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A Film Editor's Visual Intentions and Use of Perceptual Phenomena in Designing Film Edits

An Observational Study

THORBJÖRN SWENBERG

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A Film Editor's Visual Intentions and Use of Perceptual Phenomena in Designing Film Edits: An Observational Study

Thorbjörn Swenberg,¹ Dalarna University, Sweden

Abstract: This article investigates the role of perception in film editing, considered as audiovisual design work. The study is an observation of a film editor editing a documentary film sequence, where the perceptual phenomena at stake at edit points are scrutinized, with reference to perception theory. The results show that the film editor's design goal is to achieve perceptual precision for each edit, either for continuity or for discontinuity, accordingly. The more perceptual phenomena per edit, the more time and the more processing the editor has to spend on the edit until satisfied with the result. This knowledge is of importance to inexperienced film editors in order to make the editing process faster and more precise and thus shorten production time. In the wider design context, other design activities are indicated to find inspiration for future research in this study, regarding perceptual phenomena and gaze framing during design processes.

Keywords: Audiovisual Perception, Audiovisual Design, Audiovisual Distortions, Perceptual Precision

Film edits are claimed to be shaped by film editors with an intention to be attended to by viewers, or to be invisible to them (Riesz and Millar 1968; Orpen 2003; Pearlman 2009). Viewers' perception of film edits have been studied before with the conclusions that the editing principles of continuity or discontinuity matter, and that film editors must regard visual perception while editing in order to succeed (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005). Yet, it is not empirically established whether a film editor actually pays such attention to perceptual phenomena during editing, or whether editorial intentions concern perception, which are issues that this study addresses. It does so by following an editing process and identifying kinds of film editing work tasks, but also by measuring some aspects of work tasks to evaluate their role in regard to this particular process and to the editor's intentions. This approach is meant to suggest how film editing, and perhaps other audiovisual design work, could be further studied in wider contexts.

Film editing is concerned with creating comprehensibility in film stories, assessing recorded shots and sounds and selecting the appropriate parts, organizing them into sequences of film, as well as shaping the transitions (edits) between shots for perceptual convenience. Films are constructed by joining singular sounds and shots into a succession of sequences. How films then, as complete objects, can be enjoyable and comprehensible audiovisual stories, is intriguing. One horizon for elucidation is provided by considering film production as a design work (Westera 1995; Swenberg and Eriksson, forthcoming), where film editing is one of the key activities. This work can be described as art and craft, depending on a tradition that includes conventions, principles, and guidelines for how to conduct the work (cf. Niedderer and Townsend 2014). Film editors express how their skills and knowledge become embodied intuition (cf. Oldham 1992; Crittenden 2005; Adams et al. 2011). Nevertheless, there is a need for understanding film editors as audiovisual designers and what cognitive tools they use (cf. Smith and Whitfield 2005).

A rich literature exists regarding how to achieve or deny comprehensibility in film stories, principles for assessing a recorded audiovisual material, as well as how to organize sounds and shots in orders and layers that make appropriate sequences (e.g. Croy 1918; Bordwell 1985; Boorstin 1995; Osgood and Hinshaw 2009; Gaut 2010). In the craftsmen's production literature on film editing, there is also a well-established set of principles for how to manage transitions between shots in order to make them smooth so that they can pass unnoticed to the eye of the

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novice when viewing the film (Riesz and Millar 1968; Fairservice 2001; Murch 2001; Pearlman 2009). These principles are concerned with the audiovisual perception of films, and specifically the visual perception that the estimated viewers of a film are supposed to experience.

Perception psychologists have studied some of the film editing principles in question, in order to understand how they work in relation to human visual perception (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; d'Ydewalle, Desmet and Van Rensbergen 1998). Only during the last 15 years has a thorough investigation into this relation been carried out and has led to the publication of *An Attentional Theory of Continuity Editing* (Smith 2005). The theory described in this thesis by Smith explains some major aspects of how the shaping of film edits is a matter of accommodating the transitions between shots to the functioning of the human visual perception. What the theory does not explain, and what still needs to be investigated, is how editors work when they shape shot transitions, making use of film editing principles, thus making the edits smooth with regard to the film viewers' visual perception. Smith suggests that film editors develop an extraordinary sensibility to visual attentional cues, which they then use to shape edits for smoothness:

Once an editor has developed this sensitivity, they can then move away from the "rules" adapting each cut to the attentional dynamics of their viewer. This sensitivity to attentional cues should provide editors with an abnormal ability for predicting where people will tend to look in a dynamic visual scene at any particular point in time. Empirically establishing this ability would provide interesting support for an attentional theory of continuity editing. (Smith 2005, 351)

The current study attempts to empirically examine whether or not it is confirmable that a film editor is sensitive to attentional cues, as well as employ such cues in film editing when shot transitions are shaped. If so, how is human audiovisual perception considered? This is a "puzzling complexity" specific to film editing that inexperienced film editors need insights into in becoming professionals, which is knowledge that film editors are assumed to embody with increasing experience (cf. Adams et al. 2011). In providing empirical evidence on this matter, a design science approach is used, which will treat film editing as design work, where design theory provides support in understanding the shaping of digital matter for audiovisual communication (Swenberg and Eriksson, forthcoming). Achieving comprehensibility in a film story is regarded as problem solving (cf. Simon 1996). Assessing a recorded audiovisual material is considered an evaluation of meaning, with both intellectual and affective components (cf. Krippendorff 1995; Grodal 2003). Meaning thus refers to whatever are useful results of cognitive processing and assimilation of information for an individual: drawn from memory, perception, thinking, or emotions. Organizing shots and sounds into film sequences includes all these aspects. Shaping shot transitions is then the fine-grained, material handling of audiovisual matter that trims the very appearance of edits and is therefore a matter of audiovisual design. We need to examine this audiovisual design process in order to identify the role of perception. If it is found to have the function and impact appointed by editing literature and perception studies, we need to learn more about its employment (Riesz and Millar 1968; Orpen 2003; Pearlman 2009; Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005). The editor's capacity to shape transitions and to trim edits is, in this regard, a design skill that inexperienced film editors in such case need to develop (cf. Adams et al. 2011). Film editing would mean design for audiovisual perception, where perceptual precision is the key factor under scrutiny, since it is supposed to reduce audiovisual distortions to a minimum. Inexperienced film editors would need to make efforts to thoroughly embrace how perceptual phenomena should be addressed in editing.

In order to stress the point of perceptual precision, this study gathers empirical data from a documentary film editing process. Earlier studies on human perception of film edits have used film material from arranged recordings, such as drama or other fiction films, where the shots are planned for smooth editing before recordings (e.g. d'Ydewalle and Vanderbeeken 1990; May,

Dean and Barnard 2003; Smith and Henderson 2008; Shimamura, Cohn-Sheehy, and Shimamura 2014). The present study uses a case of already filmed documentary material, where the videographer has recorded scenes, in which a man tells a story about the restoration of a house. Thus, most of the recorded shots are not planned to fit each other in a certain order or sequence. Regarding the few that are, that intention may or may not prevail into the editing room and through to the completion of the film. The documentary film editor has a large impact on redirecting the film during editing, where original ideas of story and audiovisual appearances are negotiated, which is frequent procedure in documentary film-making (Riesz and Millar 1968; Nichols 2001; Hampe 2007; Rabiger 2014).

Subsequently, the documentary film editor has a more difficult task in achieving perceptual precision for smooth edits when applying film editing principles to his/her shot transitions, as the transitions he or she makes are not between shots that are intended to fit each other perceptually. This makes the case for documentary film editing being more interesting to study, since the editor's efforts in the application of editing principles should be harder and therefore probably more open for examination. Thus, if perceptual precision is hard to achieve in documentary film editing, it should be apparent quite promptly, since "[e]diting a documentary is similar no matter whether the film is short or long" (Rabiger 2014, 211). Studying the editing of a shorter documentary film sequence should suffice for understanding the core aspects of documentary film editing as process. The particular case could provide opportunity to try to identify perception as a factor when shaping edits.

Core Concepts

The understanding presented in the present study uses a set of concepts that might be used slightly differently elsewhere and therefore need to be established for the current purpose. The most central concepts for the argument are *edit*, *edit point*, *continuity*, *discontinuity*, *transients*, *attention*, and *perceptual precision*. Since this study is framed within design discourse, the use of "audiovisual design" first needs fixation.

Audiovisual design is hereby primarily ascribed to the essential activities involved in the adaptation of sound and image storytelling components to each other (i.e. sounds, shots, camera movements, lighting, and objects within the moving images), as well as to a general master script for an object of communication, such as a film (Swenberg 2012). *Film* is defined as the medium consisting of sound and a stream of still images that move by means of a fast subsequent exposure of frames (usually, twenty-four or twenty-five frames per second), whereas *a film* is considered as a complete object of communication, consisting of film. *Video* is in this regard the material on which film is recorded.

An *image* henceforth refers to a moving image with general facets, and objective properties, such as, color coherency, aspect ratio and frame rate. A *shot* is a specific instance of a moving image with composition, framing, and a start and an end, due to the order its frames were recorded by the camera. A shot starts where the camera started recording. It continues during that recording, and it ends where the camera stopped recording on that particular occasion. (When a shot is repeated several times during recording, each repetition is called a *take*.) Several shots are joined together into a *sequence* during the process of editing, where there are no gaps between the shots, and there is a sound track that runs along them.

Every visual shift in this sequence, where one shot ends and is followed by the start of the next shot, is called an *edit*. Every edit entails a *transition* between the two shots. Such transitions can occur as an immediately shift from one frame to the next, which is called a *cut*, or as a smooth blending of the two shots, which is called a *dissolve*, or appear in other graphical forms with specific names, not in use here. The point in time (from the film's start, or on a film editing tool's timeline) where an edit occurs is defined as an *edit point*.

Editing, in turn, is the work that a film editor does and includes choosing shots from a stock of recorded footage; to order the chosen shots into a film sequence; to remove, add and order bits of sound in relation to the image; as well as trim the transitions between shots until they appear

as close to what is desired as possible. If the transitions are desired to appear smooth or invisible, achieving this is referred to as *continuity editing*, where the sequences of shots appear to the eye as one continuous shot, without breaks.

When breaks between shots in a film sequence are not hidden but edits are left with transitions visible to be responded to perceptually, attentionally, or consciously by a viewer (even only possibly), these sort of breaks are referred to as *discontinuity*. *Continuity* is thus understood as the opposite to discontinuity, i.e. when breaks are hidden (cf. Smith 2005).

All phenomena in a film sequence, i.e. sound or image properties that stand out which provoke perceptual or attentional response in a human viewer, are called *transients*. Thus, it is transients, e.g. an unexpected noise or a drastic change of visual information, that provoke discontinuity by attracting a viewer's perception or attention. When provoking attention, transients are called *attentional cues*. However, attentional cues may be used to create continuity as well as discontinuity, depending on how they are employed by the editor (Smith 2005).

Within Perception Psychology, *attention* is referred to as the cognitive function by which "some sensory inputs are processed faster or deeper than others, and thus become more readily available for action, memory, or thought" (Lamme 2003, 12). This faster and deeper processing can occur at the point of sensory input, as well as during the cognitive processing of the input, or even at the stage of conscious awareness of the input (Smith 2005, referring to Lamme 2003).

Perception is, in this study, used to label the process by which sensory organs react to, and extract salient information from, the world surrounding the human body, and send signals (*percepts*) to the brain for cognitive processing. Visual information in the shot that is candidate to be salient, and thus cause visual percepts in an unrehearsed viewer, is hereby demarcated as *visual perceptual property*; e.g. objects, details, surfaces, shapes, patterns, colors, contrasts, or movements.

When trimming edits, the film editor is expected to evaluate the visual perceptual properties of the two shots to be joined in order to avoid or use visual transients, to create a continuity edit, or a discontinuity edit. *Perceptual convenience* is hereby meant to include both means of application of visual transients, since a film editor may use either, depending on the aim. Whereas *perceptual precision* is the degree to which an optimal application of visual transients is achieved, due to what is perceptually convenient. Audio aspects might also affect vision and are expected to be considered by a film editor. The estimated target effect of perceptual precision should be possible to measure by using, for instance, eye-tracking.

Problem and Questions

The present study concerns how film editors consider visual perceptual properties in moving images as one factor taken into regard when shaping the film edits, apart from emotion, story, pace, rhythm, and other film editing conventions (cf. Murch 2001). The aim of the study is to explore whether it is confirmable that a film editor actually is sensitive to attentional cues in applied continuity editing, and thus, whether the avoidance of visual transients is a part of understanding design estimations. These are issues formulated but not yet studied, either through film perception research or by studies of film production as design (Smith 2005; Westera 1995; Swenberg 2010). Empirically establishing these issues can empower moving image editing aspirants and inexperienced editors, in establishing themselves within the film and TV industry (cf. Adams et al. 2011). By unveiling the role audiovisual transients can play in a film editing process, the study aims to contribute to condensed film editing processes, and thus, in a broader sense, lead to more efficient film production practices.

In the academic contexts of visual perception and design work, respectively, the study aims to motivate the further study of perceptual considerations in design work, and the role of audiovisual transients in design processes. In order to address the main issues of film editors' sensitivity to attentional cues in continuity editing and the avoidance of visual transients as a matter of design estimations, these research questions are posed:

1. Does a film editor pay attention to attentional cues in continuity editing, and if so, what possible perceptual phenomena in moving images are considered?
2. If perceptual phenomena are considered in film editing, how are they (visual transients and others) dealt with by a film editor, in order to achieve continuity edits?
3. If perceptual phenomena are dealt with by a film editor when editing, how influential a factor are these phenomena?

Methods

In order to explore a film editor's consideration of visual perceptual properties when editing moving images and whether such perceptual considerations are of the importance suggested by previous research (d'Ydewalle and Vanderbeeken 1990; Smith 2005), the present study employs a three-step methodology. First, literature on human perception of film edits was analyzed for specific aspects of human visual perception that are supposed to be regarded in film editing "rules" and conventions. Film editors have methods and principles that help them to make film edits either smooth or apparent, which is noted and studied by perception researchers (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; May, Dean, and Barnard 2003; Smith 2005; Wang et al. 2012; Shimamura, Cohn-Sheehy, and Shimamura 2014).

Second, the researcher has observed a film editor along the process of editing a three-minute documentary film sequence. These observations were conducted in the editor's editing room, where a webcam with microphone covered the editor as well as the researcher and was monitored on the editing computer's screen. This screen was in turn recorded as a running screen-dump that not only recorded the screen, but also the sounds processed by the computer, as well as all keystrokes.

Third, the screen recordings were analyzed in two steps. They were first analyzed for editing process events, which were compared to time usage, and then specifically for perceptual properties at stake during the shaping of the film edits, which were categorized and counted per edit and compared to time consumption. Also, the number of occasions each edit was processed was counted and related to the number of visual perceptual phenomena at stake.

A full methodology for this study was presented at *The 4th International Visual Methods Conference*, and later published (Swenberg 2016). The literature study covered previous research between 1978 and 2014, where eye-tracking has been used to explain human visual perception of film edits. The most comprehensive study in this respect is the doctoral project by Tim J. Smith, which resulted in his thesis, *An Attentional Theory of Continuity Editing* (2005). This theory has contributed the largest amount of visual perceptual phenomena to scrutinize in the present study: visual transient avoidance, attention capture intention, push and pull cues, visual event segmentation, 3D-continuity matching, graphical matching, time continuity matching, focus object movement, saliency or relocation, background change, matching viewer's attentional set, employing viewer's inattentional blindness or attentional blinks, saccadic suppression, and blinks. The phenomena of visual queries posed and answered are derived from Hochberg and Brooks (1978), while point of interest is derived from Wang et al. (2012). Each one of these phenomena was translated into a code in the analysis of the editor's perceptual considerations (see Table 1). A frequent use of visual queries by the editor in this study was to pose a visual query, not letting the next shot answer the query, but instead exploiting attention by introducing a new event. This led to the introduction of the category of visual query exploitation in this study. The category of background change is delicate, since it refers explicitly to a type of edits called *jump cuts*², not included in this study. Yet, considered in combination with other perceptual phenomena, it cannot be assumed to be insignificant to the film editor when shaping an edit, and is therefore included in the current analysis.

² *Jump cuts* are cuts between shots where either the focus object changes while the background stays constant from one shot to another, or vice versa.

Table 1. Perceptual Codes

<i>Phenomenon:</i>	<i>Code:</i>	<i>Criteria:</i>
Some image feature or object is an explicit candidate intended to capture attention	Attention Capture Intention	The editor states an intention for an image feature or object to capture attention (or overtly makes it salient)
Some aspect of the film draws attention to that something is about to come (e.g. occur)	Visual Query posed	A sound or image feature indicates an event, and thus provokes curiosity on an attentional (basic) level
Some aspect of the film meets attentional expectations of what was to come	Visual Query Answered	A sound or image feature corresponds to the curiosity provoked by the previous image
Some aspect of the film exploits attentional expectations of what was to come*	Visual Query Exploited*	A sound or image feature makes use of the curiosity provoked by the previous image to capture attention*
A specific object or area within the image frame is the prime candidate to capture attention due to its saliency, after an edit	Point of Interest	There is an overtly salient object or area within the image frame that is the prime candidate to capture attention (or stated by the editor as such), after an edit
Some aspect of the film draws (pulls) or pushes perception (often in a direction) before an edit	Cue Type	There is an overtly salient sound or image feature that either pulls the eye to it, or pushes the eye away (to the middle of the screen), or triggers attention
Some part of the image, that seems not to change, draws attention to itself across an edit point	“X” aimed at Inattentional Blindness	There is an overtly salient part of the image that seemingly does not change across an edit point, and that draws (focused) attention to itself
New information presented in the film draws attention just before an edit point	“X” aimed at Attentional Blink	Viewer’s internal attention is directed towards just extracted information (maximum 500ms before edit point)
A visual event ends or starts just before an edit point, which draws attention to itself	Visual Event Segmentation	The segments of a visual event are employed as edit points, in order to exploit viewer’s attention (to events)
Spatial continuity is upheld across an edit	3D-Continuity Match	The impression of a continuous 3D space is withheld across an edit
Shots have a similar graphical layout with their respectively most salient or interesting spot on the same part of the image surface, across an edit	Graphical Match	Shots are matched across an edit in order to maintain the viewer’s gaze on the same spot of the image surface
There are no (or only small) visual transients across an edit	Visual Transient Avoidance	An edit is shaped to avoid or minimize possible visual transients
Time continuity is upheld across an edit point	Time Continuity Match	The impression of time passing continuously is withheld across an edit point (uninterrupted events)
Movement of the focal object, just before an edit point	Focal Object Movement	The edit point is chosen so that the focal object moves just before, and thus starts an event that the viewer attends to, and expects to unfold uninterruptedly
Saccade or blink provocation occurs just before an edit point	Saccadic Suppression or Blink	The edit point is chosen so that a visual event that provokes a saccade or a blink occurs just before
Saliency of focal object at a non-cued edit	Non-cued: Focal Object Salient	Across a non-cued edit, there is a salient focal object in each shot which steers viewer’s time expectations
Relocation of focal object at a non-cued edit	Non-cued: Focal Object Relocation	Across a non-cued edit, a focal object is relocated between shots, through different graphical layouts, which steers viewer’s time expectations
Matching of the focal object’s relocation to the viewer’s attentional set, at a non-cued edit	Focal Object Relocation matches Viewers’ Attentional Set	The relocation of focal object matches viewer’s attentional set, at a non-cued edit
Shift of background at an edit point	Background Change	The background of the image changes at the edit point

Source: Codes and criteria for analysis of human visual perceptual phenomena regarded in film editing, derived from perception psychology (Hochberg and Brooks 1978; Smith 2005; Wang et al. 2012). Table extended from Swenberg (2016).

Before the observations, the researcher and the film editor jointly planned the editing phase of the study for an outcome suitable for the aims of the research project. After introducing the film editor to these aims, the editing phase of the study was planned with agreement on procedures, observations, and recordings. The film editor was involved in extracting the core of what was most urgent to examine in editing. She wanted to study types of editing, while types of edits were the researcher's concerns. The advantages and disadvantages of making either a regular film sequence or several short test sequences were discussed, as well as how to stress the included types of edits for hard-to-achieve continuity. Agreement was reached on using documentary material, filmed while following a man presenting his restoration of an old building. Such material provides several kinds of complications for the editor, urging her to shape several different kinds of edits. There was also free and unrestrained access to the full material, for usage and publication, including the participator's awareness of being filmed for academic research purposes, including distribution of the research findings.

During the observations, the researcher accompanied the editor in the edit room and recorded the editor at work. Approximately six-and-a-half hours were spent on four work shifts together with the film editor while editing. Discussions were carried out on various aspects of the study, including the recorded material, editing tools, the film editor's career, or film editing in general, as well as discussions concerning this study. The film editor made all the decisions on the choice of story, shots and sounds, their order, as well as the shaping of transitions. Occasionally, when not sure of her decisions, the editor invited the researcher to join in assessing the pros and cons of various options. Only on matters regarding whether the types of edits considered to be made met the demands of the study did the researcher express an opinion. The recordings convey these conversations.

Four occasions were spent editing a documentary film sequence. The construction of the story took place on the first day, as well as choosing sounds and shots, and ordering them. On the second and third day, time was spent on shaping the edits, as well as trimming the sound. On the fourth day, the editor fine-trimmed the edit points, and on the fifth day, the complete film sequence (3'10" long) consisting of twenty-one shots and twenty edits (cuts)—was watched and elicited. The editor did not partake any further in the study.

The screen recordings were first analyzed using *Movie Maker 2012* (build 16.4.3508.0205), where codes were added as graphic titling onto the video track, on spots of the screen of minimal importance to the visual analysis. During this analysis, editing events were coded (i.e. building story, choosing and ordering shots and sounds, discussions on content, and working on edits), as well as were meta discussions (i.e. procedures, processes, tools, or the study itself). Occasionally, perceptual codes were employed (see Table 1), when perception was explicitly at stake. The consistency of the coding was supported by a second recoding, in which 4.8 percent of the applied codes were changed, equivalent to 4 percent of the video running time, after which the coded screen recordings were exported as video files.

Thereafter, the event-coded video files of the film editing work were analyzed and coded with perceptual codes for the editor's visual intentions, where intentions were stated. Whenever the editor uses sound to influence visual attention at an edit, it is coded as "Cue Type." These codes are also superimposed with graphics in yet available areas of the moving image using *Adobe Premiere Pro 5.5*. Lastly, codes for perceptual phenomena were added as the completed film sequence was analyzed audio-visually, based on the attentional aspects of continuity editing theory (including Hochberg and Brooks 1978; Smith 2005; and Wang et al. 2012; see Table 1). For all 20 edits, editing as well as perceptual aspects were then summarized, in order to map what phenomena were at stake for each edit.

Methodological Reflections

The observational part of the study included the conscious and thorough involvement of a film editor. Thus, it becomes unreasonable to keep the purpose of the study secret from the editor. Her efforts were to be estimated and measured. Her considerations on hard edits, involvement in

choosing film material, and estimating kinds of edits to test were all valuable inputs for the study. Inadvertently, there was a considerable risk that the film editor could be predisposed by such preconceptions to a degree that she would not edit according to how she normally would. This risk was lessened by the researcher requesting her to make a documentary film sequence for public distribution. After the film sequence was completed, the film editor actually considered adding this particular sequence into the documentary film she was working on in parallel, titled *A Life Worth Living* (Jonsson Wallin, Mattsson, and Sverrisson 2013).

The researcher/film editor interaction in the editing room is a more subtle matter. The researcher's opinions on sounds, shots, edits, or story could influence the editing, as well as the final result, negatively if the editor disregarded her own opinions. However, it is part of a film editor's professional habitus to nurture and defend own views on these matters while having producers and directors in the editing room (Oldham 1992; Fairservice 2001; Crittenden 2005). The film editor involved in this study acted likewise. Also, the observational setting requires social interaction, and offensive behavior must be avoided, therefore the editor's questions, when they occurred, about the researcher's opinion on edits could not be ignored. These questions were handled as discussions about pros and cons of different alternatives. However, the researcher avoided expressing a definite opinion on story, shots and sounds, or specific edits. Comprehension and the achieved continuity of edits were crucial for the study and were therefore explicitly remarked upon by the researcher.

In regard to previous studies on film editing and film edit perception, the method used—even a singular case—is capable of confirming or questioning what is stated or suggested by such studies. Editing process phenomena, as well as perceptual phenomena, can be identified and linked. In order to estimate the influence of perceptual phenomena in the particular documentary film editing process studied here and also to motivate further studies, some quantitative measures are used as an indication of relevance. In a follow-up study, viewer participants have been eye-tracked in order to see whether the editor's perceptual intentions are fulfilled or not and whether her perceptual precision at the edit points is of importance or not.

Results

In this section, I describe the primary results of the analysis of perceptual coding of the editor's working process, the resulting film sequence, as well as the elicitation talks. The main results are congregated consistent with a corresponding research question: Firstly, the literature review reveals a set of human visual perceptual phenomena that film editors regard when editing films, either according to conventions for achieving continuity, or for achieving discontinuity. These perceptual phenomena were translated for the analysis, into codes, and confirmed through stipulated criteria (see Table 1). When answering whether a film editor pays attention to attentional cues in continuity editing and what possible perceptual phenomena in moving images are considered, the analysis regarded all the mentioned phenomena. For each edit in the documentary film sequence under scrutiny, the perceptual phenomena at stake were indicated with the proper code. As expected from earlier research (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012), the film editor in this study paid attention to attentional cues when editing. For these twenty film edits, there were 154 instances of perceptual phenomena to be regarded. In nineteen of the film sequence's twenty edits, all cuts, more than one of the here-coded perceptual phenomena were present. Most of these edits were continuity edits, and some were discontinuity edits. Moreover, there were at least three perceptual phenomena considered for each of these nineteen edits, most of them visual, and in one case there were as many as fourteen different phenomena at stake simultaneously. The average number of perceptual phenomena regarded per edit was eight (the median was 7.5, see Table 2 for full record). One visual perceptual phenomenon was present in all edits: background change. This is a condition to be expected since it applies to all edits that are not *jump cuts*, a category omitted in this study. Therefore, background change is only considered in combination with other phenomena when complexity is addressed. The other phenomena that were considered

most by the editor was predominantly attention capture intention, which applies for seventeen edits, and a point of interest after the cut, which appears at fifteen edits. Graphical match was concerned for thirteen edits, and visual transient avoidance was a regarded phenomenon for twelve edits, where the editor could not avoid but minimize visual transients for five of those edits. The least considered phenomena were inattentional blindness, attentional blink, 3D-continuity match, time continuity match, and suppression of the viewer's attention through saccadic suppression or blink, where each phenomenon was present at only 25 percent of the edits or less.

Secondly, the answer to how perceptual phenomena in moving images (visual transients and others) are dealt with by a film editor, in order to achieve continuity edits, is in short: by regarding several phenomena simultaneously, often in combination. The conversations about the film sequence and the editing process show that the film editor regards the perceptual phenomena that earlier research suggests. This is largely what occupies her concern with the edits, before she is content with their respective shape. "I am attentive towards my own gaze, and trust that everyone watches [the image] as I do," the editor says. "When a cut flashes, there is something happening at that edit that disrupts, and which gets one out of the story, or out of...this flow." For continuity edits, she is content only when the visual transients and other attentional cues, caused by visual perceptual properties and audiovisual distortions, are reduced to what she finds to be a possible minimum, to avoid visual distortions.

In all the nineteen edits where perceptual phenomena are considered, at least two phenomena are apparent, in parallel, or in combination with each other. For example, Edit 2 (see Figures 1 and 2): suppression of attention and avoidance of visual transients are used by means of event segmentation (the man is finishing the opening of the door, while starting to take a step forward), time continuity (the stepping through the door is adjusted to appear as one continuous movement) as well as 3D-continuity matching (the movement is matched to appear as taking place in the same entrance), and focus object movement (the man walks). Simultaneously, a pull cue draws attention to an event that also poses a visual query before the edit (the man reaches for the door handle and starts to open the door: will he continue and enter the building?), which is answered afterwards (yes) in combination with a graphical match of a dominant object (the focus object in motion is located at proximately the same spot on the image surface, in both shots, before and after the edit) that is the point of interest (the most interesting thing in the shot is the man moving). This is one of four edits in the sequence where the shots are obviously recorded in order to be possible to join in straight order when editing. Thus, it is a planned edit.

Figures 1 and 2: The figures represent the frames next to the cut between two consecutive shots: in the incoming shot a man (the main character in this film sequence) approaches a door from outside a house and opens it, followed by a shot where the same man enters through the door shot from inside the house. This is Edit 2 (between Shots 2 and 3) in the documentary film sequence made in this research project, a continuity edit.

Source: Still frames from documentary film footage by Stefan Ek for the film A Life Worth Living (I. Jonsson Wallin)

Figures 3 and 4: The figures represent the frames next to the cut between two consecutive shots: the incoming shot is a pan that ends framing a fire-place under restoration, followed by a shot from a workshop where a man approaches the camera. The steps from the walking man are heard two seconds before the edit point. This is Edit 13 (between Shots 13 and 14) in the documentary film sequence made in this research project, a discontinuity edit.

Source: Still frames from documentary film footage by Stefan Ek for the film A Life Worth Living (I. Jonsson Wallin)

Discontinuity is the founding principle for some edits in the current film sequence. When scenes are changed, the editor uses sound cues to draw attention to the upcoming shift (for instance, Figures 3 and 4). Furthermore, there is a three-shot sequence within the film sequence that shows details of the milieu presented. These are joined with obvious shifts of visual content, however, with a sought-for rhythm where audiovisual distortions, such as camera movements or sound debris, and object movements are matched for a flow that is supposed to avoid or minimize visual transients, even when focal objects or points of interest are missing.

Thirdly, to get an estimate of how influential perceptual phenomena were in this instance of documentary film editing, two main aspects were regarded: time consumption and number of work occasions for an edit. Both aspects were related to how many perceptual phenomena there were at stake for each edit. In the analysis, the editing work was divided into four separate categories. The craftsmen's literature recognizes assessment of material (choosing and ordering shots and sounds), work on edits, and configuration of story as three distinctly different tasks a film editor conducts (Lindgren [1948] 2011; Reisz and Millar 1968; Fairservice 2001; Murch 2001; Pearlman 2009). In this analysis, I have used these categories. There are also editing work tasks, such as trimming of sound (i.e. adding and removing bits of sounds to support transitions or avoid disturbances), assessment of accomplished work so far (rhythm, flow, and more) at different moments of the editing process, as well as other tasks. These work tasks are summed up in the category other editing work.

The results are presented as proportions of the total time spent on editing work: 1/3 of the editing time was spent on assessing the material, 1/8 of the time on configuration of story, 1/3 of the time on processing edits, and 1/5 of the time on other editing work. Time spent in conversation between the editor and researcher on meta-issues, such as the editing tools, procedures, processes and this research project, is removed from this data. For each of the edits, the total time spent on deciding and elaborating its edit point was measured. The results show that a third of the editing work time, for this particular documentary film sequence, was spent on decisions and elaborations. I also counted the number of occasions the editor spent working with an edit, from first deciding on it, and then reprocessing its edit point, until content with its appearance. Both total time spent per edit and number of re-workings were related to the number of perceptual phenomena at stake for each edit. These measurements are presented in Table 2.

Table 2. Number of Perceptual Phenomena Per Edit, Related to Number of Occasions the Editor Spent Working on, and Total Working Time Spent on Each Edit

<i>Edit Number</i>	<i>Number of perceptual phenomena</i>	<i>Total time spent (s)</i>	<i>Work time per perceptual phenomenon</i>	<i>Number of occasions spent working</i>	<i>Number of occasions spent working per perceptual phenomenon</i>
1	13	775	59.6	13	1.00
2	14	736	52.6	10	0.71
3	10	373	37.3	8	0.80
4	6	144	24.0	5	0.83
5	6	653	108.8	7	1.17
6	5	116	23.2	4	0.80
7	9	746	82.9	5	0.56
8	3	146	48.7	5	1.67
9	7	146	20.9	5	0.71
10	7	22	3.1	3	0.43
11	10	161	16.1	3	0.30
12	9	490	54.4	7	0.78
13	8	94	11.8	3	0.38
14	12	285	23.8	5	0.42
15	9	316	35.1	5	0.56
16	5	95	19.0	3	0.60
17	11	243	22.1	2	0.18
18	5	511	102.2	9	1.80
19	4	26	6.5	1	0.25
20	1	19	19.0	1	1.00
Sum:	154	6097	-	104	-
Median:	7.5	202	23.9	5	0.66

Source: The Research Project Film Editors' Visual Intentions and Viewer Perceptions (Thorbjörn Swenberg)

From these figures, we see that the time spent on work with each edit varies from nineteen seconds to twelve minutes and fifty-five seconds. More edits with few perceptual phenomena at stake have been edited within a shorter time-span than those edits with more perceptual phenomena at stake. The amount of time spent working on each edit related to the amount of perceptual phenomena starts at 3.1 seconds per phenomenon and stretches up till 108.8 seconds. The number of occasions the editor spent working with each edit varies from one up to 13 times. There is also a spread in the number of work occasions per perceptual phenomenon, from 0.18 (the editor worked twice with an edit that held eleven perceptual phenomena) up to 1.80 (nine work-occasions spent on an edit with five perceptual phenomena).

Analysis of Influence

To examine whether the perceptual phenomena has an influence on the documentary film editing process studied here, correlation analyses are performed to monitor any contribution of impact. Feasibly, the share of impact perceptual phenomena may have on the task of shaping film edits will emerge. If correlations are found, their strengths will indicate the degree of influence of perceptual phenomena on the scrutinized processing of film edits (RQ3). The correlation analysis of the current data include (A) amounts of perceptual phenomena per edit related to (B) time consumption for work on those edits, and (C) number of occasions the edit was processed.

When we group the edits in two equal halves, those with eight or more perceptual phenomena, and those with less than eight, the average times differ clearly. Edits with fewer than eight perceptual phenomena show an average work time of three minutes and eight seconds, whereas those with eight or more perceptual phenomena need seven minutes and two seconds on average. When we group the three edits with the highest number of perceptual phenomena together, the editor uses on average nine minutes and fifty-nine seconds for these edits, whereas she spends on average one minute and four seconds on the three edits with the lowest number of

perceptual phenomena. In the first set of calculated correlations, time was related to the number of perceptual phenomena. The whole dataset was considered as twenty individual pairs of measure, and there was a significant correlation: $r=0.578$, with $p=0.008$ ($t=3.009$).

A grouping of edits, to scrutinize the number of occasions the editor spent working with each edit, shows that the edits with eight or more perceptual phenomena are worked on 6.1 occasions on average, whereas the corresponding figure for the edits with fewer than eight perceptual phenomena is 4.3. When the three edits with the highest number of perceptual phenomena are grouped together, the average for them is 9.3 occasions; meanwhile, the average for the three edits with the lowest number of perceptual phenomena is 2.3. Inverted, grouping the edits based on the number of work occasions, edits with fewer than five, five occasions, and more than five give averages of 5.4, 6.7, and 8.5 perceptual phenomena, respectively. Likewise, a correlation analysis is needed to distinguish whether or not these correlations are significant. Here, the correlation analysis of the full dataset as twenty individual pairs of measure shows a correlation where $r=0.527$, with significance $p=0.017$ ($t=2.632$).

Discussion

In order to examine whether perceptual phenomena are actually regarded during film continuity editing, as film editing literature and perception research suggest (Riesz and Millar 1968; Orpen 2003; Pearlman 2009; Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005), this study is devoted to the observation of the editing of a documentary film sequence. The study is designed to be able to confirm or question the suggestion made. Therein, presuming documentary film editing to be extra challenging in kind (Riesz and Millar 1968; Hampe 2007; Rabiger 2014), and similar in character whether short or long (Rabiger 2014). First, the documentary film editing process is addressed for identifying known work tasks; then for the film editor's adherence to perceptual phenomena during the elaboration of edits; and last, for possible influence of perceptual phenomena on the shaping of film edits, thus using both qualitative and quantitative data.

Initially, to understand a film editor's handling of audiovisual matter (e.g. recorded shots and sounds) as a form of audiovisual design work, with particular skills and thinking (cf. Smith and Whitfield 2005; Adams et al. 2011), the assessing of audiovisual material and trimming of film edits will now be discussed as a form of design problem solving that regards audiovisual perceptual properties (cf. Krippendorf 1995; Simon 1996). Conscious adherence to perceptual precision and perceptual convenience will be illuminated as aspects of a film editor's aesthetic design estimations. The role of audiovisual distortions that include visual transients and attentional cues will be specifically attended to. Hence, film editing theory (Reisz and Millar 1968; Fairservice 2001; Murch 2001; Pearlman 2009) and perception theory (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012) will be drawn upon.

In this study, there are several perceptual phenomena that a film editor attends to and makes use of, often simultaneously, when editing film. The analysis of the current editing work reveals how this is accomplished. There are principally five different empirical evidences upon which the answers to my research questions are based. (1) The occurrence of a film editor's use of perceptual phenomena during the shaping of edits, and (2) the range of phenomena employed address the first research question: "Does a film editor pay attention to attentional cues in continuity editing, and if so, what possible perceptual phenomena in moving images are considered?" Thus, the skills that Smith (2005) ascribes to film editors can be identified. (3) How the perceptual phenomena are treated when the editor tries to create continuity between shots addresses the second research question: "If perceptual phenomena are considered in film editing, how are they (visual transients and others) dealt with by a film editor, in order to achieve continuity edits?" The data confirms the film editor's handling of perceptual phenomena while creating harsh or smooth edits, as appointed by film editing literature (Reisz and Millar 1968; Smith 2005; Pearlman 2009).

The third research question, “If perceptual phenomena are dealt with by a film editor when editing, how influential a factor are these phenomena?,” is addressed by (4) the total amount of editing work time spent on shaping edits, along with relations of time spent on specific edits related to the number of perceptual phenomena at stake per edit, as well as (5) the number of occasions each edit is worked with, also related to the number of perceptual phenomena at stake.

Earlier research (i.e. Hochberg and Brooks 1978; d’Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012) suggests that film editors regard several visual perceptual phenomena (see Table 1). In the present study, these phenomena are taken as a starting point for analysis of the work of a film editor when editing a documentary film sequence. The editor’s work time was divided into different categories of work (cf. Reisz and Millar 1968; Fairservice 2001; Murch 2001; Pearlman 2009) to see how much time was dedicated to different work tasks, and each specific edit, where the editor’s regarding of visual perceptual phenomena reaches its principal extent. The analysis of her work reveals that a third of her working time consists of work with specific edits. In conversation about the film sequence and her editing work, the film editor repeats that perception is a major factor in her concern with the edits, until she is content with their appearance, which confirms the claims of film editing literature (Riesz and Millar 1968; Orpen 2003; Pearlman 2009), as well as suggestions by perception researchers (Hochberg and Brooks 1978; d’Ydewalle and Vanderbeeken 1990; Smith 2005). Regarding continuity edits, she tries to reduce the phenomena causing visual transients and other attentional cues to a minimum. Thus, she seeks perceptual precision by eliminating audiovisual distortions and avoiding undesired audiovisual perceptual properties. When discontinuity is perceptually convenient to provoke attention, the edits are shaped with visual transients apparent. Hence, we can identify that the film editor’s processing of perceptual phenomena occurs during the part of the editing process that regards work on edits (cf. Lindgren [1948] 2011; Reisz and Millar 1968; Fairservice 2001; Murch 2001; Pearlman 2009). This assessing, altering and trimming of film edits for perceptual convenience is thus a kind of audiovisual design problem solving meant to support the film story’s comprehensibility (cf. Krippendorf 1995; Simon 1996).

Since a significant proportion of the editor’s work time is spent on regarding specific edits, and visual perceptual phenomena is a major concern for the film editor in order to achieve continuity when editing a documentary film, it seems reasonable to claim that we have identified that our film editor do attend to audiovisual attentional cues, and that this attention takes place while shaping the singular edits. The justification for this process being representative of her documentary film editing lies in Rabiger’s (2014) statement that short and long documentary films are edited in a similar fashion. The availability of this case as a representative of documentary film editing rests upon the editing literature statements that most documentary film editing share the same preconditions (Riesz and Millar 1968; Nichols 2001; Hampe 2007; Rabiger 2014). Further, the observed editing work is in accordance with literature on film editing, written by film editors of rank (Reisz and Millar 1968; Fairservice 2001; Murch 2001), and thus confirms these writings on documentary film editing. To what extent this resembles how this particular editor, or other film editors, would work with fiction images, is another matter that requires further study. Presumably, shots that are planned for joining in editing will demand less time per edit to be joined. Even so, there is no obvious reason to expect perceptual phenomena to be wholly insignificant in the case of fiction film editing.

To some extent, all the expected visual perceptual phenomena identified in earlier research (Hochberg and Brooks 1978; d’Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012) were found in the analysis of this film editor’s work, when it was scrutinized for visual perceptual phenomena at stake (see Table 1 for a complete list of phenomena). The most frequent phenomena were attention capture intention, point of interest after the edit, graphical match, and visual transient avoidance. The editor also employed visual perception in a not previously described fashion when she used visual queries as a convenience to draw attention, but instead of answering the queries, she exploited them to direct attention to new events. This may be understood as a design approach. Since visual perceptual phenomena occurred on 154 instances for twenty edits, it is evident that several phenomena were regarded simultaneously for each edit.

Furthermore, the analysis of their occurrence, per edit, revealed that different visual perceptual phenomena were often combined at an edit. This combination of phenomena may be seen as a way of strengthening the effect of continuity, as they result in avoiding visual transients and other attentional cues, which is appointed by Smith (2005) to be core for achieving successful continuity edits. Otherwise, the film editor employs the visual transients to direct attention. Of the perceptual phenomena that the editor considered least, inattentional blindness, attentional blink, 3D-continuity match, time continuity match, they all belong to edits where events continue across each edit. In the current documentary film sequence, that was rather infrequent. Also, very rarely occurring were events that provoked eye movements just before an edit, thus the suppression of attention through saccadic suppression or blink were rare. Such phenomena, though, supposedly occur more often in films, such as fictions or instructions, where events unfold continuously, and shots are planned at recording to match such unfolding. Thus, we know that this particular editor, in the instance of editing this documentary film sequence, regarded all listed visual perceptual phenomena (see Table 1), and often combined them to make an edit as fluid, or continuous, as possible. This study confirms previous film editing literature that predicts film editors' employment of perceptual phenomena to achieve continuity or discontinuity edits (cf. Riesz and Millar 1968; Orpen 2003; Pearlman 2009; Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005).

When the number of perceptual phenomena at stake for each edit is related to the work time spent on it, the statistical strength in their correlation is unambiguous. This means that the amount of perceptual phenomena at stake has a general effect on how much time the work with an edit point consumes. The work time consumption for each edit is likely, though, to depend on other factors as well, and therefore we see a variation in the data. The relation between perceptual phenomena, with regard to per edit, and the number of occasions the editor spent working with each edit, also have significant correlation. Again, there is a variation in the data, but a higher number of phenomena on average goes with several occasions of processing. Accordingly, less perceptual phenomena at stake here have required fewer occasions of processing an edit. Once more, the variation in the data should be understood as an indication of there being other factors involved as well that cause the editor to return to work on an edit several times.

Film editors frequently mention pace and rhythm as major factors in film editing (Oldham 1992; Crittenden 2005), which might be such additional factors that influence time consumption when they shape edits. For instance, the editor in this study thought for a long while that the second shot in the current documentary film sequence had to have a long enough duration in order to fit the pace of the sequence, which made the second edit hard to solve. Only when she shortened the shot duration could she find a functioning edit point that she was content with. Reordering of shots also caused the editor to adjust surrounding edits. However, to what degree a film editor prefers to rework edits several times, or tries to become content with each edit as quickly as possible may also differ on an individual basis (Oldham 1992; Crittenden 2005). Since the design of the current study addresses one particular film editor's editing, similar studies could be conducted with a number of moving image editors, also addressing several audiovisual genres.

So, answering the first research question, the film editor of this study do consider visual perceptual properties when she shapes film edits, confirming that the perceptual phenomena regarded are those anticipated by earlier research (i.e. Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012). This is done, addressing the second research question, by often regarding several perceptual phenomena simultaneously and in combination. Attending to the third research question, the influence of perceptual phenomena as a factor taken into regard while shaping film edits is considerable. The more visual perceptual phenomena at stake at an edit, the more time could be expected to be consumed for the film editor. We can also expect such edits to have to be reprocessed several times by the editor than edits with fewer perceptual phenomena. Perceptual phenomena affect the film editing process during work on specific edits.

Thus, regarding what is perceptually convenient for each film edit is an audiovisual design estimation that the film editor has to make, in order to make it comprehensible. Problems like audiovisual distortions are evaded through achieving perceptual precision, where audiovisual transients are reduced to a minimum. Otherwise, transients in the visual perceptual property are employed by the editor as attentional cues to direct attention. These results align with earlier research in design that point out embodied cognitive tools to be of major importance to designers (Smith and Whitfield 2005; Adams et al. 2011). These results must especially be considered to be important for inexperienced film editors to embrace in their early careers. The current results also confirm perception research on film edits (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Wang et al. 2012; Shimamura, Cohn-Sheehy, and Shimamura 2014), and provide new empirical evidence from actual film editing in support of the *Attentional Theory of Continuity Editing* (Smith 2005).

Benefits, Limitations, and Future Research

The benefit of this study is its capacity to empirically identify that perceptual phenomena appointed as crucial to film editing (Hochberg and Brooks 1978; d'Ydewalle and Vanderbeeken 1990; Smith 2005; Wang et al. 2012) is present during a staged documentary film editing process. This study could also confirm the suggested uses of these perceptual phenomena in smooth continuity editing, as well as in harsh discontinuity editing (Riesz and Millar 1968; Orpen 2003; Pearlman 2009; Smith 2005). Further, the study could link perceptual phenomena with editing time consumption, regarded per edit. Left for future research, as some limitation of this study, is whether this perceptual phenomena–time consumption link has some sort of general value and whether the link perceptual phenomena reiterations of edits will reoccur for other film editors. Also, addressing the similar issues as in this study for other kinds of film editing, such as commercial adverts and fiction film, will provide broader insight into the adherence to perceptual phenomena by film editors. Based on the approach of the current study, approaching a larger number of film editors and editing processes can readily be accomplished to reach more precise and general estimations of the role of perceptual precision in film editing. Other visual design, such as visual communication design or visual procedural instructions where designers use their embodied cognitive tools to direct others' attention (Smith and Whitfield 2005; Adams et al. 2011), could use similar study setups in order to examine the role of perceptual precision during design work tasks, as well as its implications for successful design.

Conclusions

The current study of perceptual phenomena in film editing concludes that the design work characteristics of meaning making (Krippendorff 1995) and problem solving (Simon 1996) can be recognized in film editing. Achieving perceptual precision for either continuity or discontinuity, whichever is convenient, is the audiovisual design goal of the film editor, and handling perceptual phenomena is a significant part of shaping film edits and hence of the film editing process as well. This is in accordance with Tim J. Smith's *An Attentional Theory of Continuity Editing* (2005). The results of the study infer that explicit knowledge on how perception functions in film editing is important to inexperienced film editors, in order for them to become faster and more precise at editing and thus condense their own production time. Perceptual precision should therefore be explicitly emphasized in film editing curricula. The results could also inspire the study of other design work than film editing to understand the perceptual phenomena at stake during design processes that target the gazes of users or viewers, and wants to frame those gazes.

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The moving image editor who participated in this study, Ingrid Jonsson Wallin, has credentials in fictional film, documentary film and television and holds a position at Dalarna University as senior lecturer in the art of moving image production, researching documentary film storytelling. As colleagues in the same department, we share an interest in deeper studies in moving image production processes. The research project Film Editors' Visual Intentions and Viewer Perceptions was sponsored by the European Regional Development Fund and the Municipality of Falun, Sweden.

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