

Evaluations of a sequence of affective events presented simultaneously

An investigation of the peak-end rule

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Abstract

Purpose – A key finding in the affect integration literature is that for a sequence of events that unfolds sequentially, individuals attend to specific aspects of these events, such as the spread, peak, end, or trend. Due to recent findings of deviations from the peak-end rule, this study closely examines the integration processes of affective events presented sequentially and simultaneously.

Design/methodology/approach – Three experimental studies were conducted. Study 1a (financial dashboard) and Study 1b (charity advertisement) examine consumers' overall evaluation for a sequence of mixed affective events. Using eye trackers, Study 2 examines individuals' attention to particular affective moments presented sequentially and simultaneously.

Findings – The present research provides additional support for the peak-end rule for the sequential presentation of mixed-valence affective events. However, in the simultaneous mode of presentation, the flexibility to view various affective events decreases the disproportionate weights given to specific events, a divergence from the peak-end rule.

Research limitations/implications – Although the tempering effect of simultaneous presentation can be concluded, further studies are required to discern how individuals process these events and develop a predictive rule.

Practical implications – The results of the present study provide clear and actionable directions for application developers and advertising agencies: when communicating information or developing an advertisement, consideration should be given to how each affective event is being communicated.

Originality/value – It is argued that in the simultaneous mode of presentation, the flexibility to view various affective events allows greater shifts in attention that increase the salience of interconnections and thereby decrease the disproportionate weights given to specific events.

Keywords Emotion regulation, Valence, Affect integration, Presentation mode

Paper type Research paper

Introduction

We often consume information simultaneously. Technology has enabled consumers to view data on devices and dashboards across a variety of platforms – ranging from smart televisions to mobile phones to in-car navigation systems – even using multiple devices at the same time. This has led scholars to question the effects of such behavior on consumer



decision-making (Chowdhury *et al.*, 2007; Cauberghe *et al.*, 2010). In addition, media revolution has resulted in an explosion of applications that allow us to view information in a consolidated form. For example, we can view the history of our diet and exercise regime with applications such as MyFitnessPal (www.MyFitnessPal.com), use dashboards for financial decisions (Pauwels *et al.*, 2009; Alexander, 2007) and view our grades (e.g. www.moodle.com) and gaming results (e.g. PlayStation, Xbox, Wii). Such data can be displayed *sequentially* or *simultaneously* – and it can be of positive, negative or neutral valence. Researchers have been particularly interested in understanding how people integrate a series of information cues that are both informative and affective in nature (e.g. Cauberghe *et al.*, 2010, Fredrickson and Kahneman, 1993, Hoffman *et al.*, 2011, Varey and Kahneman, 1992).

Past research has examined both prospective (Varey and Kahneman, 1992) and retrospective evaluations of sequences of events (Fredrickson and Kahneman, 1993) that unfold *sequentially* and have similar valences (i.e. positive stimuli or negative stimuli, but not both). A consistent finding from this stream of literature is that when people construct an overall evaluation of a sequence of events, the total duration of the events is unimportant (Ariely, 1998; Fredrickson, 1990; Fredrickson and Kahneman, 1993; Kahneman, 2000; Redelmeier and Kahneman, 1996; Varey and Kahneman, 1992). Instead, people attend to specific aspects of these events, such as the spread, peak, end or trend. This stream of research has focused mostly on the “peak–end” rule, whereby the overall retrospective evaluations of a sequence of events is the combination of the peak or the most affective event and the end, or the very last affective event (Fredrickson and Kahneman, 1993). This contrasts with the discounted utility (DU) model (Loewenstein and Prelec, 1992), which proposes the overall evaluation to be the sum of the discounted values of each event.

However, some studies have reported deviations from this rule. For example, Miron-Shatz (2009) report that the overall evaluation of multi-episode events relies on the average rating of the emotions experienced, and Hui *et al.* (2014) indicate that peak-and-trough patterns did not play a substantial role in the overall feelings toward a TV show influenced by the last quintile of a TV show. Importantly, prior literature on sequences of events that might unfold *simultaneously* shows a compensatory mechanism distinct from the peak–end rule for mixed-valence events using photographs (Chowdhury *et al.*, 2008) and the elimination of duration neglect for mixed-valence events using graphs (Liersch and Mckenzie, 2009). These deviations from the peak–end rule warrant a closer examination of the integration processes of affective events presented simultaneously.

In this research, we investigated the affect integration process in the overall evaluation of a sequence of mixed-valence affective events that unfolded either *sequentially* or *simultaneously*. Specifically, we investigated how individuals attend to each affective event and examined the extent to which they attend to peak and final events when those events unfold sequentially and simultaneously. Using three experiments, we examined the overall affective evaluation of a sequence of mixed-valence events using investment results in financial dashboards and pictures in a charity appeal that unfolded sequentially and simultaneously. Experiments 1a (financial dashboards) and 1b (charity appeals) provide evidence that the influence of the “peak and end” event is *reduced* with simultaneous presentations (vs sequential presentations), demonstrating the role of the presentation mode in the overall affect experienced. In Experiment 2 (charity appeals), using eye trackers, we examine individuals’ attention to specific events. The results show that although attention duration was the same in both presentation modes, the simultaneous mode induced a greater shift in attention and consequently increased the salience of the interconnections between events. We posit that the salience of these interconnections decreases the disproportionate

weights given to specific events and therefore reduces the influence of “peak and end” events in the simultaneous mode of presentation.

The paper is structured as follows. We first review the relevant literature on affect integration and develop a theoretical framework for a simultaneous mode of presentation. Next, we present the results of three experiments. The final section integrates our findings and discusses their theoretical and managerial implications.

Theoretical background

In their belief-adjustment model of information integration, [Hogarth and Einhorn \(1992\)](#) proposed that in addition to the importance of the type of process, the type of response – either step-by-step (sequential) or end-of-sequence (simultaneous) – influences the model’s qualitative predictions. Examples of sequential response include viewing a series of pictures one after the other, with one image removed prior to the other image being shown ([Chowdhury et al., 2008](#)) and viewing a display of results in a list format ([Liersch and McKenzie, 2009](#)), whereby participants process the numbers in a linear format one after the next, without necessarily seeing the overall impression of the numbers taken as a whole. Examples of simultaneous response include the simultaneous publication of analysts’ forecasts on the earnings announcement date ([Caylor et al., 2007](#)), viewing a display of results in graphic format ([Liersch and McKenzie, 2009](#)) and multiple pictures on the same screen ([Chowdhury et al., 2008](#)). In the sequential response mode, individuals make a judgment after each item of information is received. In contrast, in the simultaneous response mode, this evaluation is only made after receiving all the items of information.

Sequential processing

Prior research has confirmed the “peak–end rule” as robust across various situations and contexts for a sequentially presented series of common valence events, including aversive sounds ([Kahneman, 1992](#); [Schreiber and Kahneman, 2000](#)), pleasant stimuli ([Fredrickson and Kahneman, 1993](#)), pain ([Ariely, 1998](#); [Redelmeier and Kahneman, 1996](#)), emotional responses to advertisements ([Baumgartner et al., 1997](#)), past musical durations ([Rozin et al., 2004](#)) and playful experience ([Mukherjee and Lau-Gesk, 2016](#)). In addition, the rule applies to both short and long intervals, such as physical discomfort during a single event ([Kahneman et al., 1993](#)) or over extended periods of time ([Jensen et al., 2005](#); [Stone et al., 2005](#)). Consequently, we might expect both the final event in a series of events and the peak event to influence an individual’s overall affective state after a series of mixed-valence events.

Simultaneous processing and attention

In the case of the simultaneous presentation of a series of affective events, we proposed the disproportionate weighting of the peak and final. The rationale underlying our prediction is that individuals can control their emotions by using different strategies to influence which emotions they have and when they have those emotions, i.e. individuals use different emotion regulation strategies ([Di Muro and Murray, 2012](#); [Gross and John, 2003](#)). For a series of mixed-valence events, the order of the positive and negative stimuli will have an impact on the sort of behaviors in which individuals engage ([Olsen and Pracejus, 2004](#)). This rationale is consistent with the mood repair and mood maintenance literature because people who experience negative affect are more likely to engage in behaviors that avoid unpleasant psychological states ([Carver and Scheier, 1998](#); [Schaller and Cialdini, 1990](#)). Moreover, people who experience positive affect are more likely to maintain these states ([Wegener and Petty, 1994](#); [Wegener et al., 1995](#)).

In addition, research argues that attention plays a critical role in both mood and emotion regulation (Gross and Thompson, 2007; Koole, 2009). Sanchez *et al.* (2014) report the impact of an initial affective event on subsequent attention to positive or negative stimuli in a sequence of affective events, and they find that shifting attention between affective events can have an additional impact. In a sequential mode of presentation, individuals are forced to experience a moment-to-moment sequence of affective events (Olsen and Pracejus, 2004; Chowdhury *et al.*, 2008) and therefore undergo a regulation process of either maintaining or repairing at each transition stage. Consequently, as advocated by the prior literature, a consistent peak–end rule is an appropriate rule for the overall retrospective evaluation of a sequence of affective events.

However, in the simultaneous presentation of mixed events, individuals are not restricted to moment-to-moment attention; instead, they are allowed to wander and distribute their attention across events. The nature of the response mode allows them unrestricted attention and shifts in attention. Like the modal model of emotional regulation (Gross and Thompson, 2007), which specifies a relationship between stimuli, emotions, attention and behaviors, avoidance (distraction) and engagement (concentration) are two key attention strategies in response to an event. Engagement is paying attention to an event, and avoidance is directing attention away from an event. Therefore, the overall retrospective evaluation is dependent on which event the individual pays attention to and how attention shifts between events (Gross and Thompson, 2007; Teixeira *et al.*, 2010, 2012). Thus, an individual in a simultaneous presentation condition is not only influenced by attention to specific events, such as the peak and final events, but also by the number of shifts in attention. Because the probability of a shift in attention is greater in the simultaneous mode (Gross and Thompson, 2007), the number of avoidance and engagement processes experienced by the respondent is higher. We predict that this shift in attention reduces the disproportionate weights placed on the specific peak and final events. Contrary to prior suggestions (Chowdhury *et al.*, 2008), we predict that the simultaneous presentation mode heightens contrast effects as the interconnections between episodes become more salient, leading to engagement and avoidance behaviors. Consequently, the overall retrospective affective state of an individual who simultaneously (versus sequentially) experiences a series of affective events is less influenced by the peak and final events. Therefore, we arrive at the following hypothesis:

- H1.* The role of the peak and final events in a sequence of temporally separated mixed valence events is weakened in the overall affect experienced in the simultaneous response mode compared to the sequential mode of presentation.

In the earlier discussion, we proposed that the disproportionate weighting of the peak and final events would be reduced for simultaneous presentation compared with sequential presentation. We argued that an individual's attention is not restricted to events experienced one at a time, because they are allowed to wander and distribute their attention across affective events. Therefore, we expect shifts in attention to be greater in the simultaneous mode of presentation than in the sequential mode of presentation.

- H2.* The simultaneous mode of presentation makes event-to-event interconnections salient because of greater shifts in attention to events, as compared to the sequential mode of presentation.

Experimental studies and results

We tested these predictions in a series of experiments. Experiments 1a and 1b tested the effect of simultaneous presentation on the overall retrospective evaluation, and Experiment

2 tested the response process mechanism when events were presented simultaneously. To identify the mechanism operating during the retrospective evaluation of a sequence of events, we examined contexts in which mixed-valence stimuli with a temporal sequence might be presented both sequentially and simultaneously. We thus limited the studied contexts to the stock market (Experiment 1a) and charity advertisements (Experiments 1b and 2). In addition, we chose these two contexts because the prior literature reported deviations from the peak–end rule in the use of graphs (Liersch and Mckenzie, 2009) and photographs (Chowdhury *et al.*, 2008).

As Olsen and Pracejus (2004) demonstrate, the order of presentation of these oppositely valenced stimuli can lead to different contrast effects. Specifically, a positive stimulus followed by a negative stimulus can lead to greater positive affect than presenting the positive stimulus alone. However, preceding a negative with a positive does not have the same effect. Therefore, in Experiment 1a, we examine the effects of mode of presentation for both orders of mixed-valence events, i.e. positive negative and negative positive. Moreover, as our focus was on series of mixed-valence events, and due to the debate on the bipolarity of positive and negative affect (Russell and Carroll, 1999), we decided to focus on the overall negative affect as prior research has demonstrated a negativity bias (Rozin and Royzman, 2001) in consumption behavior (Ahluwalia, 2002).

Experiment 1a: financial dashboard

Method. Participants in this experiment were 155 students in an introductory marketing course who completed the study for course credit. The study employed a 2 factor (presentation: sequential, simultaneous) between-subjects design replicated for two orders of mixed-valence combination: positive trend–negative final and negative trend–positive final. This design enabled four possible combinations of two types of presentation (sequential or simultaneous) for each of the two mixed-valence orders. The following between-subjects conditions were used: sequential and simultaneous presentations for positive trend–negative final event and negative trend–positive final event.

Stimuli. In this experiment, affect was manipulated in terms of the losses and gains experienced by individuals in a series of stock investments. The stimuli consisted of a series of five investment decisions for five pairs of fictitious stocks. To avoid other biases in stock selection, the participants received no information about the type of stock or other performance measures in any condition. The study was performed using a computerized program in which a large graph displayed the investment; the size and placement of the graph were constant across all conditions (Figure 1).

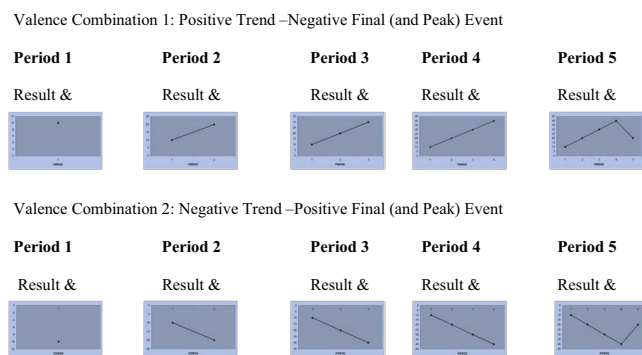


Figure 1.
Experiment 1a
sequential
presentation mode

For the sequential presentation condition, each participant was first asked to select one of a pair of stocks. The result of the investment decision, which was manipulated to be either a gain or a loss of \$10 on an investment of \$100, was then immediately presented. The participant viewed the written investment result for three seconds. Next, a graphic display was presented with the written information for 7 s (Figure 1). After the 10-s display of the investment result, the program automatically moved to the next screen to enable the participant to choose from a second pair of stocks. This procedure was repeated five times. The gain or loss in the final trial served as the peak event by fixing the overall gain or loss at \$20, which simplified the experimental manipulation by rendering the peak event identical to the final event. For the simultaneous presentation condition, the results of the participant's stock choices were not displayed until the fifth trial, when the written results and graph (Figure 2) were presented for 10 s.

Procedure. The experiment was conducted in a computer lab, and approximately 15 participants took part in each session. The computer randomly assigned each participant to one of the four conditions, with each participant assigned to only one condition. The participants were seated in a manner to ensure that they would be unable to view other participants' stimuli. The participants were informed about the stock decision study. To increase their involvement, they were informed that they would be competing with their fellow students. The participants performed the five trials and viewed the results on the screen. They then responded to a set of questions presented on the computer.

Measurement of affect. Immediately after the stimuli were displayed, negative affect was measured using the scale used by Pham *et al.* (2001). This scale consists of six items anchored at 1 (not at all) and 7 (very strongly). Six items related to negative affect are: "I had unpleasant feelings after viewing the investment results"; "I was disgusted by the investment results"; "I was fearful about viewing the investment results"; "The investment results made me feel bad"; "The investment results made me feel angry"; and "The investment results made me feel sad." The six items were averaged to form a combined score for negative affect (Cronbach's $\alpha = 0.77$).

Results. Positive trend–Negative peak event. We first analyzed the effects of presentation mode on negative affect, controlling for age and gender. A one-way analysis of covariance (ANCOVA) revealed that age and gender effects were insignificant. As predicted, a main effect was observed for mode of presentation [$F(1, 36) = 11.24, p < 0.01$] on overall negative affect. An independent sample *t*-test showed that participants felt more negative in the sequential presentation mode ($M = 2.59, SD = 1.2$) than in the simultaneous presentation mode [$M = 1.68, SD = 0.57, t(36) = -3.35, p < 0.01$]. This result is consistent with our prediction that the negative peak and final event will have more influence on the overall

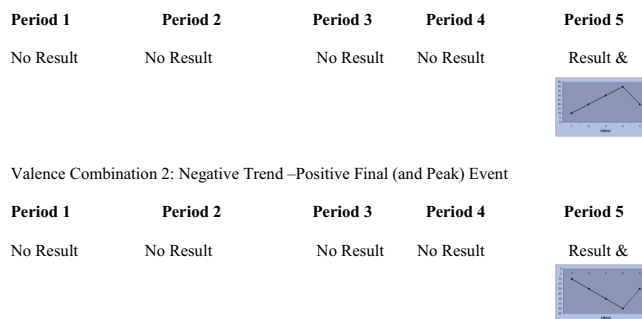


Figure 2.
Experiment 1a
simultaneous
presentation mode

negative affect in the sequential mode of presentation and, therefore, greater negative affect than in the simultaneous mode of presentation (*H1*).

Negative trend–Positive peak event. As earlier, we analyzed the effects of presentation mode on negative affect, controlling for age and gender. A one-way ANCOVA revealed that the impact of age [$F(1, 41) = 6.75, p < 0.05$] on negative affect was significant and the impact of gender was insignificant. Consistent with our prediction, we find a marginally significant effect of presentation mode on negative affect ($F(1, 41) = 6.47, p < 0.07$). More specifically, an independent sample *t*-test showed that participants felt more negative in simultaneous presentation mode ($M = 3.68, SD = 1.24$) than in sequential presentation mode [$M = 2.74, SD = 1.19, t(39) = 2.40, p < 0.05$]. This suggests that the effect of the positive peak event was stronger in the sequential condition than in the simultaneous condition. This result is consistent with our prediction that the role of the positive peak event is weakened in the overall negative affect experienced in the simultaneous response mode compared to the sequential mode of presentation (*H1*).

In addition, we analyzed the effects of presentation order and presentation mode on the negative affect, controlling for age and gender. A two-way ANCOVA revealed that age and gender effects were insignificant. The interaction effect between presentation order and presentation mode was not significant [$F(1, 73) = 0.01, p = \text{n.s.}$]. Only the main effect for presentation order [$F(1, 73) = 14.84, p < 0.001$] and presentation mode [$F(1, 73) = 19.60, p < 0.001$] on the negative affect was revealed. This result suggests that the effect of order of events does not interact with the effect of presentation mode on the overall negative affect experienced.

Discussion. As predicted, the role of the peak and final events in the overall negative affect experienced because of a sequence of temporally separated mixed-valence events was weakened in the simultaneous presentation condition for both mixed combinations of valence events. This finding provides initial evidence for deviation from the peak–end rule and provides initial support for the prediction that simultaneous presentation weakens the influence of the final and peak event on the overall negative affect experienced. It is to be noted here that when comparing presentation order, we see that in the simultaneous mode of presentation, a positive trend–negative peak event leads to lower negative affect ($M = 1.68, SD = 0.57$) than a negative trend–positive peak event ($M = 3.68, SD = 1.24$).

Despite these interesting results, this study has a few limitations. Most significantly, although the involvement check showed they were equally involved in all conditions, the context of stock market investing might be unfamiliar to some students. Therefore, based on the initial support for our prediction, we sought to replicate our preliminary findings and extend our results to a context familiar to students, namely, charity appeals. Furthermore, having shown that the order of presentation in a multi-event study did not moderate the effects of presentation mode on overall negative affect, we focus on a single order of events. Moreover, because the role of the peak and final is weakened in both negative trend–positive final and positive trend–negative final, we focus on the negative initial trend–positive final mixed-valence events in Study 1b and positive initial trend–negative final mixed valence events in Study 2.

Experiment 1b: Charity appeals

Method

Research design. The participants in this experiment included 50 respondents from students (56 per cent male) in an online panel who received payment upon the completion of the study. The study used an experimental design with two between-subjects conditions (presentation: sequential and simultaneous) in which the negative initial trend–positive final

mixed valence sequence of affective events was examined in the two conditions of sequential and simultaneous presentation.

Stimuli and procedures. In this experiment, affect was manipulated through positive and negative images in a series of pictures for a charity appeal. The stimuli consisted of a series of five pictures taken from a large database of pretested and standardized images contained in the International Affective Picture System (IAPS) (Lang *et al.*, 2008). The standardization for IAPS used the Self-Assessment Manikin, which is a graphic (i.e. nonverbal/pictorial) rating scale using a stylized person with varying levels of happiness expressed on the face to rate how pleasant/unpleasant the respondent felt when looking at each picture. This scale has nine levels (with the means reported here, “1” would represent “extremely unpleasant” and “9” would represent “extremely pleasant”). The images selected for this study were a negative picture of a baby (Image 2053) with a mean valence (SD) = 2.47 (1.87), a negative picture of a girl (Image 2276) with a mean valence (SD) = 2.67 (1.66), a negative picture of a crying boy (Image 2900) with a mean valence (SD) = 2.45 (1.42), a single neutral picture of a girl (Image 2385) with a mean valence (SD) = 5.20 (1.32) and a single peak positive picture of a baby (Image 2050) with a mean valence (SD) = 8.20 (1.31). In all conditions, the participants were told that they would view an appeal made by a well-known charitable organization and that they should rate the appeal based on the feelings that arose after viewing the appeal. They also received general information about the type of charity. The experiment was conducted using Web-based survey software, and the size and placement of the images was constant across conditions.

After receiving information about the experiment, the participants viewed the appeal on the computer screen for 36 s. In the sequential presentation condition, each image was displayed individually for 7 s; finally, all the images were simultaneously displayed for 1 s. For a series of mixed-valence events, because the order of the positive and negative stimuli is believed to have an impact on the type of behaviors in which individuals engage (Olsen and Pracejus, 2004), the three negative pictures were displayed first, followed by the neutral picture and then the final peak-positive event. In the simultaneous condition, each image was individually displayed for one second; finally, the images were simultaneously displayed for 31 s. Therefore, the order and duration in which the images were displayed in each condition was identical.

Measurement of affect. Immediately after the stimuli were displayed, the negative affect was measured using the scale employed by Pham *et al.* (2001). This scale consists of six items anchored at 1 (not at all) and 7 (very strongly). Six items related to negative affect are “I had unpleasant feelings after viewing the appeal”; “I was disgusted by the appeal”; “I was fearful about viewing the appeal”; “The appeal made me feel bad”; “The appeal made me feel angry”; and “The appeal made me feel sad”. The six items were averaged to form a combined score for negative affect (Cronbach’s $\alpha = 0.74$).

Results and discussion. The goal of Experiment 1b was to replicate and extend the results of Experiment 1a using a different context. The participants assigned to the simultaneous presentation condition indicated significantly greater negative affect than did the participants in the sequential presentation condition [$M_{\text{Sequential}} = 2.75$, $M_{\text{Simultaneous}} = 3.79$, $t(1, 48) = 2.51$, $p < 0.05$]. Participants in the sequential condition felt less negative after viewing the charity appeal, thus indicating the influence of the final and peak positive image. However, in the simultaneous condition, the effect of this positive peak and final event is weakened (*H1*). The pattern of weakening effects of the mode of presentation is similar across the contexts of charity and financial dashboards, increasing the robustness of our predictions.

Although the results of Experiments 1a and 1b supported our prediction, providing evidence for the tempering effect of the simultaneous presentation, it is not clear why this effect was observed. We have proposed that the simultaneous mode of presentation influences the individual's shift in attention between affective events, which in turn influences the overall negative affect experienced. This prediction is tested in the following eye-tracking experiment.

Experiment 2: attention to episodic events

Method. The participants in this experiment included 62 students (41 per cent male) in an introductory marketing course who received course credit upon the completion of the study. Similar to Experiment 1b, this study used an experimental design with two between-subjects conditions (presentation: sequential and simultaneous). However, in contrast to Study 1b, Experiment 2 used a positive initial trend–negative final mixed valence sequence of affective events.

Stimuli and procedure. Each participant was seated in front of a Tobii T120 Eye Tracker and an integrated 17-inch monitor with a 1,280- × 1,024-pixel resolution 50 Hz frequency. While the participants viewed the stimuli on the screen, an infrared camera located below the screen unobtrusively recorded the participants' eye gaze movements. The eye-tracking device was calibrated for each participant prior to participation, and the participants viewed the stimuli after the calibration phase.

In this experiment, affect was manipulated through positive and negative images in a series of pictures used for a charity appeal. However, we eliminated the neutral picture in the series to fit all the pictures within the width of the screen. The stimuli thus consisted of a series of four pictures taken from the IAPS (Lang *et al.*, 2008): a positive picture of a baby (Image 2075) with a mean valence (SD) = 7.32 (1.65), a positive picture of a boy (Image 2391) with a mean valence (SD) = 7.11 (1.77), a positive picture of a smiling girl (Image 2900_2) with a mean valence (SD) = 6.62 (1.97) and a single peak negative picture of a toddler (Image 2095) with a mean valence (SD) = 1.79 (1.18). The peak negative picture is not necessarily the peak affective experience in this case. The participants were informed that they would be viewing an appeal by a well-known charitable organization and that they should rate the appeal based on the feelings that arose after viewing it. In contrast to Experiment 1b, the participants in both conditions received general information about the type of charity on the first screen and the four images were then presented on the following screens. The general information text and pictures were split into two different screens to enable a closer examination of attention to the four images, our focal affective stimuli. The study was performed using Web-based survey software, and the size and placement of the images were constant across conditions.

After receiving general information about the experiment, the participants viewed the appeal on the computer screen. In the sequential presentation condition, the participants viewed the appeal on the computer screen for 24 s, with each of the four images displayed individually for 6 s. With respect to order, the three positive valence images were displayed, and the final peak negative event was then presented. However, unlike Study 1b, we removed the last second of the display of pictures simultaneously, eliminating a potential confound in the design. In the simultaneous presentation condition, each image was displayed individually for one-quarter of 1 s and thus, the order in which the images were displayed in each condition was held identical across conditions. Finally, all the images were simultaneously displayed for 23 s, thereby holding the duration and order consistent across conditions.

Measurement of affect. Immediately after the stimuli were displayed, affect was measured using the same scale as described in Experiment 1b.

Measurement of attention. Eye fixation data were used to estimate attention and shifts in attention. In this study, attention was indexed as a measure of participants' total fixation duration (Rosbergen *et al.*, 1997), measured as the sum of the duration of all fixations within an affective event. Shifts in attention were indexed as a measure of the participant's number of fixations. This metric measures the number of times the participant fixates on an affective event. If the participant leaves and returns to the same affective event, then the new fixations on the media will be included in the metric's calculations. A final measure was used as a check on the viewing order of affective events, which was indexed as a measure of the participant's time to initial fixation. This metric measured how long it takes before a participant fixates on an affective event for the first time.

Results. As predicted (*H1*), mean negative affect ratings were significantly lower for the simultaneous presentation condition than for the sequential presentation condition [$M_{\text{Sequential}} = 5.55$, $M_{\text{Simultaneous}} = 4.70$, $F(1,105) = 7.43$, $p < 0.01$]. Participants in the sequential condition felt more negative after viewing the charity appeal, thus indicating the influence of the final and peak negative images. However, in the simultaneous condition, the effect of this negative peak and final event is weakened (*H1*). Follow-up analyses examined the extent to which the presentation condition differentially influenced the attention to and gaze on the mixed-valence images for several eye-movement measures: time to initial fixation, number of fixations and average fixation duration. Table I reports the means and results of the tests of differences between the presentation conditions.

The *time to initial fixation* measure is used to assess the extent to which the order of the sequence was maintained during the simultaneous presentation condition. This measure reports the time elapsed before the eye first fixates on a particular picture and, consequently, allows us to establish the viewing order of the four pictures. Moreover, because we know that the initial focus is not on an image, it allows us to detect the specific sequence followed (e.g. from "not on an image" to a specific image, to another image and so forth. Because 65 per cent (20 of the 31 participants) followed the sequence that we established by displaying each of the four images individually for one-quarter of 1 s before the images were

	Positive1		Positive2		Positive3		Negative_Peak4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Time first fixation</i>								
Sequential	0.31	0.15	6.47	0.18	13.29	0.24	17.46	4.66
Simultaneous	1.24	0.86	3.73	0.65	4.48	1.73	6.22	3.36
<i>t</i> -statistic	5.90***		22.48***		28.06***		10.88***	
<i>Total fixation duration</i>								
Sequential	4.54	1.13	4.75	1.06	4.07	1.24	3.91	1.54
Simultaneous	4.6	1.73	4.56	1.88	4.17	1.35	3.46	2.14
<i>t</i> -statistic	0.16		0.48		0.31		0.96	
<i>Total fixation count</i>								
Sequential	9.65	3.67	9.45	4.01	8.48	3.22	6.77	3.51
Simultaneous	11.16	3.58	13.03	4.99	12.03	4.23	7.42	4.51
<i>t</i> -statistic	1.65		3.12**		3.71***		0.39	

Table I.
Experiment 2: means
of eye fixation
measures (in
seconds)

Notes: *** $p < 0.001$; ** $p < 0.01$

simultaneously displayed, we were able to examine the other measures. As expected, for the total number of fixations across the four images, we found support for our prediction that the total number of fixations was significantly greater in the simultaneous presentation condition than in the sequential presentation condition [$M_{\text{Sequential}} = 34.5$, $M_{\text{Simultaneous}} = 43.7$, $t(1, 60) = 3.63$, $p < 0.01$]. For the number of fixations for each image, we found support for our predictions for Images 2 and 3 [$M_{\text{Sequential Image 2}} = 9.45$, $M_{\text{Simultaneous Image 2}} = 13.03$, $t(1, 60) = 3.12$, $p < 0.01$; and $M_{\text{Sequential Image 3}} = 9.45$, $M_{\text{Simultaneous Image 3}} = 13.03$, $t(1, 60) = 3.71$, $p < 0.001$, respectively]. Differences in the number of fixations for Images 1 and 4 were not significant. More important, the total fixation duration for all four images did not significantly differ between the presentation conditions. The greater number of fixations in the simultaneous condition, with similar fixation duration in both presentation modes, supports our prediction that the simultaneous mode of presentation causes greater shifts in attention to affective events (H2).

Mediation analysis of attention on overall negative affect. We expected the event-to-event interconnections to become salient because of greater shifts in attention to events in simultaneous mode of presentation compared with the sequential mode. Although the nature of these salient interconnections is an important factor to predict the overall negative affect, we wondered if the total number of shifts in attention could possibly mediate the effect of presentation mode on overall negative effect. Therefore, we ran a mediation analysis using Hayes's (2013) PROCESS macro (Model 4; with 10,000 bootstrapped samples). The total number of shifts in attention was measured using the total number of fixations on the four affective events. We examined the indirect effect of total fixation on overall negative affect. There is a significant direct effect for the presentation mode ($b = -0.92$, $SE = 0.35$, 95 per cent CI = $[-1.62, -0.22]$); however, there is no significant indirect effect for total fixation ($b = 0.06$, $SE = 0.16$, 95 per cent CI = $[-0.25, 0.41]$). These results failed to provide evidence for our assumption that the effect of presentation mode on overall negative affect is mediated by the total number of fixations.

Discussion. As predicted, we found that the tempering of the overall negative affect experienced in the simultaneous presentation condition was associated with a shift in attention between affective events. In this experiment, the overall attention to each affective event was identical across the presentation conditions, implying that attention duration did not explain the observed differences in affect. The fixation count for certain Images (2 and 3) and the total fixation count varied across the presentation conditions. We corroborate that increased shifting in attention reduces the disproportionate weights given to the peak and final affective events. Furthermore, the results provide evidence of participants engaging more on Images 2 and 3 (both positive pictures) in the simultaneous (vs sequential) presentation condition. Consequently, the greater weight given to the peak event in the sequential mode of presentation is decreased in the case of the simultaneous mode of presentation.

However, we did not find evidence to support a mediating role of total fixation on the relationship between the presentation mode and the overall negative affect. This insignificant result could be due to the nature of the relationships between affective events. An example is the shift from a positive affective event to a negative affective event or from a negative affective event to a positive affective event. As Olsen and Pracejus (2004) demonstrate, the order of presentation of these oppositely valenced stimuli can lead to different contrast effects. Similarly, others (Teixeira *et al.*, 2010, 2012; Gross and Thompson, 2007) report that the overall retrospective evaluation depends on which event the individual pays attention to and how attention shifts between events. Therefore, we believe that a better measure that captures the salience of event-to-event interconnections may be required

to test the process mechanism. Although we show that the shift in attention leads to the salience of interconnections, a measure that captures the nature of these interconnections would better predict the overall retrospective evaluation.

Conclusions

When a series of affective events is retrospectively evaluated, the information can be presented either simultaneously or sequentially. Although prior studies have found evidence for the peak–end rule, these studies have generally examined affective events of similar valences that are presented sequentially. Our research provides additional support for the peak–end rule for the sequential presentation of mixed valence affective events over a longer period.

A critical difference between sequential and simultaneous presentations is the ability people have to unrestrictedly view affective events. The sequential mode of presentation forces people on the experience of a sequence of moment-to-moment affective events in a particular order. In contrast, the simultaneous mode of presentation provides the flexibility to view various affective events and allows greater shifts in attention that increase the salience of interconnections. As a result, simultaneous presentation decreases the extent to which weights given to specific events are disproportionate. These greater shifts in attention make affect regulation through avoidance and engagement more important in determining the overall affect experienced. The regulation process is determined by the nature of the interconnections during each shift in attention. For example, if a positive event shifts to a negative event, the response would impact both avoidance and negative-to-positive affect engagement. In the regulation process, the disproportionate weights placed on certain events are reduced. Indeed, prior research has shown that shifting attention toward a positive stimulus either enhances or maintains the elicited emotions, whereas shifting attention away from a negative stimulus attenuates or limits emotions (Teixeira *et al.*, 2012; Derryberry and Rothbart, 1984).

Limitations and future research

The extant literature has shown that when pleasant and unpleasant images are presented simultaneously alongside neutral images, individuals tend initially to fixate longer on the pleasant and unpleasant pictures (Calvo and Lang, 2004). This tendency is thought to reflect the increased attention toward motivationally salient stimuli (Lang *et al.*, 1997). This study deliberately made the peak and end the same event, which had the benefit of rendering the experimental manipulations cleaner. However, additional research is needed to disentangle the peak and the end and examine which has more influence on sequential affect integration. Furthermore, this research attempted to explain the weakening effect of presentation mode; however, it has not examined the rule that determines the overall retrospective evaluation of a sequence of mixed valence events that are presented simultaneously. Therefore, future research should address this rule by developing a model that focuses on how this shifting of attention leads to different combinations of interconnections that can either drive engagement or avoidance behaviors (and the resulting overall effect on the retrospective evaluation of a series of affective events). In addition, this research examined the peak-final event. Future studies should thus examine different combinations of initial and final trends and peak events for events that are presented simultaneously. Therefore, although we conclude that the tempering effect of simultaneous presentation is associated with the increased salience of interconnections between affective events, further in-depth studies are required to discern how individuals process these events and whether a general rule accurately predicts the overall affect across different sources of affect (e.g. music, smell).

Managerial implications

Our findings differentiate between sequential and simultaneous presentations of events, and therefore, they have important managerial implications. For example, claims of “improved decision-making” have been based on the use of a financial dashboard by top industry management in the past decade (see, e.g. Cleverley, 2001, for the hospital industry). By reducing information overload, dashboards provide business users with relevant and actionable information that might enable them to make decisions more efficiently. Recently, dashboards have become available to consumers and have seemed to improve consumer investment decisions (Brent, 2012; Cleaver, 2015). Financial dashboards present information simultaneously. Simultaneous presentation reduces the disproportionate weights given to specific episodic events and thus moderates the effects of emotions. Although we cannot draw conclusions regarding decision-making improvements, we can conclude that simultaneous presentation reduces the influence of extreme or more recent affective events on individuals. In addition, we find that simultaneous presentation facilitates the processing of interconnections between events prior to decision-making, limiting the influence of specific events such as the peak event or the event trend.

Similarly, applications that display information simultaneously, such as MyFitnessPal (www.MyFitnessPal.com) for diet history; Moodle (www.moodle.com) for students’ grades; and PlayStation, Xbox and Wii for game status, scores and game design (Mukherjee and Lau-Gesk, 2016) may be able to better design their presentation formats. In the case of these applications, prior research had identified the importance of the peak event, the trend, the troughs, etc. This research adds that overall affect attributable to these events may be tempered by their simultaneous presentation. In the cases of diet history and student grades, it is a good idea to present information in a simultaneous form so that too much credence is not given to any specific event. However, in the case of games, the sequential presentation of scores might be the better option to keep the gamers emotionally engaged in their performances. This research also helps ad agencies design and develop their advertisements based on the affective state that they desire for their consumers. A picture in an advertisement, although intended to make certain elements more salient, could lead to another outcome, depending on the sort of avoidance and engagement behaviors that the contrast produces.

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Further reading

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