Differential effects of film on preschool children's behaviour dependent on editing pace.

Running head: Visual editing pace and children's behaviour

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Abstract

Aim: Evidence on how the pace of television and film editing affects children's behaviour and attention is inconclusive. We examined whether a fast-paced film affected how preschool-aged children interacted with toys.

Methods: The study comprised 70 children (36 girls) aged 2-4.5 years who attended preschools in Essex, United Kingdom. The children were paired up and tested with either a fast- or a slow-paced film of a narrator reading a children's story. The fast-paced version had 102 camera cuts and 16 still images and the slow-paced version had 22 camera cuts and four still images. Each dyad took part in two video-recorded free-play sessions, before and after they watched one of the specially edited four-minute films. The number of toys the children played with before and and after the film sessions was recorded.

Results: Before they watched the films, the children's behaviour did not differ between the groups. However, after watching the film, the children in the fast-paced group shifted their attention between toys more frequently than the children who watched the slow-paced film.

Conclusion: Even a brief exposure to differently paced films had an immediate effect on how the children interacted with their toys.

Keywords: attention, film editing, play, preschool children, television.

Key notes

- Evidence on how the pace of television and film editing affects children's behaviour and attention is inconclusive.
- We examined how watching a fast-paced or slow-paced film of a narrator reading a story affected how 70 children aged 2-4.5 years interacted with their toys.

- This showed that the children who watched the fast-paced film shifted their attention between toys more frequently than the children who watched the slow-paced film.

INTRODUCTION

The ability to maintain attention on objects and tasks has implications for learning and achieving educational potential (1). Although the early development of attention might be influenced by exposure to television (TV) during childhood (2), research focusing on the relationship between the amount of viewing and the measures of attention has produced inconsistent results. Several studies have suggested an association between the time spent watching TV in childhood and hyperactivity and inattention (3), as well as more general attentional problems (4,5). Conversely, other research showed that the amount of viewing was not a strong predictor of attention functioning (6,7)

In addition to how much TV is watched, the nature of the material viewed may also be important. Wright et al (8,9) suggested that to attract and hold the attention of young children, TV employed various audio-visual features, such as visual effects - pans, zooms and fades - a high rate of action, auditory enhancement and pace variability. At the same time, rapid pacing gives less scope to reflect on and process the viewed content, potentially delivering cognitive overload (10). Fast-pace programming may affect cognitive processes and behaviour in two ways. First, audio-visual features may over-stimulate young brains during a developmental period when environmental influences are crucial and ultimately lead to deficits in attention (2,4). Second, the processing of the content is dictated by the pacing of the programme. Faster pace requires the viewer to assimilate new stimuli rather than persevere in understanding the old ones (11) and integrate numerous scene and character changes in a short time. This can lead to difficulties in understanding the content (12). Therefore, watching a fast-paced film may encourage superficial processing rather than reflective thought.

Very few studies have experimentally investigated the short-term effects of programme pacing on children's cognition and behaviour. An early investigation by Anderson et al (13) examined the effects of different pacing on *Sesame Street* on perseverance, impulsivity and levels of activity during toy play and found that the fast pace had no detrimental effects on four-year-old children. However, compared with more modern children's TV shows, *Sesame Street* has a very slow pace (14). In contrast, Wright et al (8) demonstrated that primary school children who watched a fast-paced programme, found it more difficult to integrate the information from the film and to recall the sequence of still pictures taken from the show, than children who watched a slow-paced programme.

Moreover, there is a suggestion that exposure to rapidly edited cartoons may result in poorer behavioural control and less goal-directed persistence. Indeed, children who watched a fast-paced entertainment cartoon persevered less with subsequent educational activities such as painting, playing board games or listening to the story, than the control group children who did not watch TV prior to the play session (15). Similarly, Lillard and Peterson (16) demonstrated that watching an episode of a fast-paced film had a detrimental effect on the executive function of four-year-old children. However, these studies confounded pace with content, as the fast-paced films had different content from the slow-paced films. In fact, using real-life programming with varying editing pace and content, Lillard et al (17) found evidence that it was processing a particular content, rather than the fast pace, which taxed executive function. Compared with children who viewed realistic programming, a group that watched programmes with unrealistic content, which contained events or characters that defied the laws of nature, performed worse on executive function tests. However, despite manipulating unrealistic content and editing, the films employed in this study also varied in other aspects of their content and audio-visual characteristics, such as, for example, different learning concepts, target age, presence of loud music or bright colours.

To avoid the confounding effect of content, Cooper et al (18) developed a novel experimental paradigm, in which the same raw footage was edited to produce a fast-paced film and a slow-paced film. The results of the experiment suggested that watching differently

paced films affected children's performance on the Attention Network Test. This continuous performance test (19), which integrates cueing and flankers paradigms, measures performance of the three attention components: alerting, orienting and executive control (20). The study showed that, irrespective of age, children who watched the fast-paced film made fewer errors (18). Children aged four who watched the slow-paced film had higher orienting scores, but this effect was reversed for six-year-old children. In addition, the children aged four and six in the fast-paced group, but not the children aged five, had shorter reaction times. Although due to the possible alternative explanations of orienting scores (20), these findings were somewhat difficult to interpret, it is evident that even a very brief exposure to a fast-paced film can affect children's attention.

In contrast to TV viewing, during which the pace of events presented in a programme drives child's attention, the structure of play is generally dictated by the individual child (21). Nevertheless, Choi and Anderson (21) suggested that there is an important similarity in the attentional processes underlying TV viewing and toy play. In both cases orientation towards the object of the child's activity is driven by attentional inertia, which binds together the segments of consecutive activity and protects from disruptions caused by external distractors. This ability to resist distraction from competing objects or events is one of the several processes that appear to be compromised by attention hyperactivity deficit disorder (ADHD) (22). In children, this tendency to be distracted can be observed during free play. Alessandri (23) suggested that frequent changes between toys during a free play session implied a shorter attention span and were a characteristic of ADHD. In fact, playroom observations have been successfully used to distinguish between hyperactive and control children. Compared to typically developing peers, boys who had been clinically referred for hyperactive behaviour demonstrated greater motor activity, spent less time on tasks and they increasingly switched between tasks (24,25). Moreover, Handen et al (26) found that children with ADHD changed toys more often and engaged in shorter play episodes than a control group during free play. The potential role of attentional inertia in both TV viewing and

free play makes an investigation of the effect of editing pace on children's unstructured play of particular interest.

As noted above, previous attempts to understand the role of editing pace have been limited by the confounding effect of content (13,15-17). Thus, the present study examined whether varying the pace of a short film, while keeping the content constant, would affect the frequency of switching between toys in a subsequent unstructured play session. Specifically, this experiment investigated the effect of pacing on how pairs of children behaved in a five-minute post-viewing free-play session. The methodology developed by Cooper et al (18) was adopted. Using materials with identical content, but different editing, allowed the effect of pacing to be isolated. It was predicted that exposure to a fast-paced film would reduce attentional inertia, leading to more shifts between toys during playtime.

METHOD

Participants

We recruited 70 children (36 girls) with a mean age of 43.74 months (SD= 6.00) and a range of 28-55 months from an opportunity sample attending preschools in Essex, UK. One child was excluded from the analysis due to very unsettled behaviour during the pre-film session. The experiment was approved by the University of Essex Ethics Committee. Before the study began, the children's parents had received a letter providing information about the project and the procedure and had an opportunity to withdraw their child from participation. Children were randomly assigned to one of the two experimental conditions.

Apparatus and materials

The film stimulus was played on an ASUS laptop computer (ASUSTek Computer Inc, Taipei, Taiwan), using Windows Media Player (Microsoft Corporation, Washington, USA). Audio playback was delivered via Sony speakers (Sony Corporation, Tokyo, Japan). The experiment was recorded with a Panasonic HD film camera (Panasonic Corporation, Osaka, Japan). A popular children story - *The Snail and the Whale* (27) - was used to create the experimental films. The narrative describes the adventures of a little snail and a humpback

whale during their shared journey around the world and it represents a typical story directed at preschool children.

We produced two versions of a four minute and 12 second film, which featured a female narrator reading a story by using the same unedited raw material and audio track. The narrator was filmed using three different cameras: a front view, three-quarter view and side-view. This footage was later edited together with the illustrations from the book to produce either a slow-paced or a fast-paced film. For the purpose of this study, an editing action was specified as a change from the narrator view to a still image or a change between two different narrator views, for example, from a head view to a full view. The still images were spliced into the footage to match the content of the story read by a narrator. For example, when the narrator referred to the humpback whale, an illustration from a book showing a whale half-submerged in the sea appeared on the screen. Every effort was made to make sure that the editing did not alter the comprehensibility of the content.

The slow-paced film consisted of 22 camera cuts each lasting approximately 10.8 seconds and four still images, each presented for approximately three seconds. This resulted in an average of 6.2 cuts per minute. The fast-paced film consisted of 102 camera changes with an average shot lasting 2.3 seconds and 16 still images, each presented on the screen for approximately two seconds. The average number of cuts per minute was 28.1 in the fast-pace film. Table 1 shows a comparison in cut frequency between the two experimental films, pop music videos and typical children's programmes available on UK terrestrial TV channels. In both versions of the film, the whale song was played continuously in the background as an additional audio feature.

Design

The experiment adopted a between-participant design. The independent variable was film pace: fast versus slow. The dependent variable was the number of toy episodes during the post-film session. Furthermore, the number of toy episodes during pre-film play and the participants' age were included as covariates. Thus, each child contributed two scores: a pre-film toy episodes score and a post-film toy episodes score.

Procedure and coding

Two free-play sessions – one immediately before and the other immediately after the film presentation – were used to measure the children's attention. The length of each session was five minutes. In the post-film session, the children were allowed to stay in the test room and play for up to 10 minutes, but only the first five minutes of play were subsequently coded to match the length of the pre-film play session. There were seven age-appropriate toys available to play with during each experimental session, which included a building snail pail, paper and colouring pens and a soft animal toy.

The experiment took place in a quiet room that was separate from the main preschool area. To create a natural setting and reduce the participants' anxiety about being under observation, which could have constricted their natural behaviour, children were invited to come to the test room in randomly assigned pairs. At the beginning of each session, the experimenter greeted the children coming into the test room and said: "I brought my toys to preschool today. Would you like to play with them?" Following this brief introduction, the participants were encouraged by the experimenter to engage in play activity, using the variety of toys arranged on the table. Immediately after the first free-play session, the experimenter said: "Let's watch a film now" and the children were instructed to move over to the next table where they watched one of the versions of the film. During viewing, both children sat in front of a laptop computer, approximately 50cm away from the screen, and watched the film together on one screen. Following the viewing, the children were invited to go back to the toy table and to engage in further play activity. Each session lasted approximately 20 minutes and the experimenter remained in the testing room throughout the session.

To ensure that no data were lost in case of equipment malfunction, the children's behaviour was first coded live during the test session by the experimenter who was not blinded to the experimental condition. The second observer, who was blind to the condition, coded the children's behaviour from the video recordings and these scores were used in the analysis. The experimenter and the observers coded two types of behaviours that

represented toy episodes: picking up toys and touching toys. Thus the target behaviour was defined as physical contact with a toy. To be counted, the toy had to be physically touched or picked up by a child. If a child picked up or touched two toys at the same time, the observer coded this behaviour as one toy episode. Furthermore, if a child who was in possession of one toy touched or picked up another toy without putting down the other toy, this behaviour was coded as a new episode. Engaging with non-toys, that is, other objects that were present in the test room, was rare and therefore not coded.

The percentage agreement between the experimenter and the first observer was 67.6% and the *kappa* coefficient was 0.63. Two further observers independently coded the behaviour of 25% of the children. The percentage agreement between the three observers was 80.6% and the *kappa* coefficient was 0.78. Any discrepancies in coding between the observers were resolved through discussions until a consensus was reached.

RESULTS

Analysis plan

In order to address the interdependent nature of the dyadic data collected in this study and to avoid violating the assumption of the scores independence that underlies many statistical tests, the data analysis adopted a two-step approach. In the first step, the dyad was treated as a single unit of analysis and the scores of both children were averaged within a pair to obtain a single measure of within-dyad behaviour. This approach allowed us to run an independent samples t-test to confirm that there were no differences in the dyads' play between two experimental groups prior to the film exposure. Furthermore, using the analysis of covariance we examined the effects of experimental manipulation on the post-film score. The analysis of covariance framework is particularly useful when random sampling is impossible (28) and using this approach allowed us to control for the potentially confounding effects of pre-film behaviour on the post-film play. In the second step, the hierarchical linear modelling was used to replicate the results obtained using the analysis of covariance. Specifically, at level one of the model, the individual child variables of pre-film score and age were nested in the level two variable, specified as dyads, to predict the post-film behaviour.

Analysis of covariance

The pre- and post-film scores of the individual children within each child pair were averaged to obtain a single pre-film and post-film score for each dyad. The unadjusted mean scores and standard errors of the mean are shown in Figure 1. During the pre-film play session, there was no difference across experimental groups in the number of toy episodes per dyad ($t_{(32)}$ =0.42, p>0.05).

(Insert Figure 1 here)

The dyad pre-film score was significantly associated with the number of toy episodes per dyad during post-film play ($F_{(1,31)}$ = 12.96, p=0.001, partial η^2=0.295). The dyads that watched the fast-paced film shifted between toys more compared to the dyads that watched the slow-paced film ($F_{(1,31),}$ = 4.80, p=0.036, partial η^2=0.134). That is, the type of experimental film had a significant effect on the children's subsequent attention during play, as children in the fast-edit group stopped playing with a toy and switched to another one more frequently than children in the slow-edit group.

Hierarchical linear modelling analysis

The results of the analysis using hierarchical linear modelling framework shown in Table 2 were consistent with the findings described in the previous subsection. The child's pre-film play behaviour and the type of film watched were significant predictors of post-film play, (*b*=0.50, p<0.001 and *b*=1.12, p=0.049, respectively). However, age was not significantly related to the number of toy episodes during the post-film play.

(Insert Table 2 here)

DISCUSSION

The aim of this study was to investigate whether the pace of editing affected how pairs of children behaved during unstructured play. Prior to watching the film, the dyads' behaviour

was similar across both experimental groups, as no significant difference was found in the number of toy episodes during play. Importantly, editing pace affected subsequent play behaviour. Children who watched the fast-paced version of the film shifted their attention between toys more frequently than children who watched the slow-edit version.

Unstructured play provides an opportunity to observe children's natural ability to focus attention and resist distractors during cognitive activity (29). Previous studies have demonstrated that children with ADHD engage less in structured activities and switch toys more often during free-play (23-26). In this study, the films presented to the children between the play sessions had the same content and, as a result, the observed effects can be attributed to the pace of the experimental films. This manipulation appeared to have altered the children's natural play behaviour, which had been established prior to watching the film. In comparison to the children who watched the slow-paced film, the fast-paced group played with more toys following the viewing of this film, which contained a set of rapid edits. Consistent with the findings that more unsettled behaviour during free-play could indicate problems with sustained attention, greater impulsivity and less behavioural control (23), it appears that even a very brief exposure to the fast-edited material had adverse effects on the children's behaviour.

Our finding that viewing a fast-paced film resulted in greater shifting of attention between toys is congruent with previous studies, which show an immediate detrimental effect of fast pacing on various aspects of cognitive activity (8,15,16). Moreover, these results fit with theories that have proposed that the audio-visual characteristics of TV affect cognition, especially in young viewers (9,30), although how these audio-visual characteristics interact with programme content is currently unknown. This is particularly important, as a recent hypothesis proposed by Lillard et al (17) suggested that processing of unrealistic content might be particularly taxing for children's cognitive resources. The story presented in our experimental films contains many elements of fantasy, for example, talking animals. Thus, it could have been an interaction between unrealistic content and the fast pace that drove the changes in the post-film behaviour.

Choi and Anderson (21) suggested that attention during TV viewing and toy play was driven by the same mechanism – attentional inertia – the process that pieces together segments of cognitive activity. It is thus possible that differential pacing affects attentional inertia in two ways. Slow pace facilitates orientation to the object of cognitive activity, and leads to deeper engagement during toy play. In contrast, rapid edits, that are inherent to fast-paced programmes, may disrupt attentional inertia and stimulate the need for novelty and change. This study provides supporting evidence for the negative effects of the fast-paced film. Although the effects demonstrated in this experiment are small, it is important to remember that this research investigated the immediate effects of pacing. It is possible that repeated exposure to fast-paced editing over time may have cumulative effects, and consequently, a greater negative impact on children's behaviour.

A strength of this study is that we used the Cooper et al (18) methodology that allowed the pace to be manipulated, while keeping the content constant. However, the use of novel stimuli was also a limiting factor. Professionally produced children's programmes contain a variety of audio-visual characteristics, including unrelated shifts, cuts, active motion, auditory changes, active music and talking (14). In contrast, our experimental films only employed two visual features: different camera angles and cuts and the same audio track played continuously during the film. To counteract the paucity of editing techniques used during the production of the two films, the number of cuts in the fast-edit film was higher than in much of the preschool programming. This may have, unintentionally, rendered the film less comprehensible for young viewers. However, children may often be exposed to films with even faster editing pace, such as pop music videos (Table 1). Moreover, the experimental materials did not allow us to examine the impact of the combination of various editing techniques used in real-life TV on children's behaviour. In future, it is therefore important to also explore the effect of other salient features that characterise entertainment programming, such as active motion or frequent scene and character changes, on cognitive activity.

CONCLUSION

In conclusion, the present study demonstrated that exposure to a short film can have a differential effect on children's play depending on the editing speed used. Specifically, it was found that, in comparison to watching slow-paced material, exposure to a fast-paced film resulted in more unsettled behaviour during free play. Considering that play is viewed as such a crucial activity in infancy and early childhood, and that more frequent shifts between toys may indicate deficits in attention and lack of behavioural control (23, 26), these findings are important. They suggest that even a very simple manipulation of editing features can have a differential effect on children's play behaviour. Further research is needed to explore how the actual audio-visual features of real-life TV programmes and films interact with each other and affect different aspects of cognition.

Abbreviations

ADHD**,** attention hyperactivity deficit disorder

TV, television

Conflicts of interest

The authors have no conflicts of interest to declare.

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Figure 1 **The numbers of toys that each dyad played with before and after watching a slow-paced or fast-paced film**

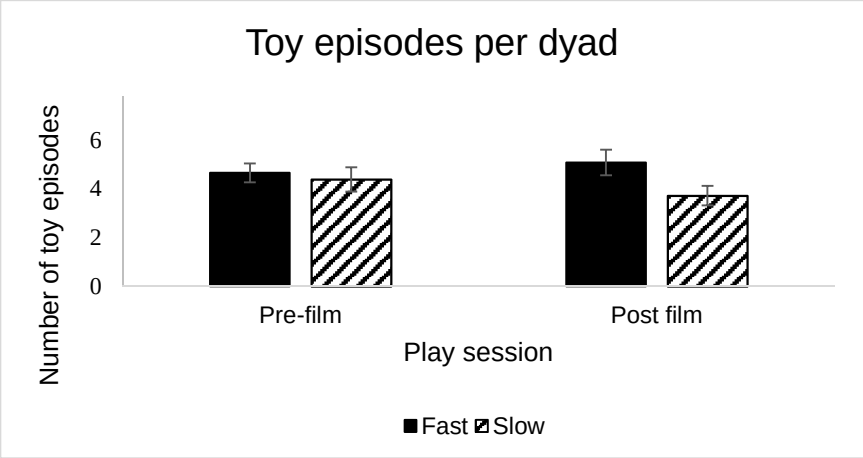

Figure 1. Mean number of toy episodes (error bars represent standard errors of the mean) during the pre-film and post-film play.

Table 1. Frequency of camera cuts in the experimental films (denoted with asterisks), pop music videos and randomly selected five-minute segments of typical children's shows available in January 2015 on UK terrestrial television.

Title	**Average cuts per minute**
Uptown Funk (music video by Mark Ronson and Bruno Mars)	37.5
Blank Space (music video by Taylor Swift)	32.0
The Snail and The Whale (fast-edit study film)*	28.2
Pokemon (children's TV programme)	16.6
Bear Behaving Badly (children's TV programme)	14.4
Old Jack's Boat (children's TV programme)	8.8
Sooty (children's TV programme)	7.6
The Snail and The Whale (slow-edit study film)*	6.2

Table 2. Fixed effects for post-film play measure.

Fixed effect	***b***	***SE_b***	***df***	***p value***	***95% CI***
Age	0.017	0.45	68.613	p= 0.694	0.108 - 0.072
Pre-film score	0.502	0.12	59.839	p< 0.001	0.253 - 0.751
Film	1.121	0.55	38.093	p= 0.049	0.005 - 2.237

b, parameter estimate; SE, standard error; df, degrees of freedom; CI, confidence intervals