The prevalence of multitasking presents challenges for theories of event segmentation.

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Abstract

Event cognition research has typically considered events to be contiguous in time, with defined starts and ends. However, people sometimes engage in more than one event at the same time. If this happens frequently, then theories of event cognition may require modification. This research study aims to estimate how often people engage in multitasking in daily life. Ninety-seven participants were asked whether they had been multitasking at four time points during the last 24 hours. Forty-five per cent of responses reported multitasking with a diverse range of event structures. Twenty-one per cent of reports specifically listed multiple overlapping activities. The prevalence of multitasking suggests that theories of event cognition need to be expanded to accommodate non-contiguous and simultaneous events.

Keywords: Daily life event; Multitasking; Event cognition.

Introduction

Our lives are filled with a constant swirl of activity, yet we remember and talk about discrete event units. The way we divide up this swirl of activity into units is called event segmentation. These event units are one of the most significant categories in daily psychology, playing a fundamental role in how we understand and remember our lives (Radvansky & Zacks, 2017). Despite the fact that the formation of these conceptual event units is influenced by external reality, it is a cognitive process that determines how individuals segment their stream of experience, a similar process to the colour perception in which colours are typically described by humans using a number of discrete terms (e.g., red, green, blue) although the colour spectrum is continuous (Conway et al., 2020; Roberson, Davies & Davidoff, 2000; Kay, Jraissati, 2010; Berlin et al., 1997).

Theories of event cognition have assumed that event units form a contiguous temporal line where one event follows another with no gap or overlap. However, in daily life we may subjectively experience events that are interrupted or overlap in time, requiring some form of non-linear structure–for instance, receiving a phone call while watching a television program. Events can also overlap in time, resulting in a single event with concurrent activities. For example, walking on the street and chatting with a friend on the phone. Thus, life is not necessarily defined as a single stream of behaviour but may be a complex system with a deep structure (Kahneman et al., 2004; Kubovy, 2015; 2020).

Non-contiguous events have been a topic of discussion among researchers from different fields of psychology (e.g. Linton, 1986; Barsalou,1988; Kubovy, 2015; 2020; Jeong, & Fishbein, 2007; Salvucci & Taatgen, 2008). For instance, Linton (1986) coined the term "extendure" to describe events that include components from many points in time. These types of events are also referred to as “extended events" by Barsalou (1988), who suggested that shared aims serve as a fundamental organising principle underpinning this kind of event structure. Notably, non-contiguous events have been largely absent in discussions of event segmentation; where they have been mentioned, it has been as an edge case outside of the scope of current investigation (Richmond & Zacks, 2017).

Recently, Kubovy (2015; 2020) described the structure of life as quasi-independent threads that occur in a concurrent and asynchronous fashion. From this "strands perspective", life events are conceived as a "deep structure", where parallel

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and independent strands carry the flow of activities and experiences. Being modular in nature, these strands can occur asynchronously, allowing multiple events to occur during a given period.

Salvucci and Taatgen (2008) take a similar approach to characterising multitasking in "threaded cognition theory". Here, one task may be left on standby while executing a new task or returning to a previous task, without losing the tasks on standby. All tasks co-occur in the same time period, but in an interdigitated way. From this perspective, engaging in more than one event is commonplace. However, neither Salvucci and Taatgen's (2008) or Kubovy's (2015) approaches have yet been incorporated into conventional theories of event cognition.

Theories of event cognition have largely maintained events as discrete and contiguous units (Radvansky & Zacks, 2017), seeing each unit as a "segment of time at a given location that an observer conceives to have a beginning and an end" (Zacks & Tversky, 2001, p3). This perspective reflects classical theories of cognitive processes, for example, James's (1981) description of conscious thought as a series of continuous processes or Barker's (1965) description of the stream of behaviour made up of distinct, qualitatively unique, and recurrent behaviour components (Barker, 1965). From this perspective, people's lives are viewed as a series of contiguous episodes, each conceived from a single activity (Kubovy, 2015; 2020).

Methodological limitations have further contributed to the assumption that events are sequential and linear. For instance, most event segmentation studies show videos of a single actor performing everyday activities such as preparing breakfast or making a bed (Boggia & Ristic, 2015; Zacks., Speer & Reynolds, 2009; Zacks, Braver, Sheridan et al., 2001; Zacks, Tversky & Iyer, 2001), while asking participants to identify the event boundaries – when each event was perceived to begin and end. Although this approach has enriched event cognition research, it cannot accommodate interruptions or overlapping events.

These methodological biases towards contiguity are not only prevalent in studies of ongoing event segmentation, but also often seen in the reconstructive event memory research where non-contiguous events have more precedent (e.g., Linton, 1986; Barsalou,1988; Kubovy, 2020). One limitation which plays a role in minimising discontinuities and privileging linear structure in participant accounts of daily occurrences is the speaker's linearisation problem (Levelt, 1981). The speaker's linearisation problem describes how people recall routines or events in a strictly sequenced fashion, and deliver them as a continuous set of events, even when many tasks overlap (Kubovy, 2015). In everyday contexts, such as reporting the days' events over dinner, the linearisation strategy may minimise memory load and maximise discourse connectivity, making it a useful means of communication but a flawed tool for memory recall. The linearisation problem also is consistent with Linton (1975,1986) and Kubovy (2020) who both note that people struggle to recall the order of events that occur between extendures or strands. These coherent noncontiguous events tend to suppress their discontinuities by their very nature. As a result, rather than focusing on the most inconsequential discontinuity, people consider and discuss the entire coherent event.

Despite the fact that these methodological and cognitive biases may render non-contiguities less visible, multitasking appears to be commonplace in everyday life. Furthermore, research suggests that multitasking is becoming more prevalent, particularly with the introduction of digital technology among young people (Zhou & Deng, 2022; Hwang, Kim, & Jeong, 2014; Carrier et al., 2009; Jeong & Fishbein, 2007; Foehr, 2006). For instance, Holme's et al study (as cited in Jeong & Fishbein, 2007) showed that nearly all audiences (over 90%) multitask with media in some manner and that roughly half of a person's daily media consumption involves multitasking. Moreover, it was observed that audiences were more likely to multitask with specific events than others, such as listening to radio when travelling or searching the internet when doing homework.

Additionally, multitasking is not only prevalent in personal contexts, but also in organisational ones. A recent study using telemetry data and a diary study found that employees frequently multitask during remote meetings by checking their email, editing documents, chatting with colleagues, and using social media (Cao, Lee et al., 2001). However, existing literature about event cognition has not examined multitasking or non-contiguous events in or outside a lab context.

This paper attempts to begin bridging the gap between theories of event cognition and potential nonlinear event structures. It focuses on participants' own everyday life rather than the presence or absence of particular activities within specific scenarios such as has been the focus for much multitasking (Zhou & Deng, 2022; Mitchell, 2022; Kokoç, 2021; Cao, Lee et al., 2001; Judd, 2013). This enables an exploration of the frequency and nature of overlapping events in daily life. Specifically, this study aims to explore how people describe their regular daily events at four different times of day, to what extent people report that they are doing multiple events at once, and the associated event sequencing.

Methods

Participants

A group of 100 participants over the age 18 were recruited from Amazon's Mechanical Turk (www.MTurk.com). Participants were compensated $15 AUD for an online Qualtrics survey that took approximately 10 minutes to complete (M=10.9 minutes, SD= 7.407). Three participants were excluded because they did not fill out the multitasking survey questions or their answers were not related to the question. For instance, they gave places instead of activities or times. Some did not specify their activities and/or their duration. The final samples included 97 participants (M(age) = 38.4 years, SD= 11.2, 39 females, 58 men). All participants gave informed consent.

Procedure

Participants were asked if they had been multitasking at four different times (9:10 am, 12:10 pm, 3:10 pm and 6:10 pm.). These times were chosen to provide a spread across the waking day and to allow for collecting a variety of daily activities. Furthermore, ten past the hour was chosen rather than right on the hour because people frequently change events right on the hour, potentially creating ambiguity in the selection of activities reported. Participants were asked to record the event(s) and their start and finish times for each time window/slot (see Figure 1). The final two questions concerned socio-demographic information such as age and gender. The survey was piloted twice, with each pilot involving 20 participants, and the subsequent version was modified in accordance with the pilot results. Minor changes were made to the survey's wording to be more explicit in asking about multitasking and time selection. Compliance was high: participants responded to 95% of the survey questions.

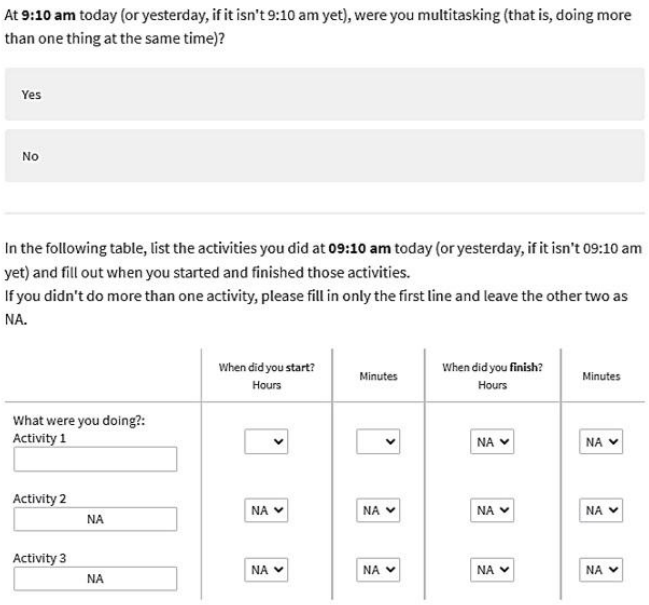

Figure 1. Multitasking survey delivered through MTurk website. Example of question that was used in this study.

Results

Multitasking and no multitasking events

Descriptive statistics showed that 45 per cent [0.40%, 0.50%] of responses were reported as multitasking across the four different times (9:10 am, 12:10 pm, 3:10 pm and 6:10 pm). Regarding the timeframe in which participants responded to the survey, 80 per cent of events were completed on the same day they occurred, whereas 20 per cent of events were completed the following day. This occurred since not all participants responded to the survey on the evening of the day the events occurred.

Similar proportions of multitasking events occurred at the four different times of day (9 a.m. and 12 p.m. 47%, 3:10 p.m. 39%, and evening 45%). A chi-square test of independence was performed to examine the proportion of events which were registered as multitasking at different times by participants. Events did not differ by morning, afternoon, and night, X2 (3, N =388) = 1.7, p = .61(see Figure 2).

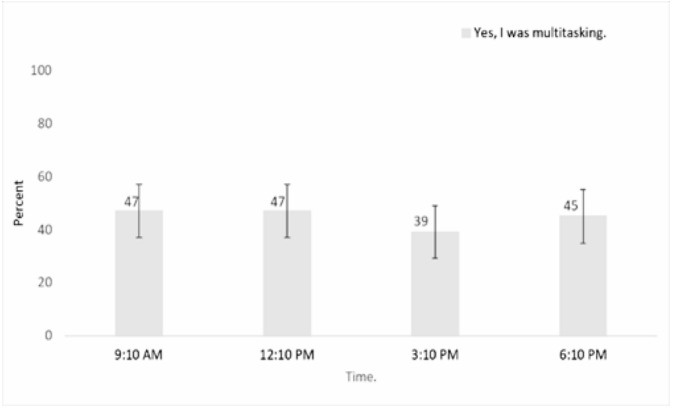

Figure 2: Bar chart with 95% confidence interval error bars of Participants' answers regarding if they were multitasking in their daily events at four different times during the day (n=97).

Multitasking events categories.

To unpack how participants perceived their multitasking events, we coded participants' responses into four categories. 1) simultaneous events, 2) sequential events, 3) mention one event, and 4) no mention of events. Descriptions for each category are given in Table 1.

Table 1: Multitasking categories.

Category	Description
Simultaneous events	Participants reported that they were engaged in two or more events at the same time.
Sequential events	Participants reported doing more than two events, but they followed each other.
One event	Participants reported only one event but reported multitasking.
No reported events	Participants reported multitasking, but they did not write any events.

However, not all of these tasks meet the requirements for classification as multitasking. To calculate a second estimate of the proportion of multitasking activities, only simultaneous events were considered. Twenty-one per cent [0.17%, 0.25%] of reported events co-occurred.

A chi-square test showed no significant differences in the proportions of multitasking categories across times, (X2 (3, N=147) = 6.7, p = 0.081) (see Figure 3). Regarding the 'no event' category, we retained responses in which participants did not mention any events because they registered one or more activities in responses to other time points.

The 'simultaneous events' category (46%) was registered as multitasking more frequently than the other three categories (5% of sequential events, 43% of one event, and 6% of no mention events). It was also observed that audiences were more likely to multitask with specific events than others, such as eating and watching television or cooking and conversing over the phone.

The examples below illustrate how concurrent events have distinct duration, overlaps, and event number structures.

The first participant ate and exercised while dancing. Despite the difficulty in determining when one event took precedence over another, this example demonstrates that some events occurred in the background while others took centre stage (see Table 2). In addition, we can observe that two events (eating and exercising) occur simultaneously during a lengthy event (dancing).

Also, it was observed that more than two events could co-occur. For instance, participant six ate, fed a baby, and watched TV (see Table 2), and all event durations had close starting and ending points in the simultaneous category. Another observed pattern was a brief event occurring within a long event. For example, subject seven checked their email for 10 minutes while drinking coffee for an hour (see Table 2).

The last pattern in this category showed that even though there were overlapped events, sometimes only one event occurred and left the others on standby, allowing participants to execute the next step in each micro-event. Still, they could start with a new event and pause or return and resume the previous events. For example, participant five had breakfast while browsing, checking their bills, and then continued browsing until 10 am (see Table 2).

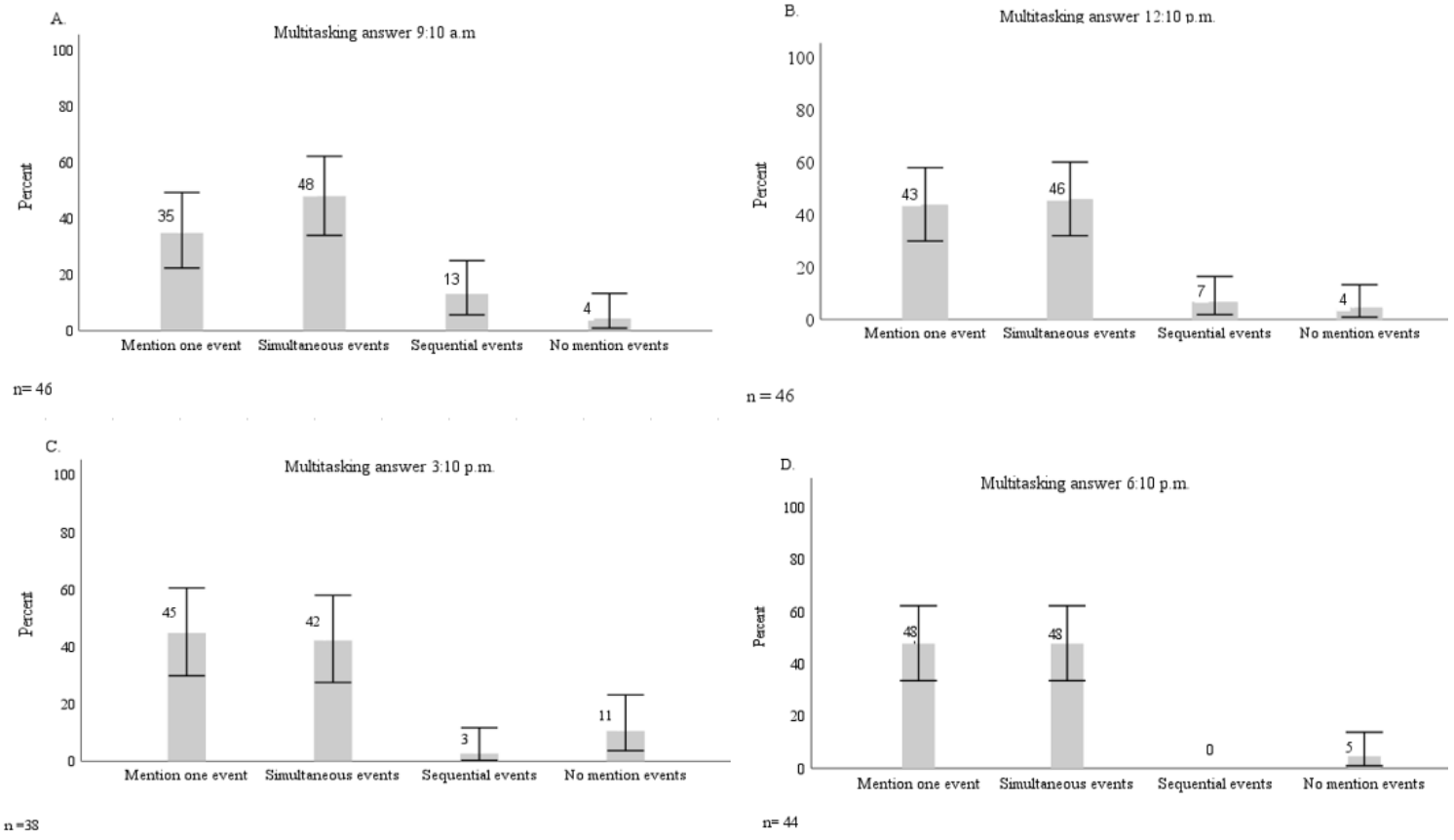

Figure 3: Bar graphs (mean scores with 95% confidence intervals) of each frame time illustrate the multitasking distribution answer in four different categories. Figure 3A shows the multitasking distribution of activities occurring before 9:10 am; the sample size was 46 events, 3B represents activities that happened before 12:10 pm, the sample size was 46 events. Figure 3C depicts multitasking answers of events that occurred before 3:10 pm; the sample was 38, and figure 3D reports the multitasking distribution before 6:10 pm; the sample was 44.

Table 2: Example participants' answers regarding “simultaneous events” category at 9:10 a.m.

Participants	Event 1				Event 2				Event 3			
	Event	Start time	Finish time	Event duration	Event	Start time	Finish time	Event duration	Event	Start time	Finish time	Event duration
1	Eating	8:05	8:45	0:40	Exercise	6:20	7:50	1:30	Dancing	6:42	8:50	2:08
2	Cooking breakfast	9:13	9:38	0:25	Checking and responding to emails.	9:20	9:57	0:37	-	-	-	-
3	Making breakfast	9:10	9:30	0:20	Talking on phone	9:10	9:40	0:30	-	-	-	-
4	Eating	8:40	9:05	0:25	Watching television	8:52	9:15	0:23	-	-	-	-
5	Browsing	9:12	10:00	1:12	Breakfast	9:30	9:45	0:15	Checking bills	9:40	9:55	0:15
6	Eating breakfast	9:00	10:00	1:00	Feeding baby	9:00	10:13	0:13	Watching tv	9:00	9:30	0:30
7	Drinking coffee	9:00	10:00	1:00	Checking emails	9:05	9:15	0:10	-	-	-	-
8	Email	9:00	9:45	0:45	Cooking	9:00	9:15	0:15	-	-	-	-

Table 3 shows participants' responses to multitasking in the ‘one event’ category. Events in this category were described at a coarse-grained level. For instance, checking office emails may involve smaller tasks such as reading, writing, opening a different browser, and searching through information. Additionally, pattern duration here was more extended than in other categories; it shows that some events lasted more than 2 hours (see Table 3, first participant and last participant).

Although participants reported less in the sequential category, we found that the sequential category events were mutually exclusive. For instance, Table 4 showed that the first participant reported "cooking" as the first event, "ready for the office" as the second, and the third event was "driving a car". All of the events were not overlapped and represented a general morning routine. Regarding duration patterns, most of those events took less than an hour.

Table 3: Example Participants' answers regarding the “One event” category at 3:10 am.

Time: 3:10 PM				
Participant	Event	Start time	Finish time	Event Duration
1	Working on computer	5:00	8:50	3:50
2	Business on computer	3:00	6:55	3:55
3	Submit office report	3:00	4:00	1:00
4	Mails	3:10	3:50	0:40
5	Working	3:00	4:00	1:00
6	Coding	4:00	6:46	2:46
7	Project Completion work	3:10	7:00	4:10

Table 4: Example Participants' answers regarding “sequential events” category at 9:10 am.

Participants	Event 1				Event 2				Event 3			
	Event	Start time	Finish time	Event duration	Event	Start time	Finish time	Event duration	Event	Start time	Finish time	Event duration
1	Cooking	8:15	9:30	1:15	Ready to office	9:30	10:10	0:40	Drive a car	10:15	11:00	0:45
2	Brach the teeth	9:11	9:15	0:04	Cleaning bathroom	9:15	9:25	0:10	-	-	-	-
3	Breakfast	9:10	9:20	0:20	Ready of office	9:20	9:40	0:20	-	-	-	-
4	Exercising	9:30	9:50	0:20	Project work	10:10	10:40	0: 30	Project meeting	11:00	11:59	0:59

Discussion

These findings suggest that everyday events frequently overlap one another, consistent with theoretical proposals that daily life includes nonlinear and discontinuous events (Kubovy, 2015). Participants reported multitasking 45% of the time, and specifically described being simultaneously engaged in two or more events 21% of the time. Differences between reported multitasking and enumeration of multiple events could be due to the replies reflecting the respondents' impressions of their own multitasking experiences rather than their actual multitasking behaviours (Carrier et al., 2009).

An alternative possibility is that participants were multitasking at one given temporal grain–for example, frying eggs while drinking coffee–but only reported their activity on a coarser temporal grain–for example, having breakfast (Zacks, 2004). This description fits with our curious finding that some participants reported multitasking while completing a single (coarse-grained) event. Indeed, we observed extended single-event durations (one- to four-hours), further supporting a theoretical overarching event comprised of many smaller tasks that may be completed simultaneously (Koch, Poljac, Müller & Kiesel, 2018; Rogers & Monsell, 1995).

Participants provided information about multiple events with overlapping time frames. The 'simultaneous events' category was the predominant form of multitasking in three periods (Figures 3A, B and D). Within this category, some combinations of events were more frequent than others (Cao, Lee et al., 2001; Jeong & Fishbein, 2007). For instance, eating and watching TV or drinking coffee and checking email (see Table 2). This may result from some tasks requiring less attentional resources due to task difficulty, the task's independence, the compatibility of tasks, and previous experience with the tasks (Jeong & Fishbein, 2007; Navon & Gopher, 1979). Additionally, the 'simultaneous event' category durations were also observed to be brief, lasting no more than an hour.

The third way participants reported multitasking events was when events happened one after the other; these were called ‘sequential events’. Participants reported different activities that could not be completed at the same time. The percentage of this category was lower than others and included recurring events (e.g., cooking, getting ready for the office, driving). However, it is essential to note that sequential events are not truly multitasking (Judd, 2013). This apparent inaccuracy on the part of some participants may also be owing to different representations of the notion of multitasking, a finding shared by other studies (e.g., Carrier et al., 2009).

When daily events are studied from an ecological context, we show that people regularly perceive themselves to be multitasking in their daily lives and that there is such heterogeneity in how people report these events Our findings underscore the need for multitasking behaviours to be incorporated into event cognition theories due to their ubiquity and variety in everyday life.

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