowen, 2009a; 2009b; Dancyger, 2011), (b) *light and color* (Block, 2008; Bellantoni, 2005; Brown, 2016; Bordwell and Thompson, 2008; Kress and Van Leeuwen, 2002), (c) *effects* (Jackson, 2016; Smith and Team, 2014; Hughes, 2012; Wohl, Van Hurkman and Spencer, 2012; Bordwell and Thompson, 2008; Block, 2008; Brown, 2016; Thomson and Bowen, 2009b), and (d) *color grading* (Hullfish, 2008; Hullfish and Fowler, 2009; van Hurkman, 2014). The first two modules aimed to familiarize the students with the semiotic functions of devices such as framing (e.g. how the shot type influences viewer identification or distancing) and light (e.g. how boosting the contrast increases the visual tension in a shot). In the last two modules the students were instructed in how to use effects to modify the original visual and aural resources (e.g. to tell part of the narrative in flashback one might combine several effects such as desaturation, glow, blur, and a warm color tint).

In addition to the lectures, the students also attended weekly lab sessions in which they were introduced to software tools for media processing, specifically image (GNU Image Manipulation Program), audio (Audacity) and video (Kdenlive) editing. As part of the lab sessions, the students had to complete several small-scale assignments related to image audio and video processing. Of particular interest for this work is the video assignment that involved the creation of a short video from start to finish. This assignment aimed to familiarize students with with technical pipeline, namely the video editing software, the general video editing workflow,



and the procedures of applying effects. As the students had virtually no prior experience in creating digital videos, this lab assignment constituted a playground in which they could safely experiment with the software and advance their knowledge and skills in video editing. The completion of this assignment ensured that the students had the minimally required technical knowledge and skill for creating digital videos. All lab assignments (including the short video one) were required: the students could not submit the main course deliverable (more information below) unless they had already submitted all lab assignments.

#### 4.2. Task

A short (1-5 minutes) DV project was the main course deliverable. Students' main task was to compose a digital multimodal message on a topic they deemed important using any content they wished in any form they saw fit. As there were no restrictions, the actual message content could be about anything that the students cared about.

As far as material sources are concerned, the students had two main options. First, they could use content off of the internet (images, videos, sounds etc). Considering the quantity and quality of media that is easily available on the internet, this was the recommended method of obtaining resources. Second, if locating resources using the aforementioned method was deemed impractical or inconvenient, the students could shoot footage. In addition to using their own devices for recording (cell phones, tablets, video cameras etc), they were also given access to high-end still and video cameras. While the DV project was an individual assignment, in case the students opted for shooting footage on their own, they were allowed to collaborate in groups of two. The underlying reasoning was that there is a lot more work involved when capturing images and videos (e.g. planning the shots, finding locations and subjects, enlisting help from fellow students and friends to act on the video, shooting the footage etc) compared to searching the internet for resources.

The projects were evaluated using two major criteria: (a) content, and (b) form. The former represents the resources (image, video, audio) that the students assembled to communicate their message as well as their sequencing. The latter represents how these resources were modified so as to meet the particular message requirements (e.g. video and audio effects). The contribution of content and form to the DV project grade was balanced (50% each). To facilitate student's planning and general orientation, this grading scheme was communicated to the students in the beginning of the semester.

### 4.3. Materials

#### 4.3.1. Software

The video editing application used in this study was Kdenlive (Kdenlive, 2016), which is a free and open source NLE available for all major operating systems. Compared to other video editors that come bundled with an operating system (such as MovieMaker for Microsoft Windows or iMovie for MacOS), Kdenlive is a more sophisticated application that supports standard editing workflows through a rich tool-set (e.g. effects, scopes).

#### 4.3.2. Instructional Materials

Considering that (a) there were no book manuals covering the functionality of Kdenlive in Greek and (b) the only online documentation was available in English, the students were provided with two sets of supporting materials. The first included concise electronic manuals (in PDF format) that covered the main program operations. These included screenshots, shortcuts, and the sequencing of steps to perform common functions. The second set included a large number of videotutorials that covered the whole post-production workflow in minute detail (editing, effects, and rendering).

### 4.4. Data Collection

The course deliverable, i.e. the final DV project, was the main source of data used for this paper. The assignment requested the students to submit (a) the *final video project* (which was rendered in a common delivery file format such as MP4, MKV or WEBM), (b) the *edit of the DV project* (Kdenlive file in XML format that stores all edit-related information), and (c) the *original resources* (namely all the source files that were imported into Kdenlive and were used to create the video). What is unique about Kdenlive is portability: access to the source files and the edit decision list (Kdenlive XML file) allows one to fully reconstruct a video project on a different computer system. This means that one has the opportunity to study each individual clip used in the project, examine each and every edit choice made, consider whether any effects are applied to a clip and how these effects are configured.

### 4.5 Analysis

We used artifact analysis (Willig, 2013) to examine the DV projects in order to determine whether color-related effects were used and how. Following Smith, Kiili and Kauppinen (2016) we treated each shot as the unit of analysis. All visual assets in the Kdenlive timeline were treated as shots. Considering the study focus on color, this excluded audio clips, title clips, and a special category of effect clips (that take as input two other image or video clips). There-

fore, we focused only on image and video clips as these were the primary carriers of visual information that could be modified through color effects. For every shot in each DV project we identified the effects that were applied to modify the chrominance. Then, the outcome of each effect was determined by comparing the corresponding shot before and after the effect had been applied.

Using this comparative analysis method, we attempted to determine the semiotic function of each effect, examining it in context. In semiotic terms, this interpretation was based on the three main color function outlined above: affinity, contrast, and punctuation.

## 5. Results

Sixty-one students out of the 76 who initially enrolled successfully completed all required course work and were eligible to participate in the final exam. Ten failed to comply fully with the specific submission requirements set (i.e. submitted only the DV projects without the edits or the source files) so their DV projects were removed from the data corpus because they could not be comparatively evaluated using the method described above. Of the 51 remaining students ten had collaborated in dyads, as they had decided to shoot footage rather than locate resources on the internet. Thus, the final data set upon which this study is based is 46 DV projects. While the unit of analysis used in the present study is the DV project, due to the fact that the students could either locate resources on the internet or shoot footage on their own, 41 DV projects were crafted by individual students and 5 were created by student dyads.

A rough overview of the topics that the DV projects covered is given in table 1. It should be noted that this categorization is not the systematic outcome of thematic content analysis, it merely represents a clustering of videos in broad topic sets.

Topic	N	%	Sample Video Project Titles
Places	13	28,26	Beauties Of Greece; New York; Christmas In Volos; Pertouli Village; Trip To Aigina
Education	12	26,09	Wildefires; Child Development; Volcanos;
Social issues	11	23,91	North Selas; Sexual Reproduction; Child Cancer
People	3	6,52	Bullying; Terrorism; Stray Aimals; Family Violence; Stop Child Abuse; Fairy Tale For Grown-Ups;
Pets	3	6,52	Leo Messi; Zoe Laskari; Jenny Karezi
Various	4	8,70	Man's Best Friends; Growing Up With A Pet; We All Love Puppies
			Life On An Island: Reality Vs. Expectations; Fairy Tale: The Giving Tree

**Table 1.** Topic Categorization

It should be noted that the categories are not mutually exclusive. For instance, the categories 'People' and 'Pets' could also be seen as sub-categories of 'Social Issues'.

As can be seen from table 1, about one quarter of the videos pertained to presentations. The main objective of this category of videos was to introduce a specific place and it usually involved a tour of some sort. Another quarter of all projects had an educational purpose. The idea behind these video projects was to present a topic of interest. Approximately one fifth of the videos were centered on social issues. The videos in this category aimed to sensitize the viewers to a particular topic (e.g. bullying). Overall, three out of four videos were related to these three genres.

### **RQ1: What is the rate of use of color effects in the video projects?**

As table 2 shows, 32 out of the overall 46 DV projects (69,57%) featured no color-related effects. Thus, about two thirds of the students did not utilize effects to manipulate the color of the source visuals. On the other hand, effects that pertained to color changes were applied in 14 DV projects (30,43%). Consequently, only about one third of the DV projects involved changes in the visuals that are color-related. Considering that it is precisely these projects that are of interest, we will focus on them exclusively for the remainder of this section.

### **RQ2: How do the students use the color effects?**

The analysis of how effects were utilized indicated three main patterns of use that are outlined in table 2.

<b>Category</b>	<b>N</b>	<b>Description</b>
<i>None</i>	32	No color effects are applied
<i>Defective</i>	4	Color effects are applied but without changing the visuals
<i>Inconsistent</i>	4	Color effects are applied but not in a systematic way
<i>Consistent</i>	6	Color effects are applied in a principled way

**Table 2.** An overview of color-related effects use per projects

#### *5.1. Defective*

The defective use of color effects indicates that, while color effects are applied in the DV project, they are not functional, i.e. do not actually change the color of the image or video clips to which they are applied. Four DV projects were found to be of this type and are illustrated below using two cases.

SEXUAL REPRODUCTION was an education-type video project that aimed to provide an overview of the process from conception to birth. The student used color to signify transitions from one clip to another. Although she could have easily resorted to using more standard transitions (such as fades), eventually she used color-based transitions. However, due to the

improper configuration of the effects, there was no impact on the corresponding image or video clips. The fact that she used several color-related effects for transitions indicates that the student has put quite some effort in changing the visuals. Regardless of this effort, however, the outcomes of the effects applied are negligible as the final images are identical to the source ones.

The FAIRY TALE: THE GIVING TREE DV project was a visualization of a well known story. Even though the student applied three color effects to three clips, the resulting visuals were indistinguishable from the source ones. This indicates that the effects might have been added but were not functional, namely failed to change the underlying visuals. This pattern suggests that the student experimented with color effects but did not get anywhere. Similarly to the aforementioned case, the setup of the three color effects was incorrect and the application of effects did not result in any change of the visual elements.

## 5.2 *Inconsistent*

In this category color effects are configured correctly, clearly changing the color of the image or video clips onto which they are applied. However, the problem is that their scope is limited. The students might apply a color effect correctly but this is a local change that does not necessarily extend to other clips in the project – even though that might have been called for. It can be said that the changes have mostly a local character. Four DV projects fell into this category and we take a closer look at two representative cases.

The ZOE LASKARI DV project details the life and times of a famous Greek actress. Most of the image and video clips used are fully desaturated. In the first part of the DV project the student added an image clip to a sequence of image and video clips that were black and white. As the particular image clip was in color, the student applied a desaturation effect to convert it to black and white. At a later point in the timeline, the student also removed all color from two sepia-toned image clips. Considering that the neighboring shots were in black and white, such color choices indicate that the student deliberately removed the color of the specific image clips to make them fit in with the local color scheme (monochrome). While such color tweaking choices are spot on, their application is not consistent throughout the project. A typical convention would be to render the past of the late actress in black and white and her more recent years in color. However, this is not the case: several clips that refer to her past are completely desaturated but other image and video clips that also refer to her earlier years are in color. What this particular DV project suggests is an appropriate but partial application of color effects. There appears to be a clear reasoning behind some of the choices related to the removal of color in some of the clips, i.e. make them fit the overall color scheme that represents the past. However, one would expect the student to apply the same reasoning to all the clips in the DV project but this did not happen.

The BULLYING DV was a social issue project that portrayed bullying amongst youngsters. In

the first part of the project the student had desaturated most of the image and video clips used. This was very effective as the student managed to craft a touching message, conveying a dark, depressing mood that is associated with bullying behaviors. The consistent use of black and white imagery helped create a moody message that sensitized the viewer. However, most of the clips in the second part of the DV are in color. Had the image or video clips of the second part been anti-bullying, this would have made sense. However, this was not the case: several image clips in the second half of the project depicting children in agony, fear, and despair – similar to the ones featured in the first part of the video – are very bright and colorful. Much like the ZOE LASKARI video analyzed above, the lack of systematicity is notable: the student appears to make the right decisions when it comes to color for one part of the DV but these do not generalize to the whole project. Not only that but the very existence of uplifting and vivid images depicting children that are subjected to bullying stands in stark contrast to the black and white imagery that came before. While it is rather difficult to account for such a discrepancy, this DV project illustrates the fact that the color changes to the source visuals were highly selective.

### 5.3 Consistent

This category represents the most sophisticated color adjustments made in the DV projects. It has four main manifestations: continuity, color scheme, tinting/colorization, and selective coloring. These manifestations are outlined in table 3. It should be noted that these are not necessarily mutually exclusive, so e.g. a color image clip can be both desaturated, so as to fit in a sequence of clips denoting the past, and also tinted in red, in order to convey feelings of tension or anger. Considering the color focus in this study, two of the six projects that fell into this category are closely analyzed.

Function	Description	Example	Effect(s)
Continuity	adapting a clip to the local context that defines shared color properties	a color clip is desaturated when inserted in a sequence of clips representing the past in black and white	Saturation; RGB Curves
Color Scheme	distinguishing between two states	representing different or opposing states (such as good vs. bad, sad vs. happy, past vs. present) using different colors	RGB Curves
Tinting / Colorization	coloring a clip in a particular hue	a clip is re-colored in a particular hue	Saturation; RGB Curves
Selective Coloring	masks are used to define areas of the frame that are to be affected by specific hues	a point of interest in the frame is masked and its saturation is increased; at the same time, the inverse mask is used to suppress the saturation of all other areas so that the element stands out	Masks; RGB Curves, Saturation

**Table 3.** Main color manipulations

The FAIRY TALE FOR GROWN UPS DV project is the second best example of principled color use. In this two-part message, the student touches on the social issue of child labor in an original, allegorical way. The first part of the DV introduces a young girl who is obviously forced to sell various items on the street. In the second part, a benevolent old lady, who is taking her own granddaughter to the playground, invites the street girl to join them. The two children play together and end up having a lot of fun. For the first time, the street child realizes what life could have been like had she not been forced to child labor. The DV is concluded with a direct call to end all child labor so as to allow all children to enjoy the joys of childhood.

What this DV project illustrates is an overall color design: the first part is rendered in black and white while the second part is rendered in color. Even though most of the image clips that the student uses for the first part of the DV were originally in color, she used effects to remove all color. This results in desaturated, lifeless images. Figure 1 presents a screenshot of the video project edit featuring the initial, colorful image used. As the vectorscope on the top right window indicates, the image is over-saturated.

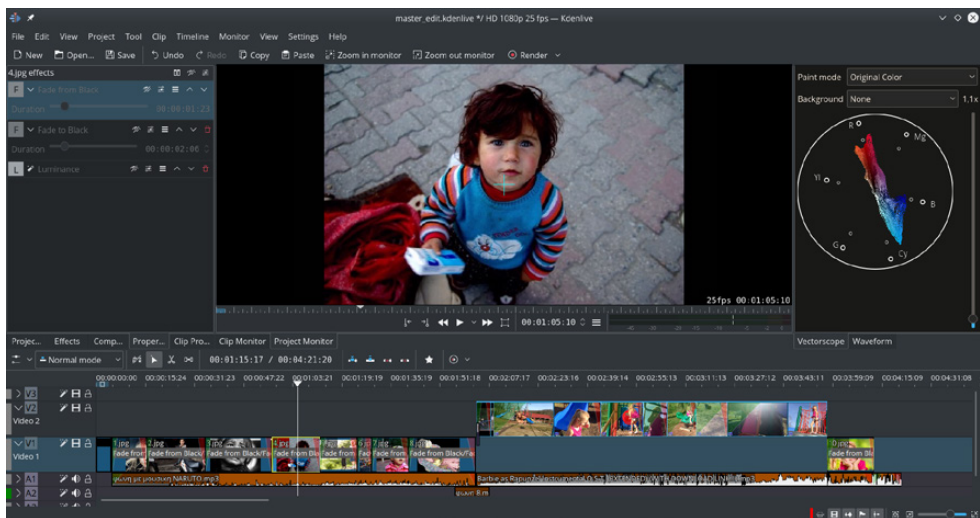


Figure 1. DV project screenshot of the original image in color

The same image is shown in Figure 2 where the student had applied the Luminance effect. The result of this operation is a fully desaturated image.

On a semiotic level, this choice portrays the current state: the world as is, i.e. the bleak world the street child experiences. On the other hand, all image and video clips of the second part of this fairy tale are in bright, saturated colors. Semiotically, this represents the ideal state, i.e. the world as it should be for the street child.

The FAMILY VIOLENCE DV project is the best example of color manipulation. It touches

on the social issue of domestic violence involving the abuse of women. It uses a combination of image and video clips to create a powerful message that sensitizes the viewer to the problem. As opposed to the FAIRY TALE FOR GROWN UPS DV project analyzed above, this project does not rely on a specific color scheme to differentiate between states. On the contrary, this DV project utilizes many different effects to change the color of the underlying visuals.

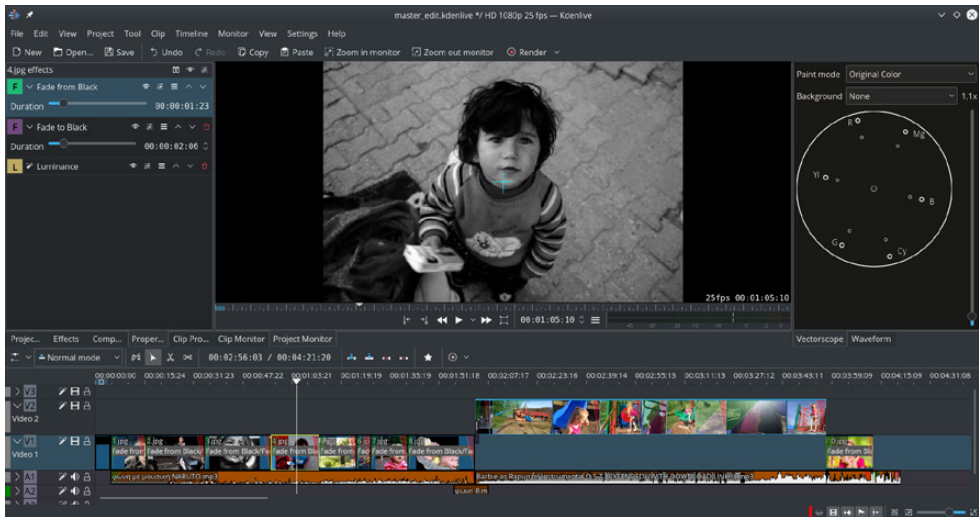


Figure 2. DV project screenshot of the final, fully desaturated image

*Desaturation.* The student removed the color from several clips. On a semiotic level (and in conjunction with the heightened contrast), this resulted in conveying a feeling of utter depression and despair.

*Tinting.* Following the complete color desaturation, tinting was often applied to certain clips. The student used a red hue to tint an entire image clip. In terms of semiotic function, red is used to represent the amplified tension between the couple, either an argument that escalates to abuse or the physical abuse phase itself.

*Saturation.* This effect builds on the top of the former ones: the student has fully desaturated the clip and then used a reddish tint to colorize the image. In some clips, the student intervention was not limited to subtle tinting; she proceeded to boost the saturation of red – in a couple of instances bordering oversaturation. Semiotically, this increase in color saturation intensifies the tension of the scene depicted in the frame.

*Selective colorization | saturation | desaturation.* What sets this particular DV project apart from all others is the systematic use of masks. Technically, masks are black and white images that are typically used to define the transparency level of a group of pixels (ranging from fully transparent to fully opaque). The student created several masks to isolate certain elements (e.g. subjects) in the frame so as to proceed to further changes.



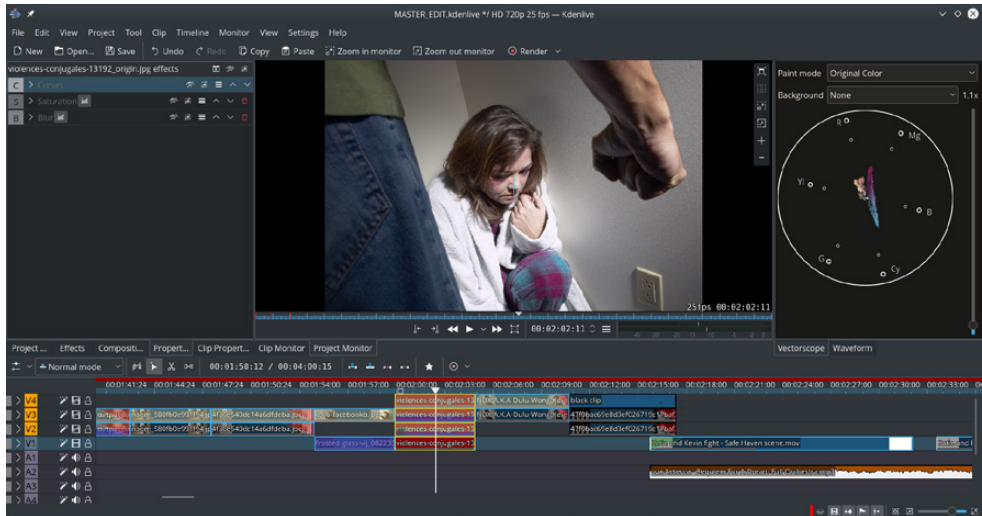


Figure 3. DV project screenshot of the original colorful image

For example, figure 3 depicts a project screenshot with the initial image used for this shot. The whole image is in color with medium saturation (see vectorscope on the top right window). Figure 4 shows the final image, which resulted from the application of several effects (Curves, Saturation, Contrast, Blur) and masks (Rotoscoping).

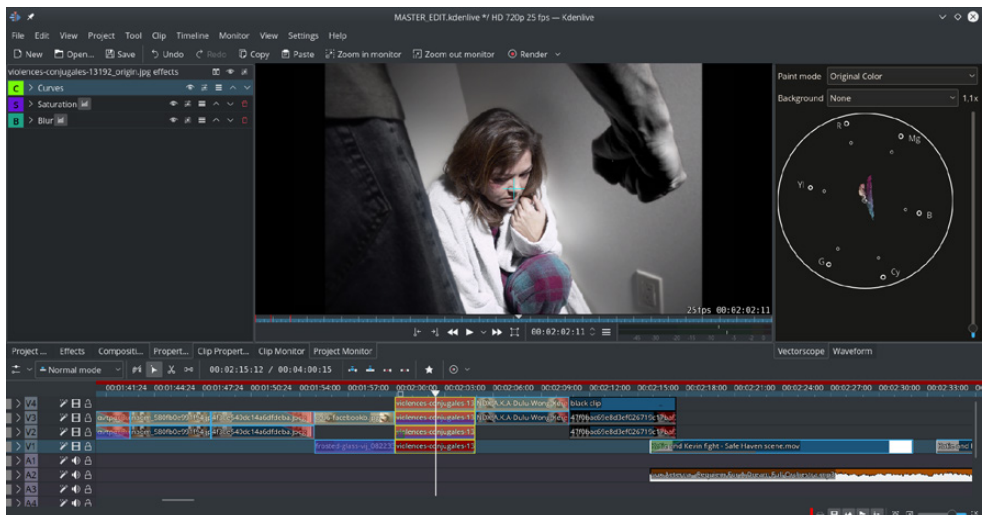


Figure 4. DV project screenshot of the final, selectively desaturated image

As can be seen from the frame, the student had completely desaturated certain image areas, leaving only the female subject in color. To achieve this she combined the clip four times

(see the stack of four clips in the timeline in the bottom window): each clip involved a separate mask and applied several color operations on different parts of the image. Figures 5a, 5b, and 5c cumulatively illustrate the respective masks that the student used.



**Figure 5a.** 1st mask detail: the female subject is separated from the rest of the image (black indicates full transparency)



**Figure 5b.** 2nd mask detail: the desaturation and tonality adjustments are limited to a portion of the male figure (black indicates full transparency)

Figure 5a indicates the use of a first mask to isolate the female subject in the center of the frame. This mask allowed the student to exclude this image portion from all color and tonality manipulations that were applied to other image areas. Figure 5b shows how a second mask enabled the student to limit the desaturation and tonality adjustments made only to the left side of the shot featuring part of a male figure. As can be seen from the frame in figure 5b, the student removed all color and reduced the tonality of this image part. Finally, figure 5c shows

how a third mask helped confine desaturation and brightness reduction only to the male arm on the top right of the frame. The black color in these last three figures represents the alpha channel, which indicates full transparency. This transparency data allows the combination of all four clips to produce the combined result featured in figure 4.



**Figure 5c.** 3rd mask detail: the desaturation and tonality modifications are only applied to the portion of the male arm visible on the frame (black indicates full transparency)

This represents the most advanced application of masks as the student was able to (a) isolate parts of the frame and (b) manipulate the chrominance of these parts further. In semiotic terms, this type of use amounts to visual punctuation: the student applies different hue values and saturation levels to different areas of the image.

In this particular DV project, the original visuals were completely transformed through effects: the student repurposed pretty much all source visuals, transformed them extensively, and recombined them so as to craft a message of outstanding quality. It is important to stress the fact that the student has paid attention to minute details.

## 6. Discussion

To participate in contemporary literacy practices that are inherently multimodal, young people would need to familiarize both with color as a semiotic resource and the digital tools that can be used to adjust color. Currently, there is a knowledge gap regarding how students of all ages use color to communicate meanings in their digital multimodal compositions. While a handful of former studies have reported the use of color-related effects, the study of effects was either emergent (e.g. Bruce, 2009; Baepler and Reynolds, 2014; Ranker, 2017) or much broader in scope involving all types of effects (e.g. author, 2019). To address these limitations,

the present study examined whether and how 46 undergraduates applied color in creating short digital videos.

The study findings indicate that all participants utilized several different effects in crafting their DV projects. However, the majority of students (about two thirds) did not use effects that manipulated the color of visual imagery whatsoever. Only about one third of the students employed color-related effects in composing their projects.

While this might seem promising, the systematic application of effects adjusting color characterized only about 20% of those projects. Overall, a little more than one in ten DV projects involved consistent color modifications, which is not satisfactory.

Only five DV projects involved shooting footage and taking photographs. This means that only a small number of projects allowed students some control over light and color during shooting. The majority of the DV projects involved the regular use of image and video resources off the internet. Considering the heterogeneity of such resources (e.g. different cameras, lenses, framing, exposure, lighting and color conditions etc), the probability that these were matched in terms of chrominance or luminance was practically zero. Consequently, shot matching in terms of light and color was the bare minimum. In addition to this low-level adjustment, color needed also to be manipulated on a higher level, such as for contrast and punctuation.

As the data analysis indicated, many opportunities for color manipulations arose but were largely missed. The majority of students simply ignored color-related effects when composing their DV projects. Although all the students were exposed to the same color-related concepts, software tools, and workflows, there was a markedly differential response: only one in eight students employed effects in a systematic manner. This finding suggests that the semiotic potential of effects for changing the original visual imagery was largely untapped. Essentially, this finding replicates a former study with participants from the same demographic (author, 2019). More particularly, a different student cohort had attended the same course and were tasked to make a similar digital artifact. The findings revealed that the rate of color-related effects was about 20% which roughly corresponds to the ratio of effects identified in this study (author, 2019).

As far as the small set of DV projects that involved the systematic use of color are concerned, the findings suggest that there was also high variation amongst the students who did use effects to modify the color of the source visual elements. At the one extreme, color-related effects were applied in four DV projects but failed to change the visuals in any substantial way due to improper configuration. At the other extreme, six DV projects included many sophisticated uses of color-related effects. As a result, the color of the source visuals was fundamentally transformed, serving the narrative functions of each respective video project. In between, four DV projects were characterized by the inconsistent application of color effects to the visual elements. The analysis of the projects with consistent application of color indicated four

main patterns of color modifications: continuity, color scheme, tinting/colorization, and selective coloring. These color uses are indicative of all three primary semiotic functions of color outlined in the introduction (visual coherence, visual distinction, and visual punctuation). The two projects that were presented in detail reveal that, at the one extreme, a small sub-set of students used color in sophisticated ways, fundamentally transforming the original visuals to communicate meanings in subtle forms.

Digital artifacts that combine static and moving images with sounds and text form the core of what Manovich (2013) has termed as the new “*hybrid language*”. Although his account of the hybrid language encompasses more than DV (e.g. 3D compositing), DV can approximately be seen as the core of this hybrid language of new media. Considering that the young generation creates multimodal messages at an increasing rate, exploring how they utilize effects in general and color-related effects in particular is of importance. Young people will need to become familiar with color and its semiotic affordances for communicating meaning. While the present study is a first step in this direction, more systematic empirical research is required to determine how to optimally induce students to “writing” with color in composing multimodal artifacts.

On the other hand, recent technological developments have practically rendered color as just another independent variable in multimodal composing (Belton, 2008; Prince, 2011; James, 2014). While color might not be a mode on its own (Kress and Van Leeuwen, 2002), it has had a deep and lasting impact on contemporary consumer culture (Błaszczuk, 2012). Considering how malleable digital technology makes color, a systematic account of digital color semiosis as it is realized through effects has yet to be developed. This is particularly important because most research to date has principally focused on composing by combining different modes (e.g. Hull and Nelson, 2005; Ranker, 2008; Bruce, 2009; 2015; Bruce and Chiu, 2015; DePalma and Alexander, 2015; Fulwiler and Middleton, 2012; Miller, 2013) rather than on how effects are used to sculpt visuals in order to communicate meanings. Given the novelty of multimodal composing, this initial emphasis is understandable. However, based on the fact that effects expand the meaning-making potential (author, 2019), it is imperative to develop a framework for describing the semiotic properties of color.

### 6.1 *Limitations*

This work has three main limitations. First, the sample is gender-biased, due to the fact that all participants were female. Therefore, the study findings are expected to apply mostly to female populations of similar demographics.

Second, this work is interpretative in nature: the author observed an effect that had been applied in a project and deduced the intentions behind its use. In most cases, this is very straightforward. For example, if a desaturation effect is applied to an image clip that is in color,

the intention is clear: the student wishes to remove (all or part of) color from the clip. On the other hand, if a student removes all traces of color through a desaturation effect and then tints the clip in a mildly saturated red tone, the interpretation is less straightforward. Why does the user select the particular color (say red) and the particular tone and saturation? Does this represent a random choice? A simple stylistic preference? Could it have been possible for the student to pick a different color, such as green or blue? Or does this choice of particular hue, saturation, and value represent a deliberate intention that is influenced by typical conventions. Tracing the reasoning behind each color effect choice would be ideal. This can be accomplished in two main ways: (a) think-out loud protocols or (b) group interaction. While in theory such options are ideal, the logistics of capturing such thought processes are very demanding. This is why most published studies on this topic involve a very small number of participants. Future research on DV effects will need to turn to such data collection methods so as to provide a thorough account of the reasoning behind each choice.

Third, the communicative context of the study was not authentic. More specifically, the sole addressee of the DV projects was the course instructor, there was no real audience to view the videos and appreciate the value of the respective messages. The students might have had a relatively high motive to craft fine videos (i.e. earn up to 30% of the total course grade) and yet the messages created served no real communicative purpose. It could be the case that such artificial conditions impact the quality of multimodal messages because a real audience gives students additional incentives for making even finer videos. Future research will need to systematically explore whether the conditions of multimodal message creation influence the rate and quality of color manipulations.

## 7. Conclusion

Becoming literate in contemporary multiscreen societies necessitates an understanding of the semiotic potential of color as well as mastery of digital tools through which color can be applied to craft messages of high modality. This study examined how novice students utilized color-related effects in composing multimodal messages. The analysis of 46 video artifacts indicated that only a small portion of the students utilized effects that adjusted the color of the visual resources.

Overall, the extent to which the study participants utilized color effects is far from satisfactory. Consequently, there were many missed opportunities as the semiotic potential of effects with respect to color was not tapped. On the other hand, the six DV projects that involved the systematic application of color-related effects suggested a very promising picture in terms of color uptake and use. More research is needed to explore students' differential response to color and determine how to best support young people to signify with color.

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