A Twist On Event Processing: Reorganizing Attention to Cope with Novelty in Dynamic Activity Sequences

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Abstract

Fluent event processing appears to critically involve selectively attending to information-rich junctures within continuously unfolding sensory streams (e.g., Newtson, 1973). What counts as information-rich would seem to depend on a variety of factors, however, including the novelty/familiarity of such events, as well as local opportunity for repeated viewings. Using Hard, Recchia, & Tversky's "Dwell-time Paradigm," we investigated the extent to which viewers' attention to unfolding activity streams is affected by novelty/familiarity and a second viewing. Viewers' dwell times were recorded as they advanced twice each through three slideshows varying in familiarity but equated on other dimensions. Dwell time patterns revealed reorganization on a number of fronts: a) familiarity elicited decreased dwelling overall, b) dwell-time patterns changed systematically on second viewing, and c) familiarity modulated the specific nature of change associated with repeated viewing. These findings illuminate reorganization in attention as action information is first encountered and then quickly incorporated to guide event processing.

Keywords: action segmentation; event processing

Skill at making sense of human action is essential to normal adult functioning. Imagine, for example, an everyday event such as cooking together with someone else. Among other things, this seemingly mundane activity requires fluently interpreting one's partner's ongoing activity and the causal effect it has on the world, seamlessly integrating all of this with an unfolding interpretation of any linguistic contributions that co-occur, and coordinating one's own activity stream to mesh with an understanding of what the other is dynamically enacting or plans to enact. Although the complexity of the processing involved is immense, action processing at the adult level appears to be so fluent that errors are rare and processing occurs largely outside of conscious awareness.

Much remains mysterious about the mechanisms subserving everyday event processing. In recent years, however, considerable progress has been made in relation to one particular component of event processing: segmentation. Event segmentation involves transforming continuously unfolding sensory information into discrete units that can be remembered, categorized, and described with language.

In principle, there are infinite possible ways to segment any sensory stream; it is therefore striking that observers asked to identify event boundaries within continuously flowing activity display considerable agreement, and this agreement holds at multiple levels of event representation. The event boundaries viewers nominate typically coincide with goal transitions, and viewers readily scale their segmentation up or down, as the task demands, in terms of the grain at which they identify event boundaries (e.g., Newtson, 1973; Zacks, Tversky, & Iyer, 2001). For example, at a coarse-grain level, viewers tend to nominate transitions between higher-level tasks (e.g., in a food preparation sequence, the transition between an actor closing an oven door and turning to wash some dirty dishes). At a more fine-grain level, viewers identify smaller-scale events within these tasks (e.g., lifting a cookie pan, placing the cookie pan in the oven, grasping the oven door, closing the oven door). Viewers' judgments at these different levels of generality display alignment, such that coarse-gain boundaries tend to align with boundaries at the fine-grain level, suggesting that viewers organize event segments hierarchically in their processing (Zacks & Swallow, 2007). Adults' segmentation is relatively robust to at least minor novelty, as well.

Several sources of evidence indicate that segmentation occurs spontaneously as viewers process unfolding sensory streams, and may be largely accomplished via implicit mechanisms. For one, magnetic resonance recordings conducted during passive event viewing display neurophysiological activity that selectively correlates with segment boundary judgments participants provided on a subsequent, second viewing of the behavior stream (e.g., Zacks et al., 2001). As well, action boundaries implicitly "intrude" on participants' processing as they carry out unrelated tasks, such as detection of an unrelated stimulus (e.g., Huff, Papenmier, & Zacks, 2012). For example, reaction times reveal that participants process the segmental structure of unfolding behavior while they engage in a change detection task.

Hard, Recchia, and Tversky (2011) recently introduced another valuable implicit measure of action segmentation: the "dwell-time paradigm." In this task, slideshows are constructed by selecting frames at a regular increment from digitized event videos (e.g., one frame every 500 msec). Viewers advance through slideshows at their own pace by the click of a mouse; latencies between mouse clicks index their “dwell time” to each slide. When dwell times are referenced to event boundary judgments (subsequently provided either by slide show viewers themselves, or by other viewers), systematic dwell-time patterns emerge: a) viewers tend to dwell longer on slides coinciding with event boundaries relative to points occurring within event units (henceforth termed a “boundary advantage”), and b) dwelling is longest to slides coinciding with coarse-grain level boundaries relative to more fine-grain level boundaries. Importantly, dwell-times arising when adults view the same set of slides in scrambled order do not reveal such patterns to the same degree. Thus dwell-time patterns appear to simultaneously reflect both the extraction of segmental structure as viewers process an unfolding activity sequence, and the hierarchical organization of the segments they extract. Also noteworthy is that viewers’ dwell times to coarse-grain level slides positively predicted their subsequent recall score for the activity sequences they viewed. The fact that dwell times make contact with event memory helps to validate dwell times as a psychologically meaningful measure of action processing.

One might question why dwell times tend to increase at event boundaries. Zacks and colleagues’ (Kurby & Zacks, 2008; Zacks, Kurby, Eisenberg, & Haroutunian, 2011) Event Segmentation Theory provides a natural account for the phenomenon. They suggest that event processing is fundamentally a process of predictability monitoring, with information value being highest where predictability is low. Event boundaries appear to represent just such information-rich predictability “troughs” within activity streams. As one event comes to a close, uncertainty abounds regarding what will occur next. Once the subsequent event is underway, predictability surges, only to plummet again as that event approaches completion. Imagine, for example, one detects another initiating a reach for a coffee mug. Motion in the midst of this reach is highly predictable (the hand predictably configures to prepare to grasp the mug as it approaches the mug), but once the reach is completed, predictability suddenly plummets: many subsequent alternatives for action arise. The actor might lift the mug, push it away, spin it around, or simply hang on to it for a time. At such boundaries, predictability is low and viewers gain highly relevant information to interpret the motion stream. Thus selectively attending to event boundaries – regions of “predictable unpredictability” – conceivably facilitates event processing.

Viewers appear to capitalize on a broad range of clues to identify segment boundaries whether explicitly reporting on the location of event boundaries or using more implicit methods such as the dwell-time paradigm. These clues include expectations/inferences about goals and intentions, as well as physical motion parameters (e.g., motion change, velocity change, motion acceleration/deceleration, and change in motion directory) (e.g., Zacks, 2004; Zacks, Kumar, Abrams, & Mehta, 2009). Statistical regularities also inform judgments about segment boundaries (Baldwin, Andersson, Saffran, & Meyer, 2008). The sensory stream possesses an inherent predictability structure; some phenomena tend to succeed one another with greater regularity than others. For example, within everyday intentional activity, the act of chopping a vegetable would be more likely to follow the act of grasping a knife than would the act of opening a refrigerator door. When predictability is high, small-scale acts cohere into larger event units. Conversely, junctures at which predictability is low reflect event boundaries. Put another way, growing familiarity with predictability structure produces increasing access to the segmental structure of activity streams. One implication of this account is that viewers’ processing will change as familiarity with the predictability structure of the sensory stream grows.

Meyer, Hard, and Baldwin (in preparation) recently documented that dwell-times are sensitive to reorganization in attentional patterns that accrue as familiarity with segment-related predictability structure arises during statistical learning. One group of adults (*knowledgeable* viewers) viewed a digitized video depicting a novel activity sequence with underlying statistical regularities (i.e., a ten-minute “exposure corpus” with four randomly combined “actions” – each composed of a fixed triad of small-motion elements, such as *feel-blow-look*), after which they advanced at their own pace through slides extracted once every 500 msec from the same exposure corpus. A second group (*naïve* viewers) provided dwell times to the same slideshow without having had any prior opportunity to acquire the statistical regularities through viewing the exposure corpus video. After slideshow viewing, both groups provided discrimination judgments for pairs of short videos, with each pair depicting one “action” (a statistically regular triad from the exposure corpus) and one “part-action” (a sequence actually viewed, but spanning a low-predictability transition from the exposure corpus).

Several noteworthy findings emerged. First, discrimination judgments revealed better-than-chance discrimination accuracy for “action” segments relative to “part-action” foils, but only in the *knowledgeable* condition, in which viewers had watched the digitized video of the exposure corpus prior to viewing the dwell-time slideshow. Thus, as expected, only those who received extended exposure to the statistical regularities within the novel activity sequence appeared to have achieved a solid knowledge of the segmental structure of the activity stream overall. Second, dwell-time patterns differed for those in the *knowledgeable* versus *naïve* conditions. In particular, *knowledgeable* viewers displayed the predicted action-level boundary advantage in dwell times indicative of sensitivity to the higher-level segmental structure defined by the statistical regularities inherent in the exposure corpus. In contrast, no comparable boundary advantage emerged for dwell-times in *naïve* viewers, who had lacked prior opportunity to acquire the statistically-defined segmental structure of the exposure corpus. Lastly, only those in the *knowledgeable* condition who displayed strong discrimination performance revealed the segment-related boundary advantage in dwell-times.

All in all, dwell-time patterns in this experiment clearly revealed learning-based reorganization in the way that viewers modulated their attention during the unfolding activity stream. These findings provided the first evidence to date documenting patterns of attentional reorganization specifically attributable to newly-acquired familiarity with segment-related predictability structure. In particular, viewers who had the opportunity to learn the predictability structure of the sequence displayed longer dwell times at junctures within the unfolding activity sequence where they came to be able to predict that predictability was low (i.e., between the end of one statistically coherent unit of action and the beginning of another). This experiment also showcased a striking degree of alignment across discrimination and dwell-time methodologies; that is, viewers who displayed newly-acquired knowledge of segmental structure in the explicit discrimination judgment task also displayed sensitivity to that same structure in their implicit dwell-time patterns. These findings provide a strong basis for confidence in the dwell-time paradigm as a valid and sensitive index of familiarity-driven reorganization in action processing.

The statistical learning paradigm utilized in the research just described has the advantage of offering complete control of the predictability structure of the activity stream. At the same time, of course, the activity streams utilized in such research by necessity are somewhat unnatural, undercutting generalization of findings to event processing in the world at large. Thus, it is important to extend this research by investigating how familiarity alters action processing in more naturalistic activity sequences. We have identified one such sequence -- tying shoe laces -- that offers considerable potential for exploring these issues while maintaining necessary methodological controls. Skill at tying shoelaces is challenging to acquire; children between 5 and 8 years of age typically require many months to grasp its fundamentals and achieve an outcome that is at least moderately effective. This may be in part because the necessary motion elements for causal success are difficult for novices to extract from the motion stream through observation alone. Although shoelace tying comes to seem trivial to the expert (i.e., the average adult), producing successful shoelace tying in fact requires not only manual dexterity, but also knowledge of causal mechanics and fluent sequencing of coordinated motions necessary to effect successful tying. Shoelace tying can be accomplished via alternative methods (in regard to which viewers differ in their familiarity). This fact presents a unique opportunity to investigate the effects of viewer familiarity on the processing of the complex motion stream that shoe-tying generates.

In the current study, we investigated differences in adults' processing of shoelace tying sequences that may arise in conjunction with increasing familiarity (as when those who understand the causal mechanics are introduced to a new method). There are at least three methods for tying shoe laces that achieve the same intentional outcome: *loop*, in which a loop is created, another lace is wrapped around the loop and a second loop is pulled through; *ears*, in which two loops are created and tied together; and *twist*, in which both laces are simultaneously manipulated to capture loops from opposing fingers. In North America, adults tend to be familiar with both the *loop* and *ears* methods, but prefer one of these methods in their own tying (thus they have highest familiarity with one particular method). In contrast, most North American adults have little to no familiarity with the *twist* method.

We predicted that, overall, methods that were less familiar would elicit overall longer dwell times, and that this would hold regardless of the specific details of the tying method involved. We also expected to replicate the "boundary advantage effect" found in previous dwell-time research; specifically, that dwell times to boundary slides would be significantly longer than to those for slides depicting within-unit content. However, we predicted that familiarity might influence observers' ability to detect and increase attention to event boundaries. Thus, a boundary advantage might differ systematically for more familiar versus more novel event sequences.

An additional advantage of shoelace tying sequences is that they allow for naturalistic repetition within the unfolding event stream. That is, we were able to explore dwell time patterns to the unfolding event once on a first shoe and again for a second shoe. We predicted that dwell-time patterns would differ from the first viewing (first shoe) to the second viewing (second shoe) as participants gained experience with a given shoelace-tying method. Thus, the above-mentioned patterns were predicted to vary across first and second viewings.

Method

Stimuli

Videos of the three methods of shoe tying were filmed on a camera at a rate of 30fps. Videos of the *loop, ears,* and *twist* methods were equal in length (each 139 seconds). Only the actor's shoes, socks, pant legs, and hands were visible in the videos. To increase consistency across the slide shows derived from the videos of the three methods of shoe tying, the lead-in and completion portions of all three slide shows were in fact identical. The slide shows differed only in their middle portion, which contained the actions that were distinctive to each method. Consistent with prior research, slideshows were created by extracting one frame every second from each of the three videos (e.g., Hard, Recchia, and Tversky, 2011; Meyer, Baldwin, & Sage, 2011). The three resulting slideshows thus contained an identical number of frames (N = 139). Sections of slides were classified as causally distinctive (e.g., differing across the three slideshows and unique to the method being demonstrated) versus non-distinctive (e.g., depicting actions that did not differ across the three methods, such as tying a double knot). Two expert coders further classified slides as depicting boundaries or within-unit action. Examples of images depicting boundary and within-unit slides from each of the three slideshows are depicted in Figure 1.

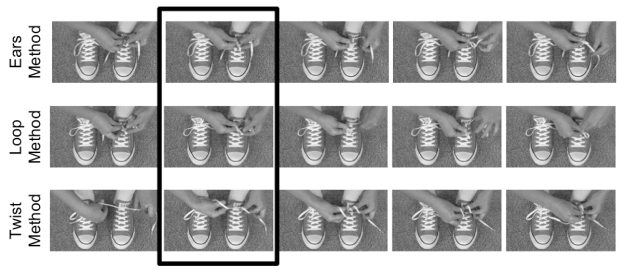


Figure 1: Example boundary and within-unit slides from slideshows depicting the *ears*, *loop*, and *twist* methods. Outline indicates boundary slides in all three slideshows. All other slides depicted were categorized as within-unit.

Participants and Procedure

142 undergraduates (61% female, M_{age} = 20 years) participated for course credit; data from three participants were excluded from analyses due to experimenter error (2) and illness. After a brief training phase to familiarize participants with the self-paced slideshow format, participants advanced at their own pace through three slide shows (the three different shoelace tying methods, in counterbalanced order across participants). Participants' dwell times, or latency between mouse clicks from one slide to the next, were recorded using Psychtoolbox (Brainard, 1997). Finally, participants were asked to rate their familiarity with the three methods of shoe tying and to demonstrate the method that they used every day.

Results

Dwell times greater than three standard deviations from the overall group mean were considered outliers. Participants' data were excluded from analyses when more than 10% of their dwell times were outliers, resulting in the exclusion of eight participants. Data from the remaining 131 participants were positively skewed, as is typical for looking time data; a log10 transformation was utilized to normalize the distribution prior to analyses.

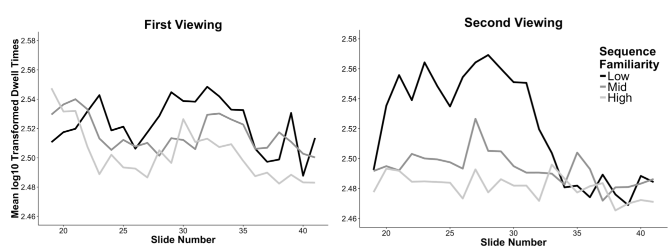
The shoelace tying method that participants used every day (assessed by the shoe-tying demonstration task) was classified as their most familiar method. For 75.9% of participants this was the *loop* method and for 21.2% participants this was the *ears* method. Only 2.9% of participants identified the *twist* method as most familiar; their data were excluded from further analysis due to the small sample size. For purposes of analysis, participant's other highly-rated method (*loop* or *ears* depending on participants' most familiar method) was classified as *moderate familiarity* for each participant. For all participants included in analyses, the *twist* method was classified as *low familiarity*. Thus, even though participants' *high familiarity* method was the method most familiar to them, the details of the specific method differed across subjects (i.e., for some the method of highest familiarity was *loop*, and for others, it was *ears*).

Our first analysis examined whether viewers dwelt longer to the degree that events were less familiar, and whether this pattern held up regardless of their own preferred method of tying (and thus the details of the specific method that was high- versus mid-range in familiarity). Log10-transformed dwell times (henceforth, simply "dwell times") were examined via a 3 (familiarity: high, mid, low) X 2 (preferred method: *loop* vs. *ears*) mixed between-within ANOVA with familiarity as the within-subjects variable and preferred method as a between-subjects variable. We found a significant main effect of familiarity, $F(2, 258) = 5.17$, $p = .006$, $\eta_p^2 = .04$, which, as predicted, displayed a significant linear trend, $F(1, 129) = 9.65$, $p = .002$, $\eta_p^2 = .04$ ($M_{HighFam}$ = 2.50, *SEM* = .02; M_{MidFam} = 2.52, *SEM* = .02; M_{LowFam} = 2.54, *SEM* = .02). The main effect of preferred method did not emerge as significant, $F(1, 129) = 0.64$, $p = .426$, $\eta_p^2 = .005$, nor did it interact with familiarity, $F(2, 258) = 1.12$, $p = .327$, $\eta_p^2 = .009$. That is, the linear trend (lowest dwell times to participants' most familiar method and highest to their least familiar method) held regardless of participants' preferred method for tying shoes and was robust to differences in the details of which method was classified as low versus mid familiarity. This linear trend of familiarity, combined with a lack of interaction involving familiarity and preferred method, confirms that dwell-times are responsive to familiarity, regardless of the specifics of the particular shoelace tying method at issue, which helps to further validate dwell times as a meaningful index of viewers' processing that is at least to some degree independent of specific motion patterns.

In question with the second analysis was the extent to which viewers displayed increased dwelling to slides depicting event boundaries, relative to slides displaying within-segment content, a basic question regarding replication of prior findings. Also of interest in this analysis was whether a "boundary advantage" was affected by a) the familiarity of shoe-tying methods, and/or b) first versus second viewing of a given method. A 2 (slide type: boundary vs. within) X 3 (familiarity: high, mid, low) X 2 (viewing: first vs. second) repeated-measures ANOVA was conducted to examine these effects. The main effect of slide type was significant, $F(1, 130) = 94.56$, $p < .001$, $\eta_p^2 = .42$, with dwelling significantly longer to boundary slides (M = 2.52, *SEM* = .016) than within-unit slides (M = 2.51, *SEM* = .016), replicating prior findings using the dwell time methodology.

The main effect of familiarity was also significant, $F(2, 260) = 5.85$, $p = .003$, $\eta_p^2 = .04$, with a significant linear trend, $F(1, 130) = 11.20$, $p = .001$, $\eta_p^2 = .04$, reflecting increased dwelling for methods that were less familiar, further confirming what was reported in the first analysis. Participants additionally displayed longer dwell times on first ($M = 2.53$, $SEM = .016$) versus second viewing ($M = 2.50$, $SEM = .016$), $F(1, 130) = 40.82$, $p < .001$, $\eta_p^2 = .24$, also indicative of dwelling reducing with increasing familiarity. We found significant two-way interactions between familiarity and slide type and between viewing and slide type, *ps* < .05. However, we will leave these aside as they seemed best interpreted in the context of a nearly significant three-way interaction between slide type, familiarity, and viewing, $F(2, 260) = 2.90$, $p = .06$, $\eta_p^2 = .02$. Simple effects tests revealed that, on first viewing, dwell times to boundary slides were significantly greater than dwell times to within-unit slides across all levels of familiarity, all *ps* < .001. On the second viewing, however, dwell times to boundary slides were greater than dwell times to within-unit slides only for the least familiar method, $p < .001$. For slideshows depicting shoe tying methods at low and moderate levels of familiarity, there was no significant difference in dwell times to boundary versus within-unit slides on the second viewing, *ps* > 0.18. These findings point to the boundary advantage being responsive to the familiarity of the event sequence depicted.

A final exploratory analysis focused specifically on reorganization in dwell times for the least familiar *twist* method across viewings. As Figures 2 and 3 depict, a notable surge in dwell times seemed to occur specifically for the second viewing of the *twist* method at the most causally distinctive portion of the shoe-tying sequence. Viewers seemed to target the causally distinctive portion of the *twist* slide show with sustained enhanced attention during their second viewing. This analysis examined the degree to which this was a systematic attentional increase from first to second viewing, and whether viewing in relation to slide type (boundary versus within slides) was affected equivalently by this attentional enhancement. A 2 (slide type: boundary vs. within) X 2 (distinctiveness: causally distinctive vs. not causally distinctive) X 2 (viewing: first vs. second) repeated-measures ANOVA examined these effects for only the lowest familiarity *twist* method of shoe tying. As expected, dwell times were significantly longer to boundary slides ($M = 2.54$, $SEM = .02$) than within-unit slides ($M = 2.52$, $SEM = .02$), $F(1, 130) = 52.63$, $p < .001$, $\eta_p^2 = .29$, and to distinctive portions of the slideshow ($M = 2.54$, $SEM = .02$) than non-distinctive portions ($M = 2.52$, $SEM = .02$), $F(1, 130) = 5.45$, $p = .02$, $\eta_p^2 = .04$. Dwell times were also marginally significantly longer on first ($M = 2.54$, $SEM = .02$) than second viewing ($M = 2.52$, $SEM = .02$), $F(1, 130) = 3.25$, $p = .07$, $\eta_p^2 = .02$. Additionally, all two-way interactions were significant or marginally significant: the slide type X distinctiveness and distinctiveness X viewing interactions were both significant (*ps* < .001) and the slide type X viewing interaction was marginally significant ($p = .08$). However, these effects must be interpreted in the context of a significant three-way interaction between slide type, distinctiveness, and viewing, $F(1, 130) = 39.76$, $p < .001$, $\eta_p^2 = .23$. This significant three-way interaction suggested that slide types were affected differentially by attentional enhancement to the causally distinctive portion of the *twist* slideshow. A boundary advantage was observed only for non-distinctive portions of the slideshow on first viewing ($p < .001$). However, by the second viewing of the least familiar *twist* sequence, participants' dwell times were higher to boundary slides than within-unit slides for the distinctive as well as the non-distinctive portions of the slideshow (*ps* < .001).



Figures 2 and 3: Dwell-time patterns across low, mid, and high familiarity slideshows on first (Figure 2) and second (Figure 3) viewings.

Discussion

To recap briefly, we investigated the extent to which adults' processing of shoelace tying sequences reorganized with respect to familiarity with a given method of tying shoe laces, and over repeated viewings of that method. We also examined the extent to which enhanced attention to event boundaries might be preserved over the course of such attentional reorganization. Overall, less familiar methods of shoe tying elicited longer average dwell times per slide, and this was so regardless of the specific details of the tying method involved. Replicating prior research, viewers displayed enhanced attention to boundary slides relative to slides depicting within-segment content. However, while this boundary advantage was present on first viewing across all three methods it disappeared on the second viewing for all but the least familiar, *twist*, method. Moreover, analyses focusing specifically on the least familiar *twist* method revealed further striking evidence for attentional reorganization. For the *twist* method, a boundary advantage was observed for non-distinctive portions of the activity stream (depicting activity familiar to viewers and similar across all methods of shoe tying) on both viewings. In contrast, for the causally distinctive portion of the shoe tying sequence (depicting activity unique to the *twist* method), a boundary advantage emerged only on the second viewing. Thus viewers' identification of boundaries within the *twist* activity stream underwent reorganization after just a single exposure to this unfamiliar shoe tying method.

Of particular interest was the impact of repeated viewing on observers' enhanced attention to events. For shoe tying sequences at high and moderate levels of familiarity, a boundary advantage was present on first viewing and markedly absent on second viewing. By the second viewing, these two relatively familiar action streams no longer contained predictability troughs -- regions of "predictable unpredictability" -- and the boundary advantage effect was reduced. For the least familiar method, in contrast, participants continued to display selective attention to event boundaries on second viewing, suggesting that just one viewing hadn't yet rendered the activity stream familiar and predictable. Further examination revealed that, though the overall boundary advantage remained, attention to event boundaries underwent reorganization across repeated viewings within this unfamiliar method.

Our final analysis, in particular, implicated enhanced targeting of predictable unpredictability on second viewing within the causally distinctive portion of the highly unfamiliar *twist* method The "predictable unpredictability" hypothesis suggests that observers must be able to identify (predict) when unpredictability will occur in order to selectively attend to these junctures. While viewers did not selectively target unpredictability (event boundaries) with increased attention in the causally distinctive portion of *twist* tying on first viewing, just the that single first viewing provided enough exposure to allow them to identify these maximally informative regions as early as the second viewing of this highly unfamiliar event. These findings showcase how rapidly viewers reorganize attention as new action information is first encountered and then incorporated to guide event processing on subsequent viewings.

Our findings also offer incentive to extend related questions to research with children, as shoelace tying is a skill that is typically acquired at approximately five to eight years of age. Additionally, the dwell-time paradigm has been validated for use with preschoolers (Meyer, Baldwin, & Sage, 2011), suggesting that the current study might be amenable to use with children who are at varying levels of shoe-tying ability. Questions of interest include: How might reorganization of streaming sensory information differ for those who are at the cusp of acquiring this new skill? Would variation in children's executive function affect their ability to effectively modulate attention to the unfolding event? How might direct motor experience reshape children's processing of shoe-tying sequences as they are in the midst of acquiring this basic motor skill? These and similar questions can inform research on the acquisition of event processing fluency in childhood.

The findings we report here further validate the usefulness of the dwell-time paradigm for examining how viewers deploy attention as they process dynamically unfolding sensory streams. More specifically, these findings showcase how attention readily reorganizes to cope with novelty as dynamic activity sequences unfold across time. It will be important to extend this methodology to other naturalistic event sequences varying in familiarity; this effort is underway. All in all, the current findings provide altogether new information about the timing and nature of changes to processing as novel event information is encountered.

Acknowledgements

The authors would like to thank Alan L. Baldwin, Rose Maier, Jenny Mendoza, Robbie Ross, and Jason Wallin for valuable conceptual input regarding this research.

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