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# Film as the Engine for Learning

## A Model to Assess Film's Interest Raising Potential

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**Abstract:** Film has been used for education ever since educators recognized its powerful potential for learning. But its educational application has been criticized throughout the decades for underuse of the distinctive potential of film: to raise interest. To understand more fully film's potential for learning, we propose a dynamic model of viewer interest and its underlying cognitive and emotional mechanisms (film's interest raising mechanisms or FIRM model). In addition, we present an analysis method for assessing the interestingness of films in learning contexts. Our model marries interest theories from cognitive film theory and educational psychology and captures the dynamics of interestingness across a film as depending on a balance between challenge posed and coping potential provided.

**Keywords:** education, emotion, film, interest, learning, motivation, video

As soon as films and projectors became affordable and manageable for the general public in the early 1940s, film started to make its way into the classroom (Masson 2012). Numerous films have been produced and used with the intention to contribute to education ever since, and audio-visual material is becoming more prominent in education with online learning taking off worldwide (Thomson et al. 2014).

From the early years on, educators recognized the medium's powerful potential to show the world outside the classroom and raise students' interest for its phenomena. Classical theories of learning in education and current empirical research in educational science have supported the notion that interest stimulates learning (Akkerman and Bakker 2019; Dewey 1913). So, there are ample reasons to believe that film could be a valuable tool to raise interest in learning contexts.

However, films intentionally produced for educational purposes (educational films) have been heavily criticized by film theorists, in particular the

underuse of film's interest raising potential (Champoux 1999; McClusky 1947; Porcher 1975; Thomson et al. 2014; Wegner 1977; Wijnker et al. 2019). In practice, the majority of educational films emphasize instruction and reproduction, typically putting talking heads on display (Hansch et al. 2015). At present, new approaches to teaching are desired that more effectively stimulate learning, such as inquiry learning and context-based learning (Savelsbergh et al. 2016). Uneasiness with such approaches implemented in new digital learning environments causes teachers to return to habits of knowledge transfer that were default long ago (Niederhauser and Lindstrom 2018). In the process, the relevant potential of film is overlooked, especially to overcome boredom and to stimulate learning.

Film theorists' critique of educational film is accompanied by their argument that film can be more beneficial for education. They have made it plausible that film is exceptionally suitable for raising viewers' interest while watching and have analyzed film features that stimulate interest (Tan 1996). But research from this field is predominantly focused on the fiction film; the use of film as an interest engine for learning in education has been neglected. In contrast to film theory, educational psychology research has abundantly shown that interest is a key condition for learning. Research on film in this field, though, is narrowed predominantly to the subcategory of educational films, notably instruction films. Educators could select a much larger supply of films for classroom use if they would avail themselves of a general account of how films raise interest and stimulate learning.

This article attempts to marry film theory to educational psychology in order to fully identify film's potential for raising students' interest in the service of learning. First, insights from film theory and educational psychology on interest are combined in a dynamic model accounting for student-viewers' interest in films (film's interest raising mechanisms or FIRM model). This model is the basis for an analysis method for assessing any film's interest raising potential for learning. Next, we demonstrate how the FIRM model and the analysis method may function as a starting point to select and produce better films for education. Our argument starts with an introduction into the theoretical conceptualization of interest in film studies and educational psychology.

### **Theoretical Conceptualizations of Interest as an Emotion**

The word interest comes from *inter-esse*, which translates into *to be in between* (Akkerman 2017; Latour 1987). Interest refers to a relationship that evolves between a subject and an object (Krapp 1999). We consider the relationship an emotional one, following Nico H. Frijda (e.g. 2009, 268): Emotions "are states characterized by occurrent motives to establish, maintain, or change subject-object relationships." Interest as an emotion in learning involves a motivation

***Film is exceptionally suitable for raising viewers' interest while watching.***

in students to strengthen their relationship with an educational object. To understand the motivational force of interest (Renninger and Hidi 2016), we need to dwell on what an emotion is.

All living organisms from bacteria to humans exhibit directed and purposeful relations with objects in the world around them. Individual organisms strive toward optimal relations with objects in their environment. For example, love, friendship, or harmony are optimal relations with intimate others. Relations are optimized as “concerns,” desired end states of striving, such as a physically nurturing environment, physical well-being, preservation, safety, equality, and belonging. When meeting with obstacles or support to concerns, this is signaled internally as negative or positive affect. Affect is an elementary response signaling pleasure or pain. Affect motivates relational action, namely the continuation or intensification of ongoing action versus stopping it and circumventing the obstacle. We can say that the main function of affect and emotion is to change relations between a subject and an object through action (Blakemore and Veuilleumier 2017; Frijda 2007). For the sake of readability, we will from here on speak of “action” meaning relational action.

There is a considerable variety of psychological approaches to emotion, emphasizing different conceptualizations of cognitive regulation of affect and action.<sup>1</sup> The Component Process Model of emotion (Scherer 2010), see Figure 1, integrates most conceptualizations into a modular emotion response model. Together the three modules or components of emotion act as an adaptive mechanism for coping with events that are relevant to an individual’s life. Modules operate in sequence, in principle.

In the first module, appraisal consists of evaluations of emoting events that are met, in terms of concerns. For example, the appraisal of loss involves the negative evaluation of an obstacle to the concern of preservation, and a threat is negatively evaluated as an obstacle to safety. The appraisal of goal attainment involves the positive evaluation of support to the concern of self-efficacy. Different emotions have different appraisals. Sadness is associated with an appraisal of loss, fear with one of threat, and happiness with one of goal attainment.

In the second module, appraisals lead to changes in action readiness and motivation, as well as to embodied physiological responses and motor expressions. The latter can be understood as supporting action and motivation for action. For example, the appraisal of loss leads to the action readiness of regaining the object, and the so-called “visceral” perceptions of one’s bodily reactions, like an increased heartbeat. The appraisal of threat leads to flee, freeze, or fight, the physiological response of adrenaline production and visceral perception of physiological arousal; and goal attainment leads to mobilizing undirected positive energy.

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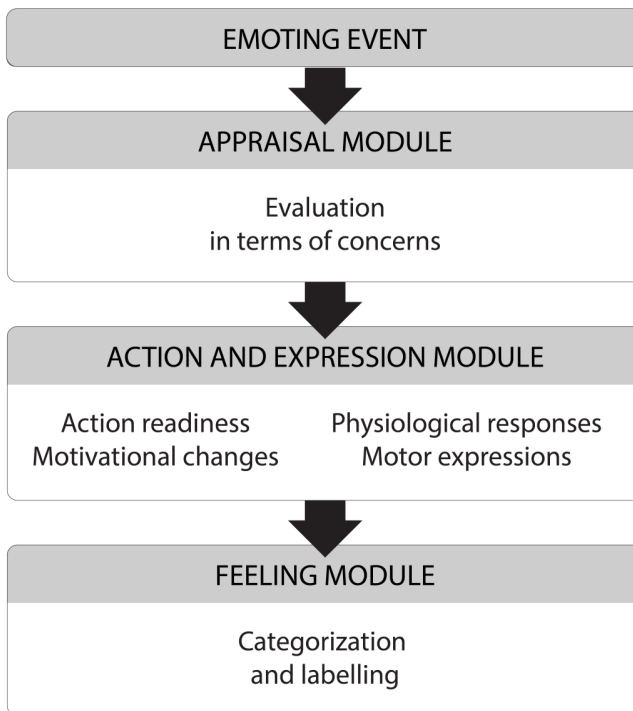


Figure 1. The Component Process Model (CPM) of emotion, based on Scherer (2010, 50).

The first two modules cover psychological responses that are not necessarily represented in consciousness. The third module renders appraisal and action-motivation aware to the emoting subject. The emotion is categorized and labeled, resulting in emotional awareness, or feeling, of appraisals, expressions, and action readiness. The emotion that develops from loss is then recognized and categorized as sadness, that developing from threat as fear, and that from goal attainment as happiness.

The Component Process Model elucidates the motivational force of emotions. According to Klaus A. Scherer (2010) emotion can be distinguished from other states of mind or body. When a situation is appraised relevant for the person’s needs, goals or values, some action readiness, that is, preparedness to act in one or another way, is necessarily induced. We add to this account of motivational force the distinctive feature of control precedence (Frijda 1986; 2007; Moors et al. 2017). This feature of action readiness in emotion refers to the priority that action tendencies assume over currently ongoing attention, thought, and behavior. Action tendencies are therefore notoriously difficult to resist.

“Interest” usually refers to a more or less permanent disposition of individuals to be attracted by certain topics. However, it is also the name for an

emotion regulating the relationship between a subject and an object in a more or less delimited episode. Andreas Krapp (1999) defined interest episodically, namely as an emotion, referring to it as a motivational state. Paul J. Silvia (2006) conceptualized interest more completely as an emotion according to the Component Process Model of emotion. The typical appraisal for interest according to Silvia consists of two elements: novelty and coping potential (see CPM module 1). Novelty refers to people's perceptions in the stimulus event of features such as "new, ambiguous, complex, obscure, uncertain, mysterious, contradictory, unexpected or otherwise not understood" (Silvia 2006, 57). Coping potential refers to whether people "can understand the ambiguous event" (Silvia 2006, 57), in other words an estimation of the "likelihood that the poorly understood event will become coherent and clear" (Silvia 2006, 58). Interest reaches positive levels when both the appraised novelty and the estimation of successful dealing with it are sufficient.

Some attempts have been undertaken to operationalize and measure interest (e.g., Cañas-Bajo et al. 2019; Silvia 2005). Jose Cañas-Bajo and colleagues (2019) measured interest in real time by having participants mark their interest by pressing buttons while viewing a film. Silvia demonstrated in a number of experiments that appraised novelty-complexity of test stimuli (poems, picture, geographical shapes) and estimated ability to understand these were predictors of interest. Interest can be called an epistemic emotion, as it arises in the pursuit of knowledge goals (Brun et al. 2008 as cited in Vogl et al. 2020). Understanding and knowing are the emotional concerns that are satisfied in interest. Silvia (2006) distinguishes as functions of interest first, to engage the person in the situation and to motivate exploration and learning, and second to provide for diversity of experience.

Interest is for action just like other emotions, say anger or fear. The affective mechanism underlying interest is the dopamine-based seeking system that produces "eager forward-directed and investigatory activities" in response to expected stimulation and reward, according to Carroll E. Izard (1977).<sup>2</sup> A general action readiness produced when an event is appraised as interesting (that is, positively appraised as both novel and comprehensible) is an inclination to invest attention and effort in it (CPM module 2). The action readiness is reflected in the facial expression of interest, which is characterized by raised eyebrows and a slight smile. Boredom in contrast, shows in drooping eyelids and tilted head (see, e.g., Keltner et al. 2019). More specifically Silvia mentions inclinations to explore the environment and to elaborate or persist in a difficult task. Most specifically, interest-driven deep and persistent cognitive elaboration of educational texts have in empirical studies been found effective for memory and comprehension (Silvia 2006, 66–72). Finally, the experience of interest reflects the mobilization of resources and the positive estimation of comprehen-

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sibility (CPM module 3). It is a positive feeling, despite the uncertainty that is characteristically appraised in the event.<sup>3</sup>

In sum, when interest is conceptualized as an emotion, we can understand why it has motivating force. A positive evaluation of novelty balanced with coping potential instigates a readiness to spend resources on exploration, elaboration, and persistent engagement with the stimulus. Because emoted, the whole person is involved in the readiness concerned, and the feeling of being interested is predominantly positive.

Film theory and educational psychology research have dealt with interest as an emotion in different but overlapping ways. The two fields of research have given us leads to describe the specific appraisals involved in interesting films and in interesting learning activities that can explain films' potential to raise interest in learning contexts.

### **Interest as Conceptualized in Educational Psychology and Film Theory**

Studies on interest in educational psychology provide empirical evidence for the link between interest and learning (Akkerman and Bakker 2019; Dewey 1913). Positive effects of interest have been shown on education outcomes such as task value perceived by students, academic achievements, and time spent on tasks (Hidi 2006; Patrick et al. 2011; Renninger and Hidi 2016; Tobias 1994). Beside interest for educational contents, interest in learning for its own sake is a valued goal of education in general. Overall, experiencing interest is pleasant in itself, regardless of the goal one is pursuing (Renninger and Hidi 2016).

Educational psychology follows the conceptualization of interest introduced above. Interest as an emotion in the context of learning is characterized as a balance between the appraisals of novelty-complexity and coping potential or comprehensibility (Silvia 2008; CPM module 1). Novelty-complexity is appraised in educational content that is new to the learners that is not encountered before or not in the current way, so that there is something to explore and to discover. The appraisal of comprehensibility on the other hand involves the learners' beliefs that although not able to grasp it entirely yet, they will be in the end. Comprehensibility is the prospect or anticipation of comprehension. The balance between novelty-complexity and anticipated comprehension fuels interest at any moment throughout engagement with the object.

Interest experienced in an educational context gives rise to the action tendency of knowledge seeking, or the willingness to pay attention and put effort in comprehending the novel-complex content, and thus relational engagement with the content (Krapp 1999, Renninger and Hidi 2016; CPM module 2). This can take various forms dependent on the learning objective. For ex-

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ample, in a chemistry course about molecular cooking, the learning objective could be to familiarize students with concepts of chemical processes and their occurrence in the real world. Interested learners are willing to put effort in finding cues that relate to their prior knowledge in order to link new information to what is already known (Schiefele 1991). Relating the learning objective to a familiar context, such as daily cooking, makes it easier for students to find relatable cues. Reaching understanding and gaining new knowledge as the rewarding outcome evokes satisfaction and raised self-efficacy, and stimulates further and future engagement (Hidi 2006; Patrick et al. 2011; Renninger and Hidi 2016; Tobias 1994); the students' interest for the educational content develops (CPM module 3). Investments made increase the value of getting to know and understand the new content further.

While educational psychology follows emotion theory in conceptualizing student interest in learning contexts, cognitive film theory follows emotion theory in conceptualizing viewer interest as an appraisal-driven emotion. Film theory has attempted to account for film viewers' interest using characteristics of the medium, in particular the narrative film. Films are studied as narrative discourses that evoke a complete story-world by piecemeal narration of events (Bordwell 1985).

Ed Tan (1996; 2008; 2018; Tan and Visch 2018) proposed a theoretical account of film-viewer interest as the emotional response to narration in the fiction film. The viewer's task is to construct the complete story-world from presented pieces. While the presentation is in progress, the viewer's appraisal of interest consists of anticipatory rather than definitive evaluations. Evaluations target the prospect of complex developments, of actions and their outcomes, and uncertainties about these (CPM module 1). Anticipatory appraisals are induced early in the film, when the initial status quo (all is clear in the fictional world) is interrupted. Viewers anticipate that the discourse will come to a close (all is clear again). Anticipated reward consists not only of prospects of closure, but also of satisfactory outcomes that the final story-world will offer (Tan 1996). For example, the discourse of *Het Klokhuis: Moleculair Koken* a Dutch informative film about molecular cooking starts with a familiar listing of food and cooking methods we use daily (all is clear). Next, an unusual duo appears, a cook and a chemist, to explore new ways of cooking (complex developments and mission are set). The film takes the viewer through the preparation of a three-course molecular menu and ends with the satisfactory closure of the presenter eating a tasty new dessert (mission completed, all is clear again).

A balance between appraisals of complex developments in the film's story or discourse on the one hand, and prospects of the film's rewarding closure on the other motivate the viewer's activity. It consists of constant building of hy-

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potheses about what will happen next, and what happened before the point where the film took off. Hypotheses are refined or rejected in favor of new ones (Bordwell 1985) (CPM module 2). Cumulated attention and effort spent in the activities can be called investments. Interest is a dynamic response because investments tend to grow over time, while also prospects of complex development and rewarding closure change from one moment in the film to another. In the example of the film on molecular cooking, from the start viewer activity is motivated by the presenter posing a challenging, yet promising, claim to viewers: we can make better and tastier recipes by analyzing the chemical processes in cooking. Viewers are challenged to find and evaluate grounding arguments for that claim in the film's proceedings, encouraged by the prospect of seeing actual chemically synthesized dishes. Viewers' hypotheses about what will happen next are also directed by announcing the preparation of a menu.

A proper balance between steadily growing investment and ditto anticipated return pushes interest to the maximum and makes film viewing a self-reinforcing mechanism. Following increases of investments and prospects of reward, experienced interest also builds up in intensity (CPM module 3) until the closure of the film takes place and the final (re)resolution is presented. At this point, viewers' interest starts to drop and so does the motivation to act (Tan 1996). In our molecular cooking film example every prepared dish functions as a reward, as partial proof for the claim that whole meals can be cooked molecularly. The finalization of one dish cues interest in the next and its particular method. Presented with the final dish viewers are left with the question what possible other methods could be applied to cooking.

Tan's (1996; 2008) account of interest applies to narrative fiction films. In narrative films, viewers action tendencies aim to anticipate story-world events ("How will this story end?"). Obviously and as hinted in the cooking film example, films used in learning contexts include non-narrative film forms as well, such as associational (displaying related images, sounds, or events), categorical (displaying concepts and instances of theses), and rhetorical (displaying an argument) (Bordwell et al. 2017). In associational films, the aim of the action tendency is to engage in free association, and to bring together seemingly unrelated images, sounds and events ("What do these images, sounds, and events mean; what do they tell me?"). In categorical films, it is induction (finding a category encompassing instances) or deduction (generating exemplifying instances for a category). In rhetorical films like our molecular cooking film example, the aim is to check and validate an argument ("Is this true?").

Thus, appraisal of complex developments balanced by anticipated closure and reward and the tendency to spend attention and effort in comprehension

***A proper balance between investment and return pushes interest to the maximum and makes film viewing a self-reinforcing mechanism.***



accompanied by embodied responses are consciously labeled as the feeling of interest and a desire to know the outcomes of the story.

### **Integration of Theories of Interest**

Summarizing the similarities between the two theories on interest, they both construct interest as an emotion. Appraisals are akin: from the perspective of educational psychology, interest is likely to be raised if learning objectives (1) are novel and complex, and (2) make the students feel capable of comprehension. From the perspective of cognitive film theory interest is likely raised

***Both perspectives posit a balance between appraisals of challenge and coping potential as key to raising interest.***

if films (1) present prospects of complex developments, and (2) raise confidence in the discourse guiding viewers to a rewarding closure. Both perspectives posit a balance between appraisals of (1) challenge (novelty and complexity; complex developments), and (2) coping potential (anticipated comprehension; anticipated rewarding closure) as key to raising interest (see the conclusion and discussion for relatedness to Flow theory). Concerning action tendencies, both perspectives similarly describe a readiness to invest effort and attention in the object of interest. Finally, both theories point at a self-reinforcing mechanism of investments resulting from these action tendencies.

### **An Integrated Model of Interestingness**

Films provoke emotions in their viewers, such as enjoyment, fear, amusement, and interest. Any film can be evaluated as to its potential to provoke a certain emotion. In experimental psychological aesthetics numerous studies have used expert analyses of art works as measures of interestingness (Haanstra et al. 2013). These measures predict actual interest of untrained viewers, for example, measured by viewing times (Berlyne 1974; Cupchik and Gebotys 1990; Silvia 2006). Film analysts—for example, reviewers—can evaluate the degree to which a horror film may frighten its target audience or the degree to which a comedy can amuse an audience. The potential of films to make their viewers interested can likewise be evaluated. Reviewers routinely report how interesting (“boring,” “exciting,” etc.) a film is. What is evaluated is the “interestingness” of a film (Krapp 1999; Silvia 2008). Assessment of a film’s emotion potential is usually based on implicit judgments using intuitive norms and categories from analytic experience. The purpose of distinguishing interestingness from viewers’ experiences is to enable the identification of film characteristics that potentially make interest rise.

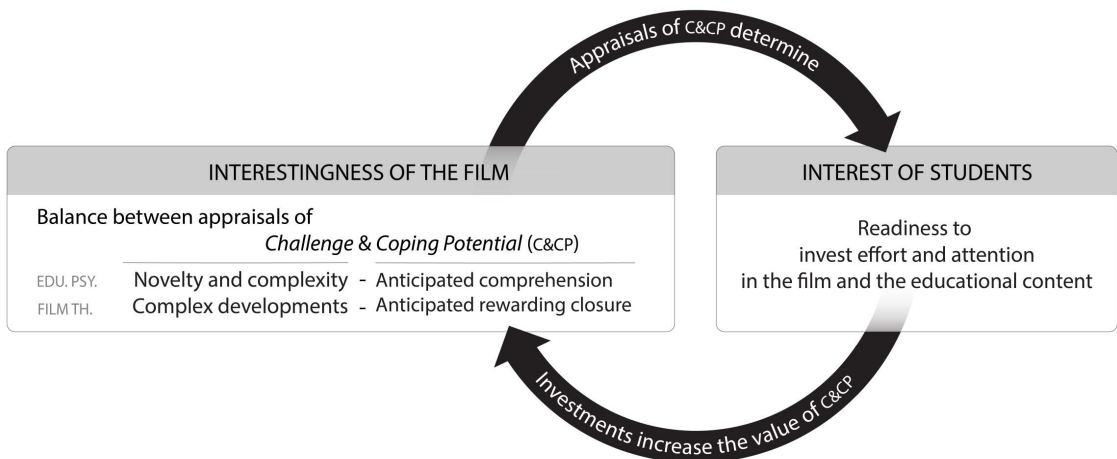
We believe that the integrated theory of interest in film viewing can be employed in an explicit analysis model of the interestingness of films. Analyzing interestingness involves a shift of perspective from the viewer to the film, from the viewer’s appraisal to the features of the film. A film’s interestingness,

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that is, its potential to provoke interest when properly evaluated by an analyst, is predictive of the interest actual viewers experience. More in particular, highly interesting films should raise stronger action readiness in target viewers. That is, their motivations and tendencies to invest effort and attention in comprehension should be higher than if they would watch a less interesting film.

Figure 2 summarizes a model of interestingness based on the combined film-theoretical and educational psychology perspectives on interest (FIRM model). In our model, a film’s interestingness depends on the balance between, on the one hand, the challenge it offers to viewers, and on the other, the coping potential it affords viewers. The higher the challenge and the coping potential, the more interesting the film is. The FIRM model explains the mechanism underlying interest raising films in learning contexts and specifies the variables that need to be analyzed or measured.

Important parallels should be noted between appraisals of interest by actual viewers and analytic evaluations of interestingness. Challenge and coping potential feature in both. However, challenge and coping potential as appraised by actual viewers are intuitive judgments, while the analytic assessments of challenge and coping potential are based on explicit structural analyses of the film’s form and presentation of contents.<sup>4</sup> As is good practice in the domain of education, teachers evaluate and judge any kind of educational material be it a book, a game, or a film before presenting it in class or using it as a reference. In any case, the teachers will keep their students in mind while



*Figure 2. Model of film’s interest raising mechanisms (FIRM model). This model describes how film raises interest in learning contexts. The interestingness of a film reflected in the film’s balance between challenge and coping potential predicts the potential interest of the student-viewers reflected in their motivation to engage with the educational content. Students’ actual investments reflect their interest development. Investments made increase the value students attribute to the appraisals and may result in further interest development.*

forming their judgment, as do the expert analysts in our study. The analysis of interestingness is not the analyst’s own emotional appraisal, but the analyst’s anticipations of appraisals made by viewers in actual viewing. In what follows, we take on the perspective of the analyst, and illustrate the use of norms and categories in film analysis for each film form to assess interestingness.

**Well-Made Films for Learning**

The specific contents that represent the challenge and coping potential balanced along the course of the film are film form specific. The film forms distinguished by cognitive film theory (Bordwell et al. 2017) can all be found in films used in learning contexts. The appraisal of interestingness varies over the forms. Table 1 exposes challenges typically posed and rewards or coping potential offered by the four most common forms. For example, narrative films evoke the action tendency of pursuit and anticipation of story-world knowledge filling causal gaps in the discourse. This action tendency is evoked if challenging narrative or story-world complications are balanced with the prospect of any resolutions to these complications. Another example: categorical films evoke the search for concepts that categorize presented instances, if the presentation of uncategorized instances is balanced with the prospect of learning how to categorize them (inductive challenge).

To determine what balance in the structure of films makes a film interesting in learning contexts, we can look at films that fail to raise interest. Complexities in the development of the film can, on the one hand, be too high and the prospect of a satisfactory closure too distant, which results in confusion and frustration. On the other, complexity can be too low, and closure too obvi-

*Table 1. Interest components as substantiated in the film categories identified by David Bordwell et al. (2017)*

		Film category			
		Narrative film	Associational film	Categorical film	Rhetorical film
Appraisals	Challenge	Story-world complications	Complexity, ambiguity	Induction: uncategorized instances Deduction: unexplained concepts	Ungrounded claim
	Coping potential	Story-world resolution	Affective experience	Instances and their categories; Concepts and their instances	Grounded claim
Action tendency	Affectively charged readiness to spend effort and attention	(Causal) Elaboration and anticipation of story world events	Free association	Induction: seeking to find categorizing concepts Deduction: seeking to find exemplifying instances	Check and possible validation of an argument

ous. Then the viewer can already tell all further developments and the ending. The resulting emotion is boredom. Whether or not the balance is appropriate to raise interest is largely dependent on a good match between the complexity level of the film and the competence level of the student-viewers. Obviously, the competence level of student-viewers is especially related to prior knowledge of subject matter and topics. Films used in learning contexts present tough challenges in view of students' available competence, while promising student-viewers closure or understanding that is valued.

We propose that well-made films for learning contexts balance challenges and coping potential all along the way. That is, they exhibit an optimal balance at every consecutive moment of the serial presentation that films constitute. Well-made films signal to viewers from the start that a rewarding comprehensible film will be offered by steadily feeding the viewers' coping potential with new information, but delay the presentation of definitive rewarding outcomes till the end (Tan 1996).

The properties of balanced challenges and reward and the delay of final reward of well-made films sustain maximal interestingness. They lead us to propose the following two claims on well-made films for learning:

1. *The film delivers on its promise.* An optimal balance between challenge and coping potential during the film maximizes interest throughout, and builds up increasing anticipations of closure and comprehension. At some point, the challenge must be traded for rewarding full comprehension. We refer to the moment when the challenge meets with full coping, as the *moment of closure*. In our molecular cooking film, the claim made by the presenter at the onset of the film about the possibility of making new molecular recipes poses a rhetorical challenge (i.e., an ungrounded claim) to the viewers: it is possible to molecularly cook a full dish. This challenge is met in the end when the dish is shown in reality. In this film there is a clear moment of closure. When there is no moment of closure, student-viewers will be left confused and frustrated. Subsequently, the positioning of that moment of closure is responsible for the strength and scope of the film's interestingness. This brings us to the second claim.

2. *Interestingness increases across the film.* An increase of interestingness from start to finish overcomes habituation of student-viewer activities and efforts with time. This claim implies an early introduction of a first challenge, and during the film outcomes are only presented piecemeal and elaborated by the viewer, which leads to a steady increase of coping potential until it fully meets the challenge at the moment of closure. In our molecular cooking film, the final dish served at the end is the crown to creation of in-between courses. Positioning the moment of closure early in the film would render the remain-

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der of the film dull and boring. Whereas signaling to student-viewers from the start that a rewarding comprehensible film will be offered—the moment of closure is on its way!—but delaying the presentation of a final rewarding outcome, interestingness is pushed to its maximum.

At the basis of these claims lies a general assumption: *the challenge and coping potential represented in the film are nontrivial*. Challenges that are not perceived as worth the effort of coping are not interesting even if optimally balanced with coping potential provided piecemeal. The same accounts for cues that are not regarded by viewers as adding to their coping potential. In addition, interestingness of films for learning has upper and lower limits set by students' prior competence. Any film is well-made only with respect to its audience's competences. What is maximally challenging to one audience can be too easy for another; what seems promising to one, may seem undoable to another.

### **Analyzing Films for Learning as to Interestingness**

Our model of interestingness can be made operational in film analysis. Next, we present a method for an expert's evaluation of how well-made a film is. Evaluation consists of analyzing the course of challenge and coping potential of the film moment by moment. This course reveals the balancing of challenge and coping potential, the moment of closure, if any (claim 1) and its positioning in time (claim 2). The method of analysis entails scoring challenge and coping potential as variables. Note that, as explained previously, it is not any empirical viewers' appraisal that is scored, but an analyst's judgment of balance, challenge, and coping potential as revealed by the film's structure. The analyst's expertise needs to cover the subject matter of the film, the targeted students' available knowledge of the subject matter, and the structuring of film discourses.

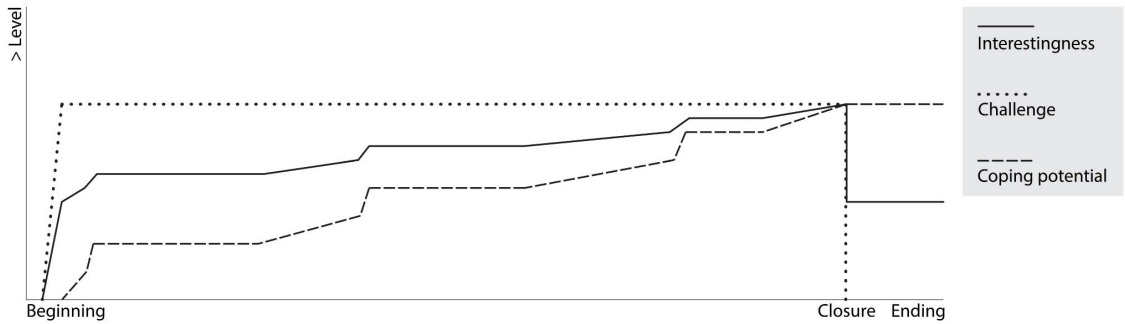
*Balance between challenge and coping potential:* The primary focus of the analyst is to identify all challenges present in the film, with respect to the intended viewers. Challenges of different film forms (see Table 1) can be found within one film. Next the analyst identifies all cues in the consecutive moments of a film that can help viewers cope with the challenges.

*Scoring challenge:* Using one's expertise, all identified challenges are assessed on a numerical scale. The score reflects the weighing of the challenge's novelty and complexity level, as can be expected to be experienced by the intended viewers (see the conclusion and discussion section for our remarks on objective scaling). The analyst needs to distinguish between main and secondary challenges. Main challenges stretch over the entire course of the film, whereas secondary challenges are only present in one or several scenes. Because challenges that stretch over a longer period of time require more effort from viewers to cope with, main challenges are assigned double the value of

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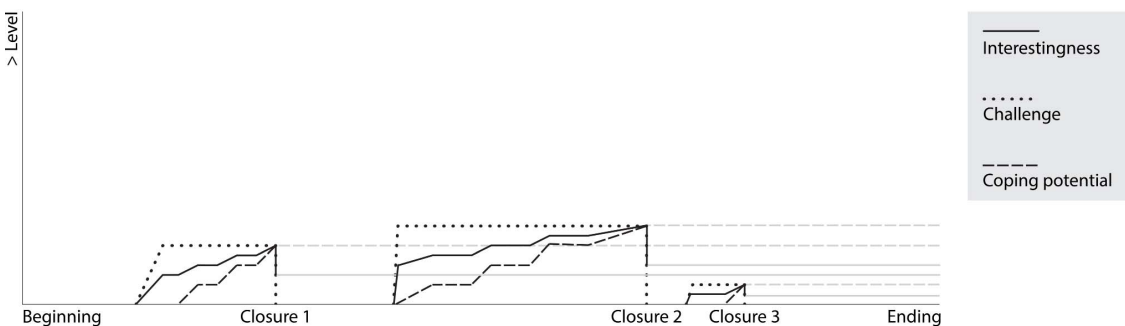
secondary challenges. The analyst assesses how a challenge once introduced builds up over consecutive moments and when it has been fully presented. In a well-made film, the challenge’s score remains at its maximal level until full closure. As soon as a challenge is answered, its score is set to zero (see Figure 3—Challenge). In the case of multiple presented challenges, the analyst sums the scores related to different challenges for each moment in the film. We refer to this as cumulative challenge (see Figure 6—Cumulative challenge).

Figure 3. Course of challenge, coping potential, and interestingness of a single main challenge film.



*Scoring coping potential:* Coping potential is assessed on an equivalent numerical scale. Each cue is assigned a score that results from the analyst’s weighing of its value for coping with the related challenge. The score builds up to reach its maximum at full presentation of the cue. Coping potential scores related to the same challenge are summed over the moments of the film. The analyst assesses the build-up of coping potential scores over the film. When the coping potential level associated with one challenge reached the maximum level of that challenge, a moment of closure is identified (see Figure 3—Challenge and Coping potential). Note that the coping potential score at the moment of closure is a terminal value; coping potential does not drop after its final value (see Figure 4—Coping potential). Hence, in the case of multiple, sequentially presented challenges, the analyst also sums coping potential scores related to different challenges for each moment, referred to as cumulative coping potential (see Figure 5—Cumulative Coping potential).

Figure 4. Course of challenge, coping potential, and interestingness of a multiple secondary challenge film, with separated lines for coping potential and interestingness related to each challenge. The remaining levels of coping potential and interestingness that result from early challenges are depicted in light grey.



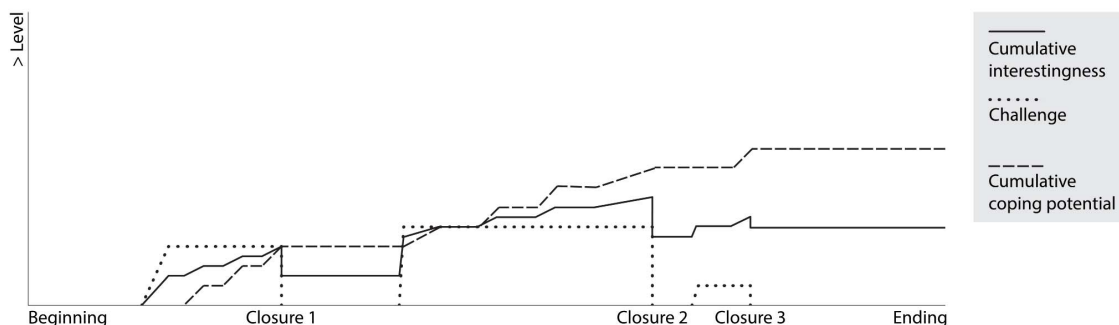


Figure 5. Course of challenge, cumulative coping potential, and cumulative interestingness of a multiple secondary challenge film.

*Scoring interestingness:* As explained above, interestingness depends on the balance of challenge and coping potential. We propose to define the variable interestingness simply as the average of the cumulative scores assigned to challenge and coping potential at any moment of the film's presentation. As a consequence, at the introduction of each new challenge and each cue to cope with that challenge, interestingness rises with half of their scores at any moment. At the closure of each challenge, interestingness drops with half of the challenge's maximum value (see Figures 3, 4, and 5).

*Evaluation of well-made-ness:* Evaluation of a film as well-made involves interpreting the course of challenge and coping potential scores over the consecutive moments of the entire film. First, the balancing of challenge and coping potential over the film is interpreted, as well as the general assumption of nontriviality. Are there moments when challenge is not balanced with coping potential? Is interestingness diminished at these moments? Are challenge and coping potential valuable to the viewers? Second, the course of challenge and coping can be evaluated with the two claims of well-made-ness in mind.

Claim 1 is subscribed to by the analyst when summed coping potential scores related to one challenge are at some moment at least equal to the maximal score of that challenge. The analyst takes this to mean that the film delivers on its promise. It rewards the viewer's anticipations it has provoked and efforts to comprehend the entire discourse in the end. The analyst can interpret, on the one hand, what cues to the final answer the film provides along the way, and on the other, the cumulation of viewers' attention and efforts from one to the next cue. Both are reflected in the cumulative coping potential curve.

Claim 2 is supported when the way to closure is gradual, so that interestingness increases across the film. The analyst may especially consider timing of challenges and whether they are main or secondary. The best designed film qua interestingness has an early introduction of a first challenge and includes multiple challenges of which at least one is a main challenge (see Figure 6). Comparing Figures 3 and 5 it can be seen that early introduction of the first challenge means both early and prolonged development of interest-

ingness. Multiple challenges presented in series (Figure 5) have both benefits and costs with regard to interestingness. Interestingness is raised with each new challenge, but only as long as the challenge is not answered. In contrast, the primary challenge (Figure 3) can be more potent over a prolonged period. A combination of the two optimizes the development of interestingness (Figure 6).

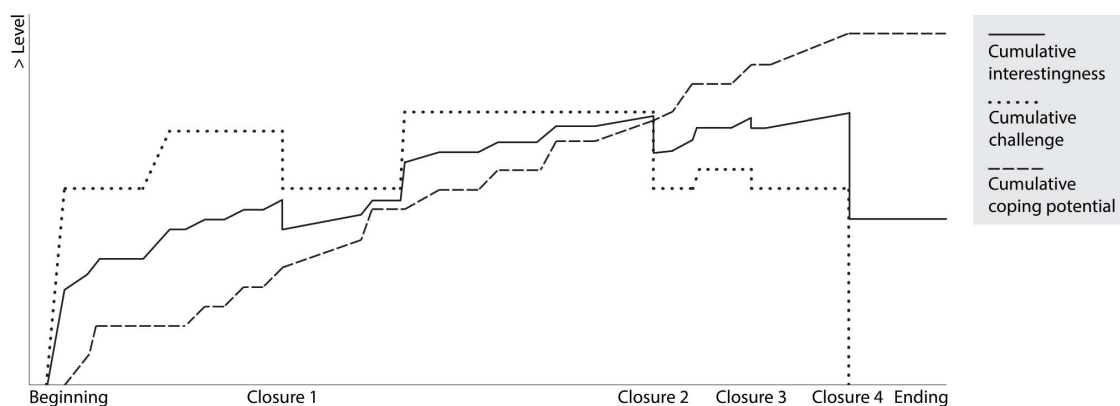


Figure 6. Course of cumulative challenge, cumulative coping potential, and cumulative interestingness of a mixed multiple challenge film.

In closing, it should be emphasized that the interestingness curve does not represent a series in time of any absolute ratings of a film's interestingness. It is the trends in the curves that are of interest for analyzing a film's interest raising potential structure. For a fully elaborated analysis, see Appendix A: *Analysis of Interestingness of Het Klokhuis: Moleculair Koken*.

## Conclusion and Discussion

Our presented theories from educational psychology and cognitive film theory both characterize interest as an emotion. Emotions are affectively charged and therefore notoriously difficult to resist. Both theories describe the manifestation of the interest emotion as the tendency for a person to invest in their relationship with the contents of the situation they are in. Emotional tendencies to engage in film viewing drive film viewers to mental and affective activity, anticipating and seeking resolutions to challenges that films pose continuously. The main challenge is to understand the complete formal contents of a film, be it the narrative—its events, plot, and characters; an associational construct—its complex and ambiguous events; a categorical system—its concepts, instances and relations; or a rhetorical argument—its claims, arguments and warrants. Emotion-driven tendencies to engage in the film's form, bring along learning activities centering on targeted educational contents, be they story events, ambiguous events, concepts, and instances or arguments. Because formal relations can be complex and require the use of knowledge of the world or its domains, learning processes can take place. Interest as an emotion fuels the



effort invested and enables enjoyment (or rather appreciation) of rewards obtained in the process of learning. Bringing together the two theories lays the foundation for our understanding of how film can activate student-viewers, and interest them—in a relatively pleasant way—for learning activities.

Based on a conceptual foundation of interest as an emotion, we have proposed a dynamic model for interestingness of films for learning (FIRM model). Moreover, we have formulated two claims on well-made—in the sense of optimally balanced and maximally interesting—films as requirements that can be assessed: (1) The film delivers on its promise, that is, all challenges should be met by coping potential, and (2) interestingness increases across the film, that is, early introduction of the first challenge and delayed presentation of the coping potential. The general assumption underlying these claims is that the challenges and offered coping potential in the film are nontrivial to its viewers. We have demonstrated how a film for learning can be analyzed as to its match with the requirements to well-made films in terms of interestingness. And we have shown how the analysis can reveal strengths and weaknesses of a film, as well as evaluate its interestingness at any moment of its presentation.

Raised interest, described as a positively appraised balance between challenge and coping potential as we did here, closely relates to the concept of flow. Flow occurs when there is a balance between perceived challenges and perceived skills (Csikszentmihalyi et al. 2014). Theories of interest and of flow both emphasize a challenge that matches the subject's ability to cope with that challenge. The main difference between the interest balance and the balance of flow is the timing of coping. Flow occurs when challenge and coping coincide completely. There is a perfect and immediate match between challenge and coping or skill. Interest is reached when challenge coincides with the prospect of coping. The matching answer to the posed question is anticipated but delayed as yet.

The present study on interestingness of film for learning has some limitations. One limitation on our theoretical model is that in explaining interestingness, it purposefully factors out another variable of film appraisals and qualities, namely enjoyability. We adhere, as some emotion researchers do, to the notion that interest is a positively valenced emotion (e.g., Izard 1992). However, interest is not identical to enjoyment, since different appraisals are at play (see Silvia 2008 and Tan 1996). In our conception, the relational action tendency in interest is a pleasantly tinted desire. This point has also been made in recent conceptualizations of interest. According to Reinhart Pekrun (2019), the activity in interest-based activity has positive affect to it. Learning out of interest then is pleasant. But it can be argued that enjoyment occurs also independently in the viewing and learning process. For example, every step in the accumulation of coping potential, every piece of the solution or argument may be greeted with pleasure. Thus, there is room for an extended emotional model of learn-

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ing with enjoyment as an independent factor. A limitation in the requirement profile of well-made films for learning is the lack of numerical scaling of challenge and coping potential. In its present early stage, it relies on an intuitive judgment of the particular analyst. We have high hopes that awaiting scales for interestingness, interrater agreement can be reached on at least the relative size of increment steps between two subsequent analysis units. A final limitation in the analysis is the absence of a grounded way to introduce a priori estimations of challenge and coping potential, thus of interestingness, in targeted audiences. We believe that the problem is far from new. Educators face the task of tweaking educational content and activities to prior knowledge and competence of their students. At least some standardized measures have been developed, such as reading or arithmetic performance classifications. Probably, in other domains any design of learning material relies on experiential knowledge of skilled teachers. There may be ways to use their collective judgments for the analysis of interestingness of films for learning.

In spite of these and other limitations, we expect that the method laid out here can be used to analyze and test a large number of films for learning as to interestingness, possibly resulting in a great many more effective patterns of balanced challenge and coping ability than the linearly rising one that we have proposed and found. A longer list of strengths and weaknesses found in the analyzed films will certainly help designers of films for learning purposes to come up with more interesting educational narratives, expositions, documentaries, and other films.

In closing, we stress the necessity of more interesting films for learning. Film's powerful potential to show the world outside the classroom, and to raise students' interest for phenomena in this world as was recognized by educators from the 1940s onward, is heavily underused. Students grow up seeing films for learning with a general emphasis on instruction and reproduction, concisely spelling out for them what content needs to be remembered. How can we expect students to be astonished, moved, surprised by film, if we prime them to search for knowledge and facts? If learning and enjoyment in learning is the primary goal of education, and if educators deem interest to be the key, then this should be reflected in how we teach. We aspire to return to film its full potential as an interest-raising tool for learning. By conducting more empirical studies we will further refine our model and analyses, and we invite other researchers to participate. This way film can finally become what Hart Wegner considered "the most influential and seductive force available to us to teach, to convince, and to transmit ideas and information" (1977, 8).

***We aspire to return to film its full potential as an interest-raising tool for learning.***

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## Notes

<sup>1</sup> We mention in particular *basic emotion theory* (Ekman 1984), *dimensional models* (Plutchik 1991; Russell 1980), *constructivist theories* (Barrett 2013; Schachter and Singer 1962), and *appraisal theory* (Arnold 1960; Frijda 2007; Lazarus 1991).

<sup>2</sup> Izard’s view of interest as an emotion motivating exploratory action has been supported in current biopsychological research. See, for example, Jaak Panksepp (2005) who distinguished basic neuro-affective systems in mammals associated with panic, fear, and rage. The “seeking system” deals with expectancy and wanting.

<sup>3</sup> “At the experiential level interest is the feeling of being engaged, caught-up, fascinated, and curious. There is a feeling of wanting to investigate, become involved, or extend or expand the self by incorporating new information and having new experiences with the person or object that has stimulated the interest. In intense interest or excitement, the person feels animated and enlivened. It is this enlivenment that guarantees

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the association between interest and cognitive or motor activity. Even when relatively immobile the interested or excited person has the feeling that he is ‘alive and active’” (Izard 1977, 216). The positive feeling has also been documented in Panksepp’s neuro-biological studies: “The seeking system is an energizing, hedonically positive functional system of the brain . . . which has been further developed into a dopamine-centred ‘wanting’ or ‘incentive salience’ model [in recent neuropsychological studies]” (Panksepp 2005, 46).

<sup>4</sup> It may be helpful here to be reminded of the role of expert analyses in psychological accounts of language use or music. Untrained persons can have strong intuitions and judgments on the grammaticality of sentences, or the harmony in a melody, but it needs expert linguist and musical analyses to get at accounts of the intuitions. Likewise, untrained film viewers do not avail themselves of the explicit norms and structural categories that experts can show underlie implicit appraisals.

<sup>5</sup> Het Klokhuis, “Moleculair-koken” (Molecular cooking). 7 August 2002. <https://www.hetklokhuis.nl/tv-uitzending/2002/Moleculair-koken> with exclusion of the non-documentary parts min. 3:42–5:39, min. 8:20–10:08, and min. 12:07–14:28.

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## Appendices

### **Appendix A: Analysis of Interestingness of Het Klokhuis: Moleculair Koken**

This film is in actual use in a Dutch chemistry class for sixteen to seventeen-year-olds. The film is an 8.20 min. segment of *Het Klokhuis—Moleculair Koken* (Molecular cooking), a Dutch educational television program for children aged nine to twelve.<sup>5</sup> The format includes documentary and staged fragments on an educative subject. The segment was selected by a chemistry teacher and only included documentary fragments. Analysis units were subsequent scenes delineated by represented actions in image, sound, and spoken comment lines.

*Balance between challenge and coping potential:* Regarding form, *Molecular Cooking* is a primarily rhetorical film with categorical elements. Rhetorical form analysis (see Table 1, rightmost column) identified as yet ungrounded claims (challenge of rhetorical films), and arguments that ground these claims (coping potential of rhetorical films); categorical form analysis (see Table 1, second column from the right) identified uncategorized instances and unexplained concepts (challenges of categorical films), and categorizing concepts for the instances and exemplifying instances for the concepts (coping potential of associational film). Appendix A<sup>1</sup> displays the analysis more fully.

Identifying challenges and coping potential, we found five ungrounded claims of which we indicated one as a main claim (challenge of rhetorical films), two uncategorized instances, and eleven unexplained concepts of which we indicated one as a main concept (challenge of categorical films). Keeping in mind the intended viewers, aged nine to twelve, over the course of the film all claims were sufficiently grounded (coping potential of rhetorical films), all uncategorized instances were categorized, and all unexplained concepts were explained (coping potential of associational film). Evaluated for the actual viewers of the Dutch chemistry class, aged sixteen to seventeen, we expect the amount and nature of the cues to deliver redundant coping potential.

*Scoring challenge, coping potential, and interestingness:* The scores we assigned to the challenges and coping potential were made while keeping in mind the intended viewers of the film (aged nine to twelve). The scores would have been lower for the older actual viewers that have more prior knowledge on the subject matter. We set the maximal challenge value equal to the value that the developing coping potential could meet in the end to reflect our evaluation of the balance between challenge and coping potential that all challenges were sufficiently met by coping potential. The maximal challenge value for each challenge was kept constant until the moment of their closure. Increases in coping potential related to the main challenge scored two points, those in relation to secondary challenges one. Coping potential scores were summed across subsequent analysis units resulting in a running cumulative. Per unit, the mean was calculated of cumulative challenges and coping potentials to score the interestingness of the unit (see Appendix A<sup>1</sup>). The development of challenge, coping potential and interestingness are summarized

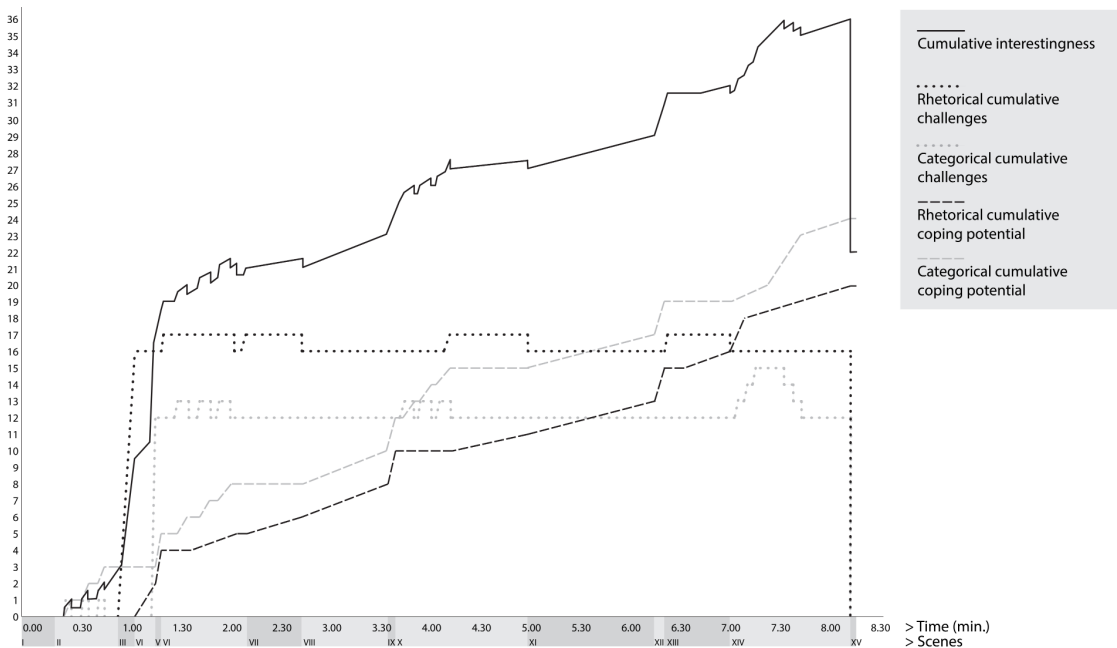
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in Figure 7 (again note that the scores are not anchored in any validated scale, however, the development of challenge, coping potential and interestingness from the film’s beginning to end is captured over the course of the scores). Appendices A<sup>2</sup> and A<sup>3</sup> graphically specify the rhetorical and categorical analyses.

*Evaluation of well-made-ness:* The main challenge of this film presents the prospect of overcoming novelty and complexities related to molecular cooking. This big challenge is initially balanced by only minimal cues for confidence that new dishes will be delivered (positive host and the cooking lab). The coping potential related to the challenge rises with progress in the cooking, and with explanations and demonstrations, making interestingness rise. We found categorical development closely linked with the rhetorical argument by challenges popping up in the process of demonstrating the possibilities of molecular cooking posed by novel terms (e.g., starchy products). The resolution was in demonstrations that each answered part of the rhetorical main challenge. In general, we found the introduction of new challenges to be well-balanced over the course of the film, as were the cues delivering coping potential.

Since coping potential could only be scored as “maximal” and not scaled as an amount, we cannot analytically assess the value of challenge and coping potential in this film—the general assumption underlying the two claims on well-made films for learning. For this one would need objective measures of competence on the subject from some reference group, plus the estimated challenge involved in proving that molecular preparation of a good novel dish according to the same group. However, it can be expected that the younger intended viewers would value the challenges posed in the film higher than the older actual viewers.

Figure 7. Cumulative challenge, cumulative coping potential, and cumulative interestingness of *Het Klokhuis: Moleculair Koken*, derived from rhetorical and categorical form analysis.





Now we evaluate the two claims on well-made film. All claims presented in the film were grounded, all uncategorized instances were categorized, and all unexplained concepts were explained. The film thus met claim 1 on well-made films by delivering on its promise. Claim 2 on well-made films was also met: interest increased across the film. The main rhetorical claim was exposed rather early in the film. There were no prominent horizontal lines in the representation of interestingness indicating the development had paused, and arguments and categories or instances were presented piecemeal. However, there were minor drops after the closure of each secondary challenge. Because the categorical development was closely linked with the rhetorical argument, the closure of each secondary challenge also resulted in a rise of the coping potential related to the main challenge. A drop of the interestingness level at the closure of a secondary challenge never negatively exceeded the level of interestingness that was already reached before the start of that secondary challenge, and due to the relatedness of secondary and main challenges even less than would have been the case with non-related fragmented challenges.

**Appendix A': Film Analysis on Rhetorical and Categorical Elements  
in the Film *Het Klokhuis*: Moleculair Koken**

Please refer to the online appendix for full-color versions of the figures.

Scoring:

- Increase in perceived coping potential (the prospect of meeting the challenge posed) related to main challenges: 2 points, indicated with (+ +);
- Increase in coping potential related to secondary challenges: 1 point, indicated with (+);
- The total amount of points assigned to one challenge = maximum value of the challenge = coping potential met in the end, indicated with (-);
- Challenge was assumed to remain fully present until completely resolved or explained.

Note that the cumulative challenge drops one point whenever a secondary challenge is met by the coping potential. See for example categorical components in scene II: with the introduction of *Unexplained concept 1: Products* the cumulative challenge increases one point, and drops one point with the introduction of the *Exemplifying instances of 1*. The cumulative challenge does not drop when a main challenge is partially met by the coping potential because it is not yet fully met. However, the introduction of related coping potential causes the cumulative coping potential to rise. See, for example, rhetorical components in scene IV: with the introduction of *Prospect of proof for main claim* the cumulative coping potential increases two points (not just one because it is related to a main challenge) while the cumulative challenge remains at fourteen points. The cumulative challenge related to the main challenge remains stable until the end of scene XIV.

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Scene	Time	Action and image	Lines	RHETORICAL COMPONENTS					CATEGORICAL COMPONENTS					OVERALL CUMULATIVE				
				Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Interest
I	0:00	Het Klokhuis leader																
II	0:20	Close-ups of pans, knives, bowls, a stove. An empty kitchen. Several products in the front. Bart enters the shot from the left, zoom out.  Close ups of shrimps, tomatoes and cucumber, apples and pears, ginger and mint, strawberries and grapes.  Back to Bart in the kitchen.  Close ups of stirring sauce in a pan, backing a piece of fish, putting a plate in the oven, chopping asparagus, pouring liquid in a bowl, pouring something steamy in a bowl.  Back to Bart in the kitchen.	<p><b>B:</b> Food is fantastic. Nature supplies us with endless delicious products.</p> <p><b>B:</b> Meat, fish, vegetables, fruit, herbs, seeds, nuts.</p> <p><b>B:</b> And then you can do all kinds of things with it in the kitchen:</p> <p><b>B:</b> Cooking, baking, roasting, stewing, cutting, mixing, cooling.</p> <p><b>B:</b> Countless recipes have been created over the years.</p>															
		Bart stands still next to the products that were shown in the close ups.	<p><b>B:</b> From <i>Babi pangang</i> to kale stew and from mayonnaise to salt herring. But the question is: Can we still improve those recipes? Or better yet: Can we also come up with new recipes?</p>															
III	0:58	Bart walks toward the camera through a hallway.	<p><b>B:</b> <i>But of course!</i> If you research the preparation of food and you look very precisely what happens, you can use that knowledge to cook even better and tastier.</p>															

(continued)

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IV	1.08	Close up of Eke's hands while peeling an orange, zoom out to Bart, Eke and Jan in the kitchen. Close ups of Eke's face, and his hands while cutting chives. Back to Bart, Eke and Jan. Close ups of Jan's face while looking through a microscope and his hands while placing a new slide underneath it. Back to Bart, Eke, and Jan in the kitchen.	<p><b>B:</b> We are going to cook with knowledge and this is a top duo for that: Eke Mariën, top chef and recipe creator, and this is Jan Groenenwold, chemist, food detective at Utrecht University. The cook and the chemist. We are going to make a <b>molecular three-course meal</b>.</p>		Prospect of proof for main claim	(++)	16	2	9		Main unexplained concept: Molecular meal		(12-)	12	3	7.5	28	5	16.5
V	1.21	Title on the background of the prepared dish	Appetizer: Orange mayonnaise pudding		Prospect of proof for main claim	(++)	16	4	10		Exemplifying instance of main		(++)	12	5	8.5	28	9	18.5
VI	1.25	Close up of vinegar being poured into a glass.	Zoom out, Bart pours vinegar into a glass. Bart adds oil to the vinegar.	<p><b>B:</b> One of the tricks of cooking is of course bringing different ingredients together into a new, tasty combination. But what if the ingredients don't want to mix?</p> <p><b>B:</b> Take for example vinegar, here, and sunflower oil.</p> <p><b>B:</b> Vinegar is an...</p> <p><b>B:</b> ...aqueous ingredient ...</p> <p><b>B:</b> ... and sunflower oil...</p>	Secondary claim 1	(-)	17	4	10.5		Unexplained concept 4: Ingredients		(-)	13	5	9	30	9	19.5
							17	4	10.5		Exemplifying instance of 4		(+)	12	6	9	29	10	19.5
							17	4	10.5		Uncategorized instance 1: Vinegar		(-)	13	6	9.5	30	10	20
							17	4	10.5		Categorizing concept 1: Water-based ingredient		(+)	12	7	9.5	29	11	20
							17	4	10.5		Uncategorized instance 2: Sunflower oil		(-)	13	7	10	30	11	20.5

Scene	Time	Action and image	Lines	RHETORICAL COMPONENTS					CATEGORICAL COMPONENTS					OVERALL CUMULATIVE			
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		Resulting in two layers of liquids on top of each other in the glass.	<b>B:</b> ... an oily ingredient. And watch what happens. They don't want to mix!														
		Bart holding the glass turning to Jan. Jan takes an egg from a box. Close up of Jan breaking the egg on the edge of the glass and adding the egg to the liquids. Jan puts a hand blender into the glass and starts mixing. Close up of the glass where the ingredients turn into mayonnaise.	<b>B:</b> But Jan, how can we still mix these liquids? <b>Jan:</b> That is possible, with an egg. You add an egg to the mixture. Then you take a hand blender and put it in.	Proof for secondary claim 1													
		Close up of Jan explaining. Close-up of the mayonnaise. Jan and Bart sitting next to the mayonnaise, Jan still explaining.	The egg contains molecules, protein molecules. They are very good at protecting the oil droplets that I am mixing. And because they are so well protected, that mayonnaise will no longer fall apart.	Secondary claim 2													
VII	2:17	Close up of a hand that puts mayonnaise on a glass slide. Close up of hand placing the slide underneath the microscope. Close up of hand turning the wheel of the microscope. Close up of Jan looking through the microscope while explaining. Zoom out, Jan moves away from the microscope, Bart enters the shot from the right and looks through the microscope. Image through the microscope of bubbles moving past each other. Bart moves away from the microscope and looks toward the computer screen in the back displaying the same image of the bubbles. Back to Jan image of the bubbles. Back to Jan and Bart, Jan explains to Bart.	<b>J:</b> Look Bart, this is what mayonnaise looks like under the microscope. <b>B:</b> Wow, all little balls huh?! <b>J:</b> Yes, those are fat drops. You can see them sitting very close together here. They do not flow together like fat and vinegar, because there is a layer of protein molecules around them, around those drops.	Proof for secondary claim 2													

(continued)

Scene	Time	Action and Image	Lines	RHETORICAL COMPONENTS				CATEGORICAL COMPONENTS				OVERALL CUMULATIVE						
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VIII	2:39	<p>Close up of hands cutting oranges. Close up of Eke's head while cooking. Close up of flame lighted underneath a pan on a stove. Close up of boiling butter in the pan. Close up of Bart, pan to the left where Eke is standing. Over shoulder of Eke while Bart is listening. Zoom in on Eke pouring juice through a sieve. Close up of measuring glass being filled with juice. Over shoulder of Eke. Close up of Eke knocking mayonnaise in a bowl while Bart pours in the juice. Tilt to Bart's face. Close up of the bowl in which the mayonnaise is being knocked. Close up of three glasses being placed on the kitchen counter. Close up of Eke's hands while putting the mayonnaise into the glasses with a spoon. Eke filling the three glasses. Eke putting the glasses into the microwave. Close up of Eke's finger pressing the microwave's button. Top view of Eke emptying a glass onto a plate. Close up of Eke cutting a cucumber. Top view of Eke placing the cucumber onto the plate, and putting shrimps on the plate. Close up of Eke's hands cutting chives. Top view of Eke scattering the chopped chives on the dish. Bart and Eke standing next to each other in the kitchen. Close up of the plate being placed onto a set table. Zoom out to Bart sitting at the table and Eke standing next to it. <b>Top view of the prepared dish (point of view of Bart).</b> Back to Bart sitting. Bart starts eating, zoom in on Bart. Bart starts eating, looks into the camera. Zoom out, Eke watches Bart eat.</p>	<p><b>Lines</b></p> <p><b>B:</b> Eke, what are we going to make?</p> <p><b>Eke:</b> We're going to make an orange mayonnaise. And um, you normally make mayonnaise with vinegar. And now I use orange juice instead of vinegar, reduced a bit so that it is very concentrated. And then I add orange oil.</p> <p><b>B:</b> You can really see it starting to foam right?!</p> <p><b>E:</b> Yes, you can see it going. I put it in a small container and then it goes in the microwave. And then you get a lot of heat for a very short time.</p> <p><b>B:</b> Yes.</p> <p><b>E:</b> Then the egg white in the mayonnaise solidifies. And the air that I just punched in, it is trapped inside the egg white, it cannot get out. So then you get a very light mayonnaise cake. It's a new dish. Look Bart: Orange mayonnaise pudding, with Dutch shrimps, a little cucumber and ...</p> <p><b>B:</b> Hmmm... What a special combination. Yummy!</p> <p><b>E:</b> Yes, orange and shrimp go really well together.</p>	Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Interest
				Proof for main claim	16	8	12			(++)	12	10	11	28	18	23		



Scene	Time	Action and image	Lines	RHETORICAL COMPONENTS	CATEGORICAL COMPONENTS	OVERALL CUMULATIVE
				Challenge		
				Coping potential		
				Points - main in red		
				Cumulative Challenge		12
				Cumulative Coping potential		15
				Cumulative Interest		13.5
				Challenge		
				Coping potential		
				Points - main in red		
				Cumulative Challenge		16
				Cumulative Coping potential		11
				Cumulative Interest		13.5
				Proof for secondary claim 3		
				Points - main in red		
				Cumulative Challenge		(+)
				Cumulative Coping potential		
				Cumulative Interest		
				Challenge		
				Coping potential		
				Points - main in red		
				Cumulative Challenge		28
				Cumulative Coping potential		26
				Cumulative Interest		27

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XI	5:06		<p><b>E:</b> Now we are going to make a béchamel sauce with a little herb cheese. Look, I have a very tasty herb cheese here, a spring cheese with all kinds of spring herbs in it and a little paprika. And I will soon stir it through my béchamel. And you make a béchamel on the basis of butter, you melt it, you add some flour, then you cook that flour in the butter, then you actually stir it and then you pour milk in it and that binds, that becomes a bound sauce. And you melt your cheese through it and then you are actually done with your cheese sauce. There you go Bart. This is a piece of cod fillet with the cheese sauce we just made and asparagus on the side. Enjoy your meal.</p> <p><b>B:</b> Thank you, I think that will work. Hmmm.</p> <p><b>E:</b> Approved?</p> <p><b>B:</b> Sure!</p>																
XII	6:22	Title on the background of the prepared dish	Dessert: Strange fruit with oil snow																

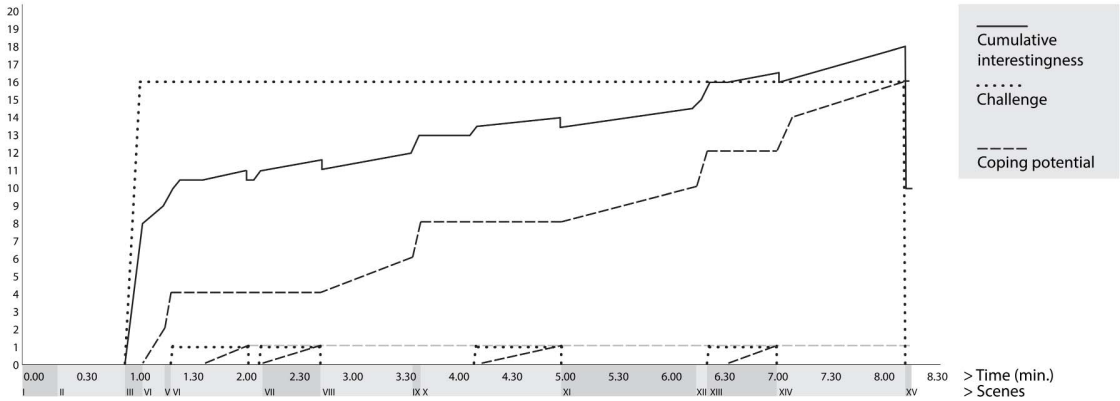
(continued)





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				Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Points - main in red	Cumulative Challenge	Cumulative Coping potential	Cumulative Interest	Challenge	Coping potential	Interest			
			<p><b>E:</b> I use an aerosol that normally contains whipped cream. I empty a carbon dioxide cartridge into it and I also put grapes in it and if you leave that for a while then the carbon dioxide will sit in those grapes and then you get fizzy grapes.</p> <p><b>E:</b> Then there comes the ultimate one that is with nitrogen I am going to make a foam, or ice I should say, of oil and I flavored that oil with rosemary.</p> <p>[All introduced Categorical concepts in this scene also function as exemplifying instances of the main Categorical challenge]</p> <p><b>B:</b> Hmmm. Oh, this is really delicious, you can taste the rosemary, the berry juice, the strawberry. This really is the perfect ending to a molecular dinner Eke!</p> <p><b>E:</b> Awesome.</p> <p><b>B:</b> Hmmm.</p> <p><b>E:</b> Very good. I'm glad you like it.</p> <p><b>B:</b> Definitely!</p>																		
XV	8:20	Het Klokhuis outro					16	18	17	16	18	17	16	22	12	0	24	12	0	44	22

**Appendix A<sup>2</sup>: Course of Challenge, Coping Potential, and Cumulative Interestingness Due to Rhetorical Elements in the Film *Het Klokhuis: Moleculair Koken***



**Appendix A<sup>3</sup>: Course of Challenge, Coping Potential, and Cumulative Interestingness Due to Categorical Elements in the Film *Het Klokhuis: Moleculair Koken***

