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The Extended Theory of Cognitive Creativity

Interdisciplinary Approaches to Performativity

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Chapter 16
It Doesn't Seem_It, But It Is. A Neurofilmological Approach to the Subjective Experience of Moving-Image Time

Ruggero Eugeni, Stefania Balzarotti, Federica Cavaletti, and Adriano D'Aloia

Abstract This article illustrates the first steps of a research project concerning the "Subjective Experience and Estimation of Moving-Image Time" (SEEM_IT). After introducing the theoretical background of the research, that links time perception to the embodied experience of movement, the article presents the main empirical results of an experiment aimed at assessing how spectators' time perception is affected by the style of editing and the type of represented action in short video clips. Though the style of editing played a major role in influencing SEEM_IT, it also significantly interacted with the type of represented action. The article reassesses these findings by discussing them within the theoretical framework of the research.

Keywords Time perception · Film experience · Neurofilmology · Duration estimation · Time passage · Editing · Action

16.1 Introduction

As we exit a movie theatre after a film screening, it frequently happens that we have the impression that time flew or dragged by, or even that a single scene of a film seemed to pass slower or faster than it actually did. Time perception at the cinema depends on a complex combination of several factors both objective (i.e. related

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to the concrete modalities of aesthetic presentation and physical performance of actions, to the specific nature of the depicted actions and to the narrative context in which they take place) and subjective (for instance, the spectator's affective attitude and sensitivity in that precise moment, his or her genre preferences, etc.). Despite the complexity and apparent impenetrability of the matter, specific aspects and dynamics of moving-image time perception can be isolated and investigated.

This article illustrates the first theoretical and empirical results of a research project concerning the perception of time during the course of a moving-image experience (e.g. fiction and non-fiction films, tv series, commercials, video clips). This research on the "Subjective Experience and Estimation of Moving-Image Time" (SEEM_IT) is set within the framework of "neurofilmology" (D'Aloia and Eugeni 2014), which is an epistemological and methodological approach based on the dialogue between film theories and both the experimental and speculative tools of cognitive psychology and neurocognitive sciences. One of the aims of this research program is to refine and update the current models of moving-image spectatorship. After introducing the general theoretical framework of the research (Sect. 16.2), the procedures and the main results of a psychological-behavioural experiment conducted on SEEM_IT are described and discussed (Sects. 16.3, 16.4, and 16.5). The conclusions are devoted to reassessing the experimental findings within the theoretical framework of the research (Sect. 16.6).

16.2 Theoretical Framework

16.2.1 Time and Moving-Image Theory

Throughout the history of film theory and cinema studies, scholars have developed more or less systematic analyses of time as a specific feature of the film experience. During the era of narratological semiotics in the seventies, the temporal dimensions of the film experience were conceived of as a textual effect of the interactions between story and discourse (Chatman 1978; Genette 1972) or of an enunciational dynamic (Bettetini 1979). Afterwards, beginning in the nineties, cognitive-analytic aesthetics started to pay greater attention to time as a fundamental aspect of the film experience while rejecting the idea of a real interaction between the fictional representation of time and its subjective experience. Gregory Currie (1995, 2004), for example, argued that the spectator cannot experience the fictional events as happening in his own actual present (the so-called "claim of presentness") because he has no place in the fictional world physically, and thus there is no interaction between the spectator's egocentric (bodily and proprioceptual) sense of time and the time of the fictional world (for the opposite stance, see Terrone 2017). Such an approach risks denying the qualitative articulation of the spectator's temporal experience. Totally different – and in our view more productive – is the position expressed by Paul Ricoeur (1984–1988) from a phenomenological and hermeneutic point of view. Following the French philosopher, the textual plot as "configured time" is an instrument of mediation between individual and "prefigured" time on the one hand, and cultural and "refigured" time on the other. Although developed in the field of literary analysis, this perspective allows for the rethinking of the temporal experience of film narrative in a post-cognitive key.

More recently, this landscape has widened under a twofold pressure: on the one hand, the increasing attention to Gilles Deleuze's works on film time, distinguishing between a classical "movement-image" and a modernist "time-image" (Deleuze 1986, 1989; see Mroz 2012), and on the other, the presence of new, complex time architectures in contemporary cinema (Carruthers 2016; McGowan 2011; Mulvey 2006; Stewart 2007; Trifonova 2007) and television storytelling (Ames 2012; Mittel 2015). More generally, scholars have started to focus on the "cultural" nature of cinematic time and its relationship with the social shapes of time (Doane 2002; Ethis 2006; Powell 2012). From this point of view, cinema and audiovisual media have been more or less explicitly linked to the collective experience of time (see for instance Adam 2004; Burges and Elias 2016; Crow and Heath 2002; Keightley 2012), both in the "classical" and "modern" era (characterized by time's spatialization, compression, and acceleration) and in the "postmodern" condition (characterized by time's extension, fragmentation, and fluidity, and by the dominance of a "broader/enlarged present"; see for instance Sobchack 2004).

Finally, in the last few years, many scholars have tackled the issue of time experience in film viewing from a cognitive or neurocognitive perspective. A first group of interventions addressed the problem from the Event Segmentation Theory perspective (Magliano and Zacks 2011; Radvansky and Zacks 2014; Shipley and Zacks 2008; Zacks 2015; Zacks and Magliano 2011). In this case, the discussion concerned the relationship between transitions inside the represented world (including temporal transitions), film editing processes, and the spectator's segmentation of events and actions. On the one hand, the debate gave rise to an analysis of the processes that constitute continuous diegetic time on the basis of continuity editing (Berliner and Cohen 2011; D'Ydewalle et al. 1998; D'Ydewalle and Vanderbeeken 1990; Germeys and D'Ydewalle 2007; Smith 2012, 2013; for a critical review, see Poulaki 2015). On the other hand, such an approach promoted the identification of the basic units of narrative comprehension (micronarratives), linked in turn to the experience of cinematic "nowness" (Tikka and Kaipainen 2014, 2015). In this way, the discussion has oscillated between the processes of the constitution of diegetic (i.e. represented) temporality and the experience of the "nowness" of spectators' temporality. However, it has not investigated the (possible) relationships between the represented action, its understanding and segmentation by viewers, editing styles, and the qualitative and quantitative experience of temporal duration – what we call SEEM_IT.

A second group of cognitive and neurocognitive contributions has focused on the perception of temporal duration by using naturalistic moving images as stimuli (see for instance Wearden 2005, 2008). In particular, these kinds of studies have investigated the relationships between estimations of temporal duration and either emotional factors (Fayolle et al. 2014; Loftus et al. 1987) or the “neural engagement” of viewers (Cohen et al. 2017). In other terms, these interventions analyse SEEM_IT, but without referring to the textual and semiotic processes and styles of the moving images (editing, in particular).

Finally, a third limited group of cognitive and neurocognitive interventions has analysed the relationship between SEEM_IT and editing processes. Leaving aside the compelling but non-systematic observations on the “elasticity” of time experienced in film viewing by Damasio regarding Alfred Hitchcock’s *Rope* (Damasio 2002), it is worth mentioning here the works of De Wied et al. (1992) and Manoudi (2015). The first study (on which see also De Wied 1994) focuses on the estimation of temporal durations in viewing suspense movie scenes; Manoudi’s work instead analyzes the effects of editing techniques and styles in determining viewers’ estimation of time duration (see our discussion in Sect. 16.5).

In conclusion, SEEM_IT appears to be a multi-faceted and multi-disciplinary object: although intrinsically characterized by a subjective dimension, SEEM_IT interacts on one hand with the semiotic structures of moving images, and on the other with the social shapes of time experience. In Ricoeur’s terms, we could say that *subjective experience translates textual forms into socially shared shapes of temporal experience*. On the basis of this framework, we decided to start the SEEM_IT survey from an empirical, psychological, and behavioural investigation concerning the interactions between the semiotic construction of moving images and the subjective experience of time. The strategic design of the research considers a subsequent shift towards the social dimension of the phenomena of time perception (see discussion in Sect. 16.6).

16.2.2 From Time Perception to Embodied Timing

The choice to base the analysis of SEEM_IT on an empirical ground leads our research toward the broader field of psychological, cognitive and neurocognitive studies of timing and time perception. We need to carefully consider what the theoretical implications of such a methodological move are.

“Timing” – a general label encompassing qualitative and quantitative experience, perception, judgement, estimation of time speed, order and duration – has become a central issue of neurocognitive studies in the last few years (Arstila and Lloyd 2014; Block and Grondin 2014; Buonomano 2017; Benini 2017; Drayton and Furman 2018; Matthews and Meck 2014; Merchant and De la Fuente 2014; Merchant et al. 2013; Roenneberg 2012; Vatakis et al. 2018; Wearden 2016; for less specialist yet well documented studies see Burdick 2017; Hammond 2012; Klein 2007. For the philosophical background of subjective time experience see also Mölder et al. 2016; Phillips 2017). In this context, scholars have underlined different aspects of the experience of time, in particular its subjective dimension, its different “windows”, and the multiplicity of psychological mechanisms and underlying neural dynamics responsible for its constitution, perception, and evaluation. In any case, the empirical research focused in particular on two aspects of the subjective perception of time:

qualitative judgement (speed) and *quantitative* estimation (duration), considered as separate variables (Wearden 2015; Wearden et al. 2014; Droit-Volet and Wearden 2016; Droit-Volet et al. 2017).

Within this field, a relatively recent trend outlines the *embodied* nature of timing experiences (Altshuler and Sigrist 2016; Flaherty 2011; Meck and Ivry 2016; Wittmann 2009; Wittmann 2016). Among the different (and not necessarily competing) theories of embodied timing, we decided to pay special attention to the models that link timing to the planning, coordination, and monitoring of *movement* and *action* (Droit-Volet et al. 2013; Gallagher 2011; relevant precursors of this tendency have been Fraisse 1964; Guyau 1890; Piaget 1969), since these are central features of moving images. Following this trend, "the sensory-motor states acquired during experience ... provide the material for certain judgments of time, and at least for explicit judgments of time or human awareness of time" (Droit-Volet 2014: 494). Moreover, from this point of view, *the experience of time is considered as deriving from both the personal performance of actions (including their proprioception), and the observation of the other's actions and movements*: indeed, perceived moving objects and/or subjects, as well as pictures of bodies in dynamic postures are subjectively evaluated as longer in duration than the same objects and subjects pictured as static, in standing postures, or moving away from the observer (Brown 1995; Nather et al. 2011; Nather and Oliveira Bueno 2012; Droit-Volet et al. 2013; Nather et al. 2014; Vatakis et al. 2014; Wang and Jiang 2012; Wittmann et al. 2010). These findings can possibly be interpreted as referring to a process of *embodied simulation* of the other's actions and movements (Gallese 2005) on the basis of mirroring brain circuits (Ferrari and Rizzolatti 2015; Rizzolatti and Sinigaglia 2007; Rizzolatti and Sinigaglia 2016), a process assumed to be active within dynamic and reciprocal interactions of subjects in *joint action* regimes, (Aglioti et al. 2008; Colling et al. 2014; Sebanz et al. 2006; Sebanz and Knoblich 2009; Vesper and Van Der Wel 2013; Vesper et al. 2016), such as couples of dancers or musicians (Vicary et al. 2017; Wolf et al. 2018). Although we chose not to investigate the neural bases of such phenomena at this stage of our research, we should nonetheless note that the evidence gathered by some studies directs scholars' attention to certain areas responsible for the computation of time in connection with movement and proprioception, in particular, the Supplementary Motor Area (see for instance Coull et al. 2016) and the insular lobe (Wittmann 2016).

These considerations take on particular relevance in the visual perception of moving images (see Gallese and Guerra forthcoming). In this case, in fact, we find the coexistence of at least three types of movement: (a) *Diegetic movements* of represented subjects and objects, and in particular actions or gestures performed by the characters; (b) *Discourse movements* linked to camera movements, image sliding rate (normal, fast, time-lapse, slow, freeze frame), editing pace, and variations in angle and distance/size between shots in editing; (c) *Bodily movements* enacted by the viewer, and particularly head/eye movements (fixations, saccades), startled responses, muscular movements, etc.

In conclusion, our decision to ground the analysis of SEEM_IT on empirical research entails two main theoretical consequences. On the one hand, the complexity of the subjective experience of time is reduced – at least temporarily – to the two variables of the qualitative judgment of speed and of the quantitative estimation of duration: other aspects (such as the perception of the order of events and their eventual iteration) are traced back to these two basic variables. On the other hand, the connection with empirical research drives SEEM_IT towards an embodied and inter-embodied foundation, and more generally towards a conception of moving image experience as based on embodied simulation.

16.3 An Experiment on SEEM_IT: Premises and Method

Our pilot experiment on SEEM_IT was conducted in collaboration with a professional film crew and a team of psychologists from the Università Cattolica del Sacro Cuore in Milan. The experiment aimed at understanding the interactions between Action types and editing styles in ten short video clips specially designed for the purpose of this research. The spectator's temporal experience was measured both in qualitative terms (time passage judgment and action speed judgment) and in quantitative terms (estimation of duration). The actions were differentiated in terms of intentionality/goal-orientation and in terms of linearity/absence of internal iteration of sub-actions. As for the Editing styles, in this pilot experiment we voluntarily avoided any kind of manipulation of time (e.g. ellipses, slow or accelerated motion, alteration in the order or repetition of sub-actions). Consequently, in all videos, the editing affected only the spatial dimension (angle and size) and the pace of shot changes.

16.3.1 Stimuli Construction

16.3.1.1 Editing Style

A professional film crew shot three different routine actions in a professional studio with two sets of seven cameras and using nine different shot sizes and angles. For each action, we edited the videos using three different styles: (A) master shot (no editing); (B) slow-paced editing; (C) fast-paced editing. In the editing process, we were careful to maintain an identical duration for the three videos representing the same action: in other terms, although differently edited, the three videos of the same action have the same duration.

In the master shot version (A), the entire action was shown from a frontal perspective, medium shot, without any cut interrupting it. Version (B) was edited according to *match-on-action* cuts (5 shots from different angles and distances, including establishing shots): this style implies a high possibility of "edit blindness", (Smith and Henderson 2008) typical of *continuity editing*, which in turn is functional to a clear and "economical" narrative understanding of the represented action (Cutting 2005; Cutting and Candan 2013; Magliano and Zacks 2011). Version (C) presented a higher number of cuts (11–13) and more angle/distance changes (7~), including point-of-view shots, *plongées*, close-ups, and cut-in shots; this style was intended to emulate *intensified continuity editing* (Bordwell 2006; see also Cutting and Candan 2015) by increasing the number and varying the angle of shots while avoiding clear violations of continuity rules.

16.3.1.2 Action Types

The potential effect of Editing style on SEEM_IT was tested across three types of routine actions, performed by a trained actor in front of cameras: (1) pouring some water into a glass and drinking it ("Drinking water"); (2) cutting a half-loaf of bread into two parts with a knife ("Cutting bread"); (3) repeatedly moving a glass and a loaf of bread on a table ("Moving objects"). In addition, the actor was asked to perform the action "Moving hands" (i.e., gently moving his hands upwards on the table in a circular motion; Action 0): this action was presented only in the (A) master shot (no editing) version at the beginning of the experiment as a control stimulus aimed at preventing a possible "novelty effect".

Actions (1), (2), and (3) differ in terms of intentionality/goal-orientation and in terms of linearity/non-iteration of sub-actions. More precisely, "Drinking water" (1) is an action clearly oriented both by local goals (sub-actions including grasping, lifting, tilting, putting down a bottle, grasping, lifting, holding a glass and bringing it to mouth, drinking, putting down the glass) and by a global agent's intention. Moreover, it is a completely linear action, without any element of iteration or repetition. "Cutting bread" (2) is an action with a clear intention, including evident goal-directed motor acts as subcomponents: grasping a bread knife, holding a loaf, cutting the loaf in two pieces, and placing them on a dish. Moreover, it implies the iteration of one of the sub-actions (the gesture of cutting the loaf is clearly repeated two times as the knife sinks in it). Finally, "Moving objects" (3) includes clear goal-directed motor components such as grasping, holding, and putting down different objects. The global intention, however, is not defined, and no final goal can be identified. Moreover, it presents a high degree of iteration, since the object displacement (two objects being moved two times each) can appear to be a slightly varied repetition of the same gesture.

As we said, the groups of three videos representing the same action had the same duration; moreover, all the clips had similar durations: 12" for "Moving Hands", 13.5" for "Drinking Water", 11" for "Cutting bread" and 11.8 for "Moving Objects".

A summary of the combination of Action types and Editing styles is shown in the following table:

Action types	Editing styles		
	A Master shot	B Slow-paced	C Fast-paced
0. Moving hands [control clip]	0A	–	–
1. Drinking water (*goal-directed, linear*)	1A	1B	1C
2. Cutting bread (*goal-directed, iterative*)	2A	2B	2C
3. Moving objects (*undefined goal, iterative*)	3A	3B	3C

16.3.2 Procedure and Measures

16.3.2.1 Participants and Tasks

The sample consisted of 76 undergraduate students, with normal visual acuity and unaware of the specific purposes of the study. The participants' mean age was 20.72 (DS = 3.26). Each participant watched all nine video clips, which were administered in randomised order. The additional control video clip 0A was presented at the beginning of the experimental session in order to control for a potential "novelty effect". Eye-movements were recorded while participants watched the video clips using a Tobii X120 eye-tracker, but these data are not reported in this article.

In order to prevent the participants from counting seconds in their minds, we invited them to provide a short oral description of the content immediately after watching each clip ("*Now please tell me what happened in this video clip*"). Then, participants were asked to report their Emotional involvement rating three adjectives on a 7-point Likert scale (i.e., boring, interesting, engaging; $\alpha = .82$); to express a Time passage judgement (on a 9-point Likert scale from "*time dragged*" to "*time flew*"), an Action speed judgement (from "*very slow*" to "*very fast*"), and finally to estimate the Duration of the clip in seconds (by indicating a numerical value between 1 and 30 s). Notably, following current literature (e.g. Droit-Volet and Wearden 2016; Droit-Volet et al. 2017; Wearden 2015; Wearden et al. 2014), we decided to keep the qualitative (judgement) and quantitative (estimation) aspects of time perception as separate variables, both in data collection and analysis.

At the end of each session, participants were required to complete two tasks assessing their individual estimation ability in order to control for individual differences in the ability to perform cognitive estimates.

16.3.2.2 Analysis

Repeated measures ANOVAs with Bonferroni pairwise comparisons (Editing style x Action type) were used for data analysis. For accuracy of duration estimates, Individual Time Estimation Ability was included as a covariate.

In addition, a repeated measures ANOVA was used to compare accuracy of duration estimates when including the 0A control video clip (master shot only).

16.4 An Experiment on SEEM_IT: Results

Overall, the results highlighted the prominent role of fast-paced editing (C) in affecting spectators' experience, since this Editing style showed an effect on each of the variables under observation. Specifically, in comparison with slow-paced editing (B) and no-editing (A), it was rated as more emotionally involving, and generated higher ratings of "time flying" and of action speed. Moreover, fast-paced editing led to significantly higher overestimations of durations (in particular compared to no-editing master shot A).

16.4.1 Emotional Involvement

Concerning emotional involvement, the analysis yielded a significant main effect of Editing style, $F(2150) = 13.02$, $p < .001$, $\eta 2 = .15$. The interaction between Editing style and Action type was also significant, $F(4300) = 2.53$, $p = .040$, $\eta 2 = .03$, while the main effect of Action type was not, $F(2150) = 2.75$, $p = .077$. Pairwise comparisons showed that the fast-paced editing was rated as more emotionally involving than the master shot ($p < .000$) and the slow-paced editing ($p < .01$), while no difference emerged between the slow-paced and the master shot editing. Significant pairwise comparisons are shown in Fig. 16.1.

16.4.2 Action Speed and Time Passage

Concerning Action speed, the analysis yielded a significant main effect of Editing style, $F(2150) = 15.73$, $p < .001$, $\eta 2 = .17$. The interaction between Editing style and Action type was also significant, $F(4300) = 4.02$, $p < .01$, $\eta 2 = .05$, while the main effect of Action type was not, $F(2150) = 1.25$, $p = .287$. Pairwise comparisons showed that the action was rated as faster when fast-paced editing was used compared to master shot ($p < .000$) and slow-paced editing ($p < .01$), while no difference emerged between slow-paced and master shot editing. When univariate ANOVAs were used to analyse the interaction effect, however, the results showed that Editing style had a significant effect (i.e., action was judged as faster) for "Drinking water", $F(2150) = 17.49$, $p < .001$, $\eta 2 = .19$, and "Cutting bread", $F(2150) = 6.35$, $p < .01$, $\eta 2 = .08$, but not for "Moving objects", $F(2150) = 2.52$, $p = .09$. Significant pairwise comparisons are shown in Fig. 16.2.

Similar results were obtained when Time passage was considered. The analysis yielded a significant main effect of Editing style, $F(2150) = 7.74$, $p < .01$, $\eta 2 = .09$. The interaction between Editing style and Action type was also significant, $F(4300)$

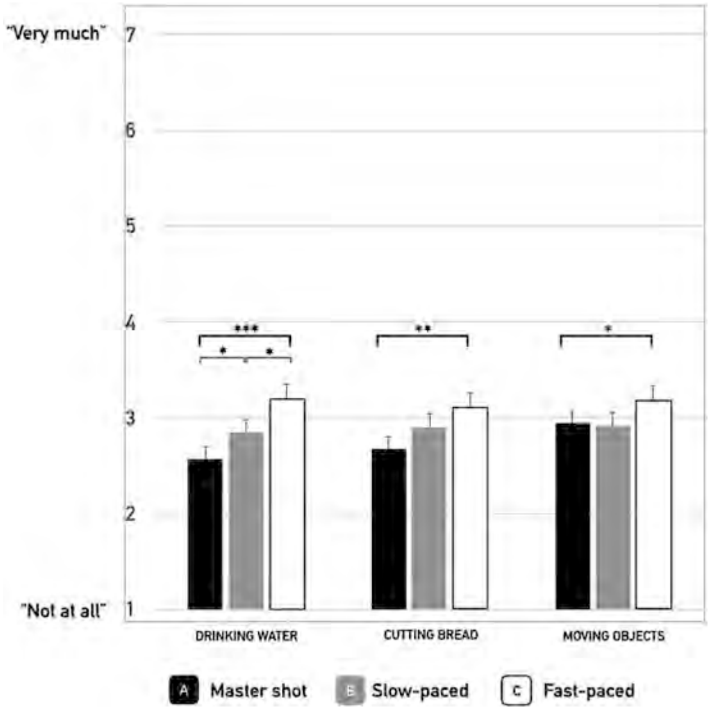

Fig. 16.1 Emotional involvement. *** p <.001; ** p <.01; * p <.05. Error bars represent standard error of the mean

= 3.39, $p < .05$, $\eta 2 = .04$, while the main effect of Action type was not, $F(2150) = .73$, $p = .486$. Pairwise comparisons showed that time was judged as "flying" rather than "dragging" when fast-paced editing was used compared to master shot ($p < .01$) and slow-paced editing ($p < .01$), while no difference emerged between slow-paced and master shot (no editing condition). When univariate ANOVAs were used to analyse the interaction effect, however, the results showed that Editing style had a significant effect (i.e., time flew) for "Drinking water", $F(2150) = 7.83$, $p < .01$, $\eta 2 = .10$, and "Cutting bread", $F(2150) = 6.69$, $p < .01$, $\eta 2 = .07$, but not for "Moving objects", $F(2150) = .93$, $p = .396$. Significant pairwise comparisons are shown in Fig. 16.3.

Overall, we can observe that time judgments depend not only on the Editing style, but also on the Action type. The fast-paced editing (C) influenced subjective time judgements when considering action 1 ("Drinking water"). When participants watched this action, their judgements about both Time passage and Action speed mirrored the stepwise distribution of the editing conditions (A), (B) and (C), with (C) inducing the sensation of the highest rate of both time flow and action.

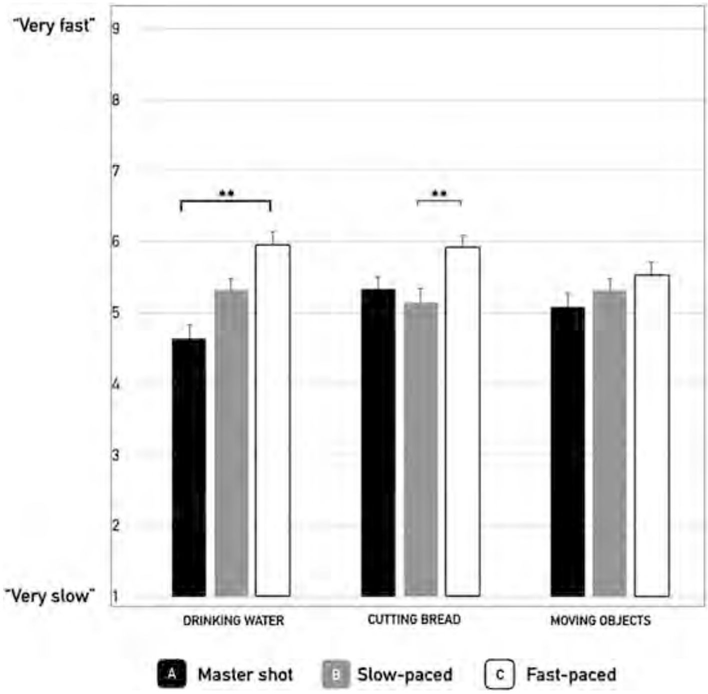

Fig. 16.2 Action speed. *** p <.001; ** p <.01; * p <.05. Error bars represent standard error of the mean

By contrast, in the case of "Cutting bread," the slow-paced editing did not produce a judgment of greater or faster Time passage with respect to the master shot (even though fast-paced editing C still triggered a judgement of higher speed), thus breaking the ascending order of the effects of the three editing conditions. Finally, when considering the action "Moving objects," neither the slow-paced nor the fast-paced editing affected Time passage or Action speed judgements significantly.

16.4.3 Duration Estimation

Concerning accuracy of Duration estimates, we first compared the participants' estimates of the duration of the control video clip (0A) to the duration estimates of the other Action types (Master shot only). The analysis yielded a significant effect, $F(3222) = 22.15, p < .001, \eta 2 = .23$. Pairwise comparisons showed that "Drinking

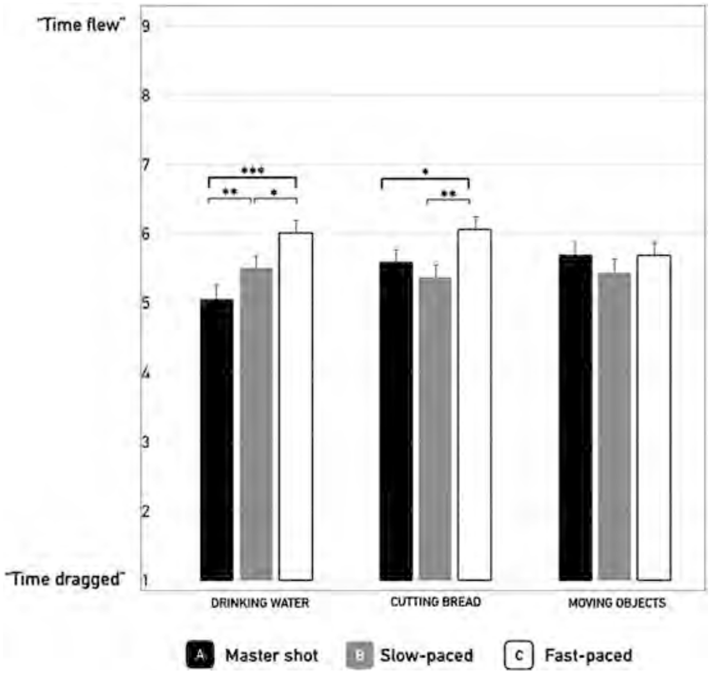

Fig. 16.3 Time passage. *** p <.001; ** p <.01; * p <.05. Error bars represent standard error of the mean

water" generated more accurate estimates than all the other Action types, followed by "Cutting bread", "Moving objects", and finally by the control action (0A).

We then conducted a 3 (Editing style) × 3 (Action types) repeated measures ANOVA. The analysis yielded a significant main effect of Editing style, $F(2150) = 5.13$, $p < .01$, $\eta 2 = .06$, and of Action type, $F(2150) = 32.23$, $p < .001$, $\eta 2 = .30$, while the interaction between Editing style and Action type was nonsignificant, $F(4300) = .83$, $p = .506$. Individual estimation ability (included as covariate) was also significant, $F(174) = 4.18$, $p < .05$, $\eta 2 = .05$. Bonferroni adjusted pairwise comparisons showed that duration was overestimated when fast-paced editing was used compared to the master shot ($p < .01$); moreover, "Drinking water" generated more accurate estimates than the two other Action types, with "Moving objects" producing the highest rate of overestimation. Significant pairwise comparisons are shown in Fig. 16.4.

In sum, when considering the results of the Duration estimation task, we found a significant effect of both Editing style and Action type. Although the duration of the videos was generally overestimated and the fast-paced condition (C) triggered on average the greatest overestimation, variations in the duration estimates were primarily determined by the Action type. More precisely, the duration of "Moving objects" was overestimated to a greater degree than that of "Cutting bread," and the

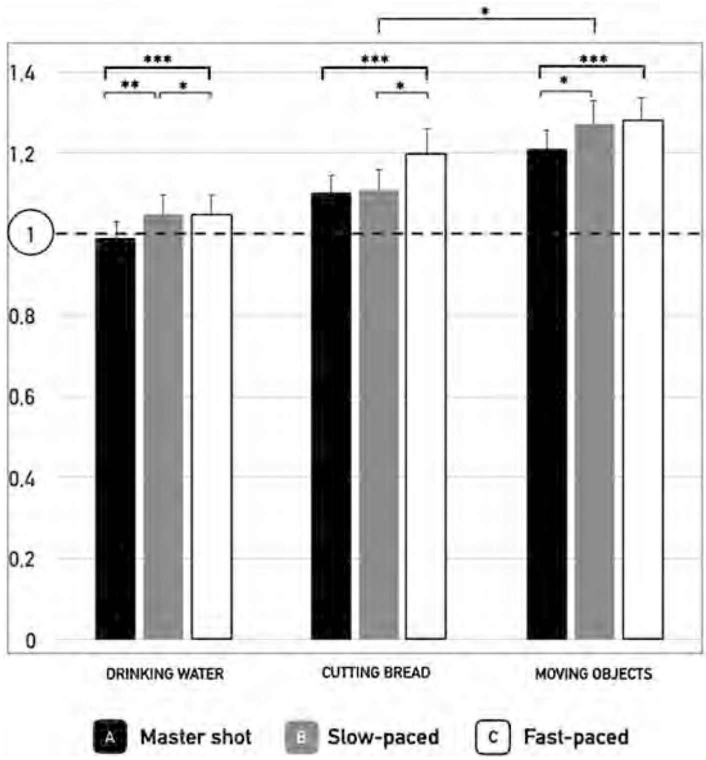

Fig. 16.4 Duration estimation accuracy. *** p <.001; ** p <.01; * p <.05. Error bars represent standard error of the mean

duration of the latter was overestimated to a greater degree than "Drinking water." As a consequence, the greatest degree of overestimation occured when combining "Moving objects" with fast-paced editing. These conclusions are confirmed by a comparison between the estimates of the master shots only (excluding any kind of editing) and the control video: the estimation of "Drinking water" was closer to the actual duration, while we found growing overestimations for "Cutting bread" and "Moving objects". These findings suggest that, when considering participants' Duration estimates, the effect of the Action type represented in the video clip overcame and evened out the effects of the Editing Style. At the same time, the fact that the greatest Duration evaluation was found when "Moving objects" was arranged according to the fast-paced editing seems to imply that the two variables may synergistically interact.

A final remark concerns the relationship between qualitative judgements (i.e., action speed and time passage) and Duration estimates. To examine this issue, we computed two-way correlations between participants' ratings and Duration estimates. Overall, no significant associations emerged (mean $r = -.08$, $p > .05$), with the exception of significant negative correlations between Duration estimates and Time passage (mean $r = -.26$, $p < .05$), as well as between Duration estimates and Action speed (mean $r = -.32$, $p < .01$) when fast-paced editing was used. Thus, for fast-paced edited videos, lower estimates of duration were associated with higher judgements of speed and time flowing quickly.

16.5 An Experiment On SEEM_IT: Discussion

16.5.1 The Role of Editing and the Body of the Film

In general, the findings clearly show that editing plays a role in determining the perception of time. In particular, fast-paced editing results in a judgement of acceleration of both the passage of time and the course of the action; moreover, it triggers an overestimation in the evaluations of durations. This first conclusion confirms the data in the literature regarding the influence of what we called "discourse movement" in the determination of temporal perception, in particular of durations (see Sect. 16.2.2) – on the condition, however, that we admit that *the editing introduces an additional kind of movement with respect to ordinary experience*.

Therefore, if we accept the hypothesis according to which the experience of viewing moving images consists in the extension within a technological apparatus of the ordinary experience of the embodied perception of time, we will have to admit that the embodied simulation of the movement in this case involves not only other subjects, but also a different kind of body, that is *the perceiving/expressing body of the film* (Sobchack 1992; Bellour 2009; Smith 2017). The movements of this body should be considered multiple yet connected (see our list in Sect. 16.2.2). In any case, the problem of a temporal relationship between the film viewer and the body of film still remains widely to be explored (for some attempts see Gallese and Guerra forthcoming).

16.5.2 Judgments and Estimations: Dancing with the Movies

However, we have also seen how editing interacts with the *type of represented action* in determining temporal perceptions. Regarding the Action speed judgments, slow and fast-paced Editing styles produce a clearly progressive acceleration only in the case of a linear and clearly goal-oriented action such as "Drinking water." On the contrary, the effect of editing becomes less certain in cases of a less clearly linear and goal-oriented action such as "Cutting bread," and ends up fading in cases of a repetitive and non-goal-oriented action such as "Moving objects." As for the estimation of durations, although the edited clips tend to produce a certain overestimation compared to the master shots, it is first and foremost the Action type that determines a substantial accuracy ("Drinking water"), a slight overestimation ("Cutting bread"), or a greater overestimation ("Moving objects"). These data confirm the results obtained by Manoudi (2015) (although the experimental conditions were slightly different from ours), according to which "the significant variability found in time estimation was due to the type of events presented in the stimuli (i.e., some events are by nature more dynamic than others) and the different proportion of static and dynamic shots in each scene" (30).

It is therefore necessary to ask why some Action types interact with Editing styles differently from others in determining temporal judgments and estimates. If we adopt the model of an embodied perception of time grounded in the observation of actions and movements of other subjects or objects in an embodied simulation mode, we can advance two hypotheses. The common premise of the two models is that *the body schemata of movement and action possess an intrinsic temporal dimension*, expressed both in terms of speed and duration, so that "the experience or the reactivation in memory of the dynamic of a previous action or event may . . . influence a current time judgment" (Droit-Volet et al. 2013: 114). In other terms, body schemata represent typical forms of (procedural and temporalized) *body memory* (Koch et al. 2012).

The first model, which we will call DABS (Direct Application of Body Schemata), implies that body schemata that are well-defined in terms of linear ordering and clear goal-orientations of actions are also endowed with a "hard" temporality, which is recalled and superimposed upon the viewing moving images by the spectator. As a consequence, actions observed in moving images are exposed to regular acceleration according to the speed of editing; moreover, the "hard" temporality ensures in any case a realistic estimate of the durations. On the contrary, actions that are less linear and with less clear goal-orientations are endowed with a "soft" temporality: on the one hand, this "soft" time interacts with the Editing styles in such a way as to produce judgments of time and action speed that are in part independent from editing pace; on the other hand, it implies an overall overestimation of the durations.

The second model, which we will call CABS (Conjectural Application of Body Schemata), implies that the temporal determinations of the body schemata function as matrices for formulating hypotheses about movement and action timing: these hypotheses or expectancies are gradually tested during the spectator's online experiential processes (possibly together with other types of non-temporal determinations, such as spatial, narrative, etc.). In the case of a linear and clearly goal-oriented action, such as "Drinking water," the matrix foresees a (relatively) rigidly pre-established course of action, so that if the experiential data coming from the moving images regularly confirm such hypotheses, editing pace remains the only element determining a perception of higher speed. At the same time, this experiential process knows no contradiction of hypotheses and expectations, hence the absence of an overall overestimation of temporal durations. On the contrary, in the case of body schemata that are less or not at all linear and goal-oriented, the matrix of hypothesis is weaker, and therefore the activity consisting in advancing hypotheses, testing them, and reformulating them becomes more complex and intense. As a consequence, the influence of editing on the judgment of speed becomes more troubled, and the duration of the action as seen in the moving images tends to be overestimated.

The CABS model, implying a prevision or expectancy mechanism, would find some confirmations in the literature. First of all, it is consistent with the theoretical hypotheses and the more cautious experimental demonstrations by De Wied et al. (1992), despite the fact that these were advanced in a non-embodied theoretical context: according to the authors, time evaluation can be manipulated through the distortion of the spectator's temporal expectation systems, which in turn can be produced by film editing, mainly through ellipsis at the level of sub-actions. Second, the CABS model would resonate with more general theories that link temporal perception to the framework of the spectator's expectancies in relation to event coherence (e.g. the "expectancy/contrast model" by Jones and Boltz 1989, that De Wied et al. 1992 applied to film experience), duration (Boltz 1993), order (the "Memento effect" studied by Liverence and Scholl 2012; Meyerhoff et al. 2015), or even to action tasks (Boltz 1998). Third, and more specifically, a model implying a forecasting and adaptive component can link the experience of viewing moving images to the well-studied field of (embodied) joint and coordinate action and perception, such as that enacted by couples of dancers or piano players (see Sect. 16.2.2): in activities requiring sensorimotor coordination of two or more subjects, each of them hypothesizes a temporal development of the other's movements based on embodied simulations, checks their actual development, and adapts his or her movements to the shared action in progress, possibly reassessing his or her matrices of temporal expectancies. If applied to our object of study, these models seem to disclose the hypothesis that *the viewing of moving images does not entail simply "watching" a film, but rather consists in "playing" and "dancing" with it*.

The suggestion of this hypothesis does not in any case resolve many open questions: what exactly are the temporal qualities of a body schemata and how are they coded? How do non-transitive or reflexive actions behave in this regard? Is there a relationship between the hypothetical activity of the spectator and the segmentation of the action into sub-actions (according to the Event Segmentation Theory approach)? If so, does editing cause differences in the hypothesis process? Are both of the models presented here coexistent and working in synergy, or is the first one better suited to data related to speed judgment and the second to duration evaluations?

16.5.3 Limitations

Although the results of the current study are promising, several limitations bear noting. An important limitation concerns the operationalization of the independent variables. In defining the different Editing styles, number of cuts and shot angle were not manipulated independently, and for this reason it is not possible to disentangle their differential effects on the dependent variables. That is, the significant differences we found between the Editing styles may be due to either the number of cuts, the shot angle, or a combination of the two. Likewise, concerning Action types, the characteristics of goal orientation and linearity were not varied independently. This methodological limitation was mainly due to the explorative nature of this initial study, since a completely crossed design would have required a higher number of conditions, and would be better addressed in a set of multiple experiments. Future work could address these issues, examining the differential impact of shot angle/number of cuts, as well as of action properties on individuals' time perception. Third, the order of the self-report questions regarding subjective time judgements and duration estimate was not counterbalanced. Although we did not find significant correlations among these variables across all the videos, the negative correlations we found between duration estimates and time judgments when watching fast-paced videos may be due to the presentation order (i.e., participants estimated duration *after* judging Time passage and Action speed).

16.6 Concluding Remarks

In Sect. 16.2, we stressed that the pilot experiment illustrated in the central sections of this article is part of a broader framework of research on SEEM_IT: as we said, SEEM_IT represents a strategic object, since on the one hand it is connected to the semiotic forms and processes of the moving image, and on the other refers to the social forms and processes of the collective perception of time.

Regarding the first aspect, our experiment has highlighted a strong link between forms of editing in moving images, the narrative articulation of the represented action, and the temporal experience of the viewer. Even if further analysis and verification are necessary, it seems that the considerations advanced go in the direction of an embodied semiotics and pragmatics of the film text, and open the possibility of methodologically-updated close readings. Even if the experimental procedure focussed on the two dimensions of Speed of time/action passage and Duration evaluation in the subjective experience of time, it is possible to extend the analysis to other dimensions – for example by adopting micro-phenomenological methods (Petitmengin 2006).

The second aspect did not emerge directly in this experiment; more generally, the issue of the relationship between the specificity of temporal experience established and driven by the viewing of moving images, and the specificity of modern and contemporary forms of the experience of time remains open. One can ask for example how much and through which processes the massive diffusion of moving images has conditioned the modern and contemporary perception of social time as accelerated, compressed, dilated etc., noted by many observers (see Sect. 16.2.1). Although such work largely remains to be done, we can nevertheless observe that the embodied approach offers an interesting starting point: indeed, the embodied perception of time is a *relational* and *intersubjective* phenomenon, as it implies a deep relationship with the time lived and expressed by other bodies, even in the absence of pre-established common goals (Laroche et al. 2014; Gallotti et al. 2017; Schirmer et al. 2016). In the case of the moving image experience, bodies tend to multiply: here we find the represented ones, the body of the film, those of the viewers, and those of other spectators. The experience of viewing moving images is therefore in itself a *multibody* one, and it implies not just the *investment* of body schemata, but also (especially in the CABS hypothesis) their *manipulation* and *alteration* (Fingerhut and Heimann 2017), which would correspond, in turn, to a more or less deep and stable modification of the shared time experience.

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