The Role of Temporal Landmarks in Autobiographical Memory Processes

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The prevalence of temporal landmarks has been revealed in a wide range of tasks associated with autobiographical memory, such as recall and dating of personal events. The author examined 3 types of events that have usually been considered landmarks: flashbulb memories, 1st experiences, and reference points in personal histories. The differences between landmark events and nonlandmark events are considered, and evidence is presented showing the effect of these landmarks on memory tasks. It is suggested that the effect of temporal landmarks on these tasks is twofold: (a) performance on the tasks is intricately linked with how our autobiographical memory system is structured, and temporal landmarks may play a critical role in this organization; and (b) landmarks may be actively and spontaneously used by individuals as cues when performing recall and dating tasks (the cuing hypothesis). Both of these factors serve to systematically bias performance, leading to robust phenomena such as calendar effects and reminiscence peaks in recall and improvements in accuracy in dating.

We all have special periods of time in our lives. These periods emerge from and stand in marked contrast to the seemingly unending stream of trivial and ordinary occurrences that happen to us everyday, much like a figure in a photograph stands out from the background. A virtually infinite number of these normal and insignificant events occur in our lives daily, and most are quickly forgotten. Special periods of time, however, are not simply those memories that are not forgotten; in addition to being retained in autobiographical memory like other memorized events, they act as organizing principles for these other events. I have chosen to call periods of time that serve this dual role temporal landmarks, and they can be characterized as follows:

1. Temporal landmarks serve a passive role in that they themselves are events and occurrences stored in autobiographical memory. The manner in which encoding of these landmarks differ from that of other stored memories is considered later.

2. Temporal landmarks serve an active role in organizing autobiographical memory. The effects of these landmarks can be seen in the encoding of new memories, the consolidation and reconstruction of stored memories, and the retrieval of old memories.

This article examines evidence of the prevalence of these landmarks in autobiographical memory research, and, more specifically, their role in memory processes. The overall goal of the article is to describe how such landmarks may drive the structure and organization of our memories. To this end, the article is partitioned into six main sections. First, I present a brief historical overview of research involving temporal landmarks. In the second section of the article, I outline three qualitatively different events or occurrences that have been considered in the literature to act as temporal landmarks: vivid public events (flashbulb memories), vivid personal events ("first experiences"), and reference points in calendars. Included in this section are data from questionnaires that directly asked students for the landmarks in their lives. I then describe evidence of such landmarks in the access to and retrieval from autobiographical memory. In the fourth section, I discuss explanations that have been offered for these findings and attempt to dissociate the effects of landmarks during the memory processes of encoding and storage versus retrieval. The fifth section involves the effects of landmarks on dating accuracy, a current hot topic for memory and survey researchers. Finally, I discuss several proposed models of autobiographical memory that have used the notion of temporal landmarks.

A Brief History

Reference Points

The idea that temporal landmarks are represented in memory differently from "regular" events is not a new one. Over a century ago in his book Diseases of Memory, Ribot (1882, as cited in Conway, 1990) conceived of autobiographical memory as consisting of reference-points, which he defined as "events, states of consciousness, whose position in time we know" (p. 18). Moreover, he proposed an active role of these reference-points in retrieval:

Reference points are not arbitrarily chosen; they obtrude upon us. Their value is entirely relative . . . They have as a general thing, a distinct individuality; some of them, however, are common to a family, a society, or a nation. These reference-points form for each of us different series corresponding to the events that make up our life: daily occupations, domestic incidents, professional work, scientific investigations, etc., the series becoming more numerous as the life of the individual is more varied. These reference-points are like the mile-stones or guide-posts placed along the route, which, starting from a central place, diverge in different directions. (p. 18)
According to Ribot, reference-points serve to make retrieval an efficient process by localizing events in memory on the basis of these landmarks. By locating these reference-points, one instantly accesses all associated (local) memories; in a sense, reference-points reduce the number of memories that need to be searched during retrieval. This active role delineated for temporal landmarks by Ribot is very similar to recent proposals by memory researchers (e.g., Kurbat, Shevell, & Rips, 1998; Robinson, 1986). In addition, Ribot mentioned two ideas that appear repeatedly over the course of this article: Temporal landmarks can be both personally idiosyncratic ("distinctly individual") and culturally shared. This is an important notion in the section in which I discuss what memories qualify as temporal landmarks. I now turn to a more explicit discussion of how such reference-point landmarks may mediate organization of our memories through personal reference systems, a modification of Ribot's original notions that appeared almost a century later.

**Personal Reference Systems**

Tulving (1972) was the first to define autobiographical memory (what he called episodic memory) as a distinct memory system in and of itself. He characterized episodic memory as possessing two features, one functional and one structural. First, episodic memory "stores information about temporally dated episodes or events, and temporal spatial relations among these events" (p. 385). Second, events in episodic memory are "always stored in terms of autobiographical reference to the already existing contents of the episodic memory store... . A person's episodic memories are located in and refer to his own personal past" (p. 385–386). This latter feature strongly emphasizes the fact that the entry of events into memory is influenced by what is already in memory; moreover, events are encoded in terms of individually idiosyncratic "personal pasts," structures that Tulving (1983) termed personal reference systems. These personal reference systems, as the name suggests, are distinct to an individual, represent personal knowledge and information, and serve as frameworks in which events are stored in autobiographical memory, much like schemata and scripts organize knowledge about stereotypical events and activities (i.e., Bartlett, 1932/1964; Schank & Abelson, 1977).

Personal reference systems provide the organizing principles by which otherwise disparate events in memory are structured (i.e., Kolodner, 1983). Autobiographical memory is, then, apart from its component events, personally distinctive in the sense that its organization is dependent on the particular collection of reference systems owned by a person; that is, every possible reference system is unique to the individual who possesses it, because even stereotypical reference systems by definition must be created and modified through one's own personal experience. For example, although two people may share a script for a highly typical event such as "going to a restaurant," the actions that make up those scripts may differ considerably across the two individuals. The idea of reference systems does not have to be restricted to these sorts of structures that may be culturally or socially shared. In fact, what may serve more significant roles in organizing autobiographical memory are those structures that are personally idiosyncratic.

**Spatial and Temporal Landmarks**

Before one examines what kinds of events are typically landmarks, it is important to note that use of the term landmarks to describe those events that seem outstanding in our lives is not accidental. In fact, the choice of this term seems especially appropriate, perhaps because the analogy between landmark memories and their spatial brethren possesses a number of striking similarities. There are two such parallels that are essential to our thesis: the first is in regards to the origin of spatial landmarks, and the second concerns how people may use landmarks as aids. Each of these is discussed in turn.

1. As described by Lynch (1960), spatial landmarks all have some aspect or factor that makes them singular, unique, or memorable. He suggests figure–background contrast as the principal factor, although this may be more definitional than explanatory. Lynch proposed that "once a history... or a meaning attaches to an object, its value as a landmark rises" (p. 81). Temporal landmarks similarly arise as a result of entrenchment in personal reference systems or life themes, and those events that are assigned to personal narratives have a greater probability of becoming landmarks.

2. Sadalla, Burroughs, and Staplin (1980) suggested that spatial landmarks (or "reference points"), because of their high salience to subjects, serve as "anchors" by which spatial knowledge of a location is organized, in that the representations of a region or area rely more heavily on the reference point than on other locations. For example, these anchoring landmarks have been shown to be represented more accurately than other points (Ferguson & Hegarty, 1994) and to be more useful when determining the location of other landmarks (Couclelis, Golledge, Gale, & Tobler, 1987). It is useful to keep this set of findings in mind as I discuss how landmarks may drive biases in autobiographical memory tasks in the second half of this article.

Both points that are borrowed from the spatial landmark literature are also telling for temporal landmarks. For example, one of the main proposals of this article is that personal reference systems comprise to a large extent the temporal landmarks I have mentioned earlier; that is, the landmarks in our memory provide the structure for the rest of our personal events and experiences, much like the location of less important buildings may be encoded in terms of their relationship with more important ones. Obviously, these personal reference systems differ between individuals, because no two people share exactly the same set of temporal landmarks; moreover, certain landmarks may be more salient for one kind of person than another. How these landmarks serve to frame memory determine in what way we perceive of our memories. Because temporal landmarks may play such a central role in the structure and organization of autobiographical memory, it is important to be clear about exactly what kinds of events are temporal landmarks. This is the subject I now address.

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1 Although Tulving (1983) intended for the two terms to be synonymous, see Larsen (1992) for discussion of how autobiographical memory may be a subset of episodic memory rather than a functional equivalent, and see Conway (1990) for the opposite view.
Types of Temporal Landmarks

As mentioned in the introduction, there have been three basic types of memories that have received attention as being possible candidates for temporal landmarks: (a) public events, or flashbulb memories; (b) personal events, especially "first" experiences; and (c) reference points in calendars. This last type is discussed in the context of extended events and lifetime periods.

Flashbulb Memories

R. Brown and Kulik's (1977) seminal study regarding people's remembrances of the circumstances of assassinations and other major public events spurred an incredible amount of subsequent research concerning very vivid public events (see Conway, 1995, for a review). These types of events were called flashbulb memories because the event itself and insignificant details surrounding it seemed to be preserved in strict veridical fashion in autobiographical memory, much like a photograph preserves indiscriminately both the subject and the background of the picture. The methodology of their experiment was quite simple: Brown and Kulik chose 10 major events (including the oft-used example of the assassination of President John F. Kennedy) and asked individuals whether they recalled the circumstances in which they first heard of the event; respondents then wrote down accounts of these circumstances, rated the consequentiality of the event on their own lives, and estimated how many times they had talked about the event previously. Their principal findings were that consequentiality, number of rehearsals, and elaborateness of the memory as measured by length of response were all highly correlated. Moreover, on the basis of the elaborate perceptual detail in the responses, Brown and Kulik concluded that flashbulb memories were qualitatively different from regular autobiographical memories and that this difference occurred at encoding. They invoked the concept of an evolutionarily old encoding mechanism from neuroanatomist Livingston termed "Now Print!" that is responsible for taking a mental "snapshot" of our surroundings when we are in a state of shock or surprise; thus, the event is preserved perfectly in memory, complete with the circumstances around it.

R. Brown and Kulik's (1977) conclusion that flashbulb memories are completely veridical snapshots is problematic and came under heavy fire in the 1980s. Neisser (1982) argued that flashbulb memories were in fact not veridical records of the original events (see Neisser & Harsch, 1992, for evidence that some flashbulb memories may be confabulations). Neisser and others (e.g., McCloskey, Cohen, & Wible, 1988) suggested that there was no qualitative difference between regular events and flashbulb memories and that it was not necessary to propose a special encoding mechanism like "Now Print!" to account for the differences between these types of events. In fact, there is evidence in the Brown and Kulik study itself that supports the notion that flashbulb memories do not differ from regular events in terms of encoding. As mentioned in the previous paragraph, both rated consequentiality and number of rehearsals of the event were highly related to whether events were flashbulb memories or not. Brown and Kulik proposed that the "Now Print!" mechanism fires when individuals experience a consequential event, but this probably is not the case as consequentiality as a rating is a retrospective measure; that is, individuals usually do not know at the time of encoding that an event will be of importance or consequence to them later (with obvious exceptions such as the death of a family member). In fact, those events that seem initially consequential often become trivial over time. For example, at the moment I was first driving a car alone, I probably felt that it was a nerve-wracking experience as well as an important step in my becoming an adult. However, at this point in time, I cannot recall any of the circumstances of that incident.

Despite the significant relationship between rehearsals and elaborateness of response that they found, R. Brown and Kulik (1977) chose to say that rehearsals had no effect on flashbulb memories. In other words, repeated retrievals of flashbulb memories result in the same or similar responses each time a memory is retrieved. This hypothesis is dubious at best considering what is known about the effect of schema on memory (i.e., Bartlett, 1932/1964). A more reasonable assumption is that the more an event is rehearsed, the more elaborated that event's properties in memory. The major thrust of Neisser's response was that flashbulb memories do not differ qualitatively from ordinary memories in terms of encoding. The elaborateness of flashbulb memories arise from repeated retrievals of the event. It is interesting that Neisser (1982) chose not to implicate consequentiality or emotionality of the event as reasons as to why the events were subject to more rehearsals. There are problems with his conclusion as well.

Pillemer (1984) ran a study similar to Brown and Kulik's design in which individuals were asked for their memories regarding the assassination attempt on President Ronald Reagan. They were also asked to rate the consequentiality, emotionality, and the number of rehearsals of the event. Although most had flashbulb memories of the event (i.e., the descriptions met the criterion for flashbulb memories that R. Brown and Kulik, 1977, had earlier proposed), there was no effect of consequentiality or number of rehearsals. Individuals rated the event as low in consequentiality and said that rarely if ever had retrieved the event before being asked to in the experiment itself. However, they rated the event as highly emotional. These results throw into question Brown and Kulik's notion that consequentiality is important for an event to be encoded as a flashbulb memory; moreover, unlike Neisser's conclusions, they suggested that rehearsal does not play a major role in the formation of these memories but that emotionality does. However, this conclusion itself has not gone without rejoinder. For example, Christianson (1989) found that emotionality and surprisingness had no effect on how accurate individuals were in recounting the assassination of Swedish Prime Minister Olof Palme.

Other researchers, though, have compromised, finding it necessary to implicate both encoding factors (e.g., emotionality, surprisingness, consequentiality) and number of rehearsals in the formation of flashbulb memories. Bohannon (1988; Bohannon & Symons, 1992) has conducted a series of longitudinal studies analyzing reports of the Challenger explosion and found that accuracy of the reports were directly related to both emotionality and number of rehearsals. Similarly, Conway et al. (1994) proposed a model of formation of flashbulb memories formulated on three encoding factors (prior knowledge, importance, and affect) and one postencoding factor (rehearsal—elab-
In general, there seems to be little agreement regarding whether flashbulb memories truly exist, and, if so, the factors that lead to their creation. The one commonality across the experiments is that a singular public event assumed to be the type that produces flashbulb memories is preselected by the experimenters and subsequently used to cue memories. That the findings mentioned in this section are so disparate raises the question of whether these public events are the main types of events about which people have flashbulb memories. A more reasonable experiment would elicit individuals' own flashbulb memories, rather than cueing them with major public events.

**Personal Events**

Rubin and Kozin (1984) did just that. They asked undergraduates to recall three flashbulb memories and to rate the national importance, personal importance, level of surprise, consequentiality, vividness, and emotionality associated with each event. Their most important finding was that individuals recalled hardly any public events (such as assassinations) at all: Less than 5% of all elicited events were rated as being nationally important. In addition, surprise was not a major effect, further damaging R. Brown and Kulik's (1977) hypothesis that there is a specialized mechanism for encoding surprising events. Like Pillemer (1984), Rubin and Kozin found no effect for consequentiality or number of rehearsals; unlike Pillemer, there was also no major effect of rated emotionality. In fact, the two most telling measures were personal importance and vividness. The latter measure is an aspect of the memory itself; that is, flashbulb memories by definition are highly vivid. However, the fact that individuals rated more than 70% of the events as being above average in personal importance suggests that these salient personal events (and not public ones) are the usual types of experiences that stand out in autobiographical memory.

**First experiences.** The question is, then, what characterizes personal events that become temporal landmarks? In a passage strangely reminiscent of Miller's (1956) classic treatise concerning his persecution by a "magic number," Robinson (1992) described just such a type of event:

> I have become an anthologist in recent years captured by a class of memories which keep turning up. Like an unfamiliar word which seems to pop out everywhere after it has been learned, I have become sensitized to memories of first experiences [italics added] in newspaper articles, personal reminiscences, movies, and novels. The variety of these memories intrigued me and I tried to account for them in terms of theories of autobiographical memory. (p. 223)

Robinson went on to propose two possible ways to conceive of first experience memories as being different from regular memories. The first is a categorical approach in which first experience memories play the privileged role of being the initial exemplars in the formation of an event category. Subsequent events of the same type are stored in memory only in terms of how they differ from this initial memory. Similarly, Conway (1990) wrote:

> Memories of first-time experiences form the basis of more complex schematic knowledge structures which will eventually be constructed in memory as similar events are experienced. As such first time-events are enshrined in a knowledge structure and so are highly accessible, other memories, less directly associated with organizing knowledge structures, may be less available or only retrievable under special circumstances. (pp. 91–92)

This kind of approach is problematic, because any distinctive event can be considered a first experience depending on the specificity of the category of which the event is an exemplar. For example, a typical first experience such as "first kiss" could be the initial exemplar in any arbitrary number of categories ranging from the plausible ("kisses," "kisses with X") to the outlandish ("kisses with X on September 19," "kisses in a movie theater in 1996"). Moreover, any mundane event (e.g., "brushing my teeth this morning") can be construed as a "first" experience (e.g., "First time brushing my teeth on September 19"). Where does one draw the line in terms of formation of new event categories? This question has remained relatively unanswered, although there have been attempts proposing a privileged "basic level" for event categories like that for object categories (e.g., Morris & Murphy, 1990; Rosch, 1976). The hypothesis that an intrinsic link exists between first experiences and event categories, however, has not yet been addressed empirically.

**Personal histories.** Despite conceding that the categorical approach was important, Robinson (1992) chose instead to focus his attention on personal histories, "primary forms of organization in autobiographical memory . . . (that) organize temporally distributed experience into thematically-related 'streams'" (p. 223). He believed that first experience memories were the fundamental elements of personal histories, and thus crucial to the organization of autobiographical memory. In his article, Robinson examined one particular type of personal history, that of personal relationships. He felt that this type was a canonical example of personal histories much like "going to a restaurant" is for scripts, because memories regarding relationships primarily consisted of first experiences: the first kiss, the first sexual episode, the first argument, the first holiday spent together, and so on. Especially important in such accounts is the first meeting between the two parties. Robinson pointed to these initial meetings as examples of first experiences being "first" only in retrospect. Events are not automatically encoded as "firsts" and only gain this designation as they become important and are rehearsed repeatedly over time. Robinson proposed four functions for why individuals tend to rehearse these first meetings and reminisce about them with partners and other people:

1. First meetings formally distinguish the relationship from others and link it contextually with concurrent "streams" in the partners' separate histories.
2. They provide reference points for assessing the current status and meaning of a relationship.
3. They are used to link past and present into a coherent, continuous story.
4. Rehearsing these memories is a prospective activity, a projection of a hoped-for future that continues present intimacy. (pp. 229–230)

These functions of establishing context, providing reference points, and linking the past, present, and prospective future are
not specific to personal relationships; rather, they are characteristics of salient first experiences in all personal histories.

**Calendars and Lifetime Periods**

As stated in the previous section, there have been a number of suggestions to the effect that event categories are similar to object categories in that the structure of event categories is hierarchical (e.g., Riefkin, 1985) and that there is a privileged "basic level" for processing that individuals prefer to describe events at (e.g., Morris & Murphy, 1990; Rosch, 1976). For example, "brushing one's teeth" can be described at a subordinate ("brushing one's teeth with Crest toothpaste") or superordinate ("a hygienic act") level. Although much of the categorical approach has concentrated on events in taxonomic hierarchies, there are other ways to conceive of the structure of events. It may be possible that events are also structured in terms of partonomic hierarchies, where the relationships between subordinate and superordinate levels consist of "is-a-part-of" links rather than "is-a-kind-of" ones. For the previously mentioned example, "moving one's hand back and forth" is a part of "brushing one's teeth" and a part of "getting ready in the morning." Some researchers have adopted this way of looking at superordinate event categories as single, "large-scale" events composed of parts that are events themselves.

For example, Neisser (1986) has proposed that autobiographical memory is composed of these "nested levels of experiences" that are increasingly molar as one moves upward in the memory structure and increasingly molecular as one moves downward. Using Barsalou's (1988) terminology, events become extended as one scales the hierarchy. Extended events, then, are abstract periods of time that collect events that possess the same "theme." Using Robinson's example, all events having to do with relationships with X (including first experiences) fall under the umbrella of the extended event "My Relationship with X." Extended events are demarcated by salient specific items such as first experiences; the beginning of "My Relationship with X." In this sense, Robinson's personal histories may be considered a subset of Barsalou's extended events.

Conway and Bekerian (1987) proposed a similar concept to extended events, which they called *lifetime periods*, defined as general periods of time that have "marked beginnings and endings, and represent events which have some common theme" (Conway, 1990, p. 115). Their examples include "when I was an undergraduate," and "when I was in sixth form." Like Robinson's personal histories, extended events and lifetime periods represent general events at a very abstract level in the hierarchy, which have as subordinates events that are related by a common theme. Salient temporal markers in extended events can be internally (personally) imposed, as in Robinson's example of personal relationships. They can also be externally (socially or culturally) imposed, as is the case when the event involves timetables or deadlines such as in academics, religion, work, sports seasons, or holidays (e.g., Robinson, 1986). Whereas first experiences serve as temporal landmarks for personal histories, the dates in these externally instituted calendars serve as temporal landmarks for general extended events. In other words, a college student demarcates the extended event of "My Sophomore Year" with the landmarks "Beginning of first semester," "End of first semester," and so on. Because memory is hierarchical, as extended events become more abstract, so do their temporal landmarks. For example, if the student were to instead think back on "My High School Years," his or her salient markers would probably include "Beginning of Freshman Year," "End of Freshman Year," and so on. This suggests that the salience of particular sets of temporal landmarks in a recall task may depend on the specific cue given for retrieval. Compelling studies that students do indeed break up their school year(s) in this manner are presented in a subsequent section.

**Summary**

Three main types of possible temporal landmarks have been discussed: vivid public events, vivid personal events, and calendar reference points. Although the first of these three is the one that has received the most study, it is probably the least important, at least in terms of frequency of mention (Rubin & Kozin, 1984). Evidence as to the qualities of such an event that make it memorable are still equivocal but may be uninteresting considering that more often than not, these major public events are not the type of events that are recalled by individuals in response to free recall or Galton-type cues. Rather, they tend to recall events that are personally rather than publicly important. Many of these events are first experiences of the type defined by Robinson (1992). Finally, reference points from externally instituted calendars may serve as temporal landmarks, because they represent the most salient points in time in the personal histories that define us as individuals and members of a particular culture (i.e., occupation, religion, pastimes, etc.).

To reiterate, then, temporal landmarks in a person's memory are events that are (a) ones in which the person was personally involved, (b) events that are of great personal importance to the person, and (c) events that act as points of reference in the personal histories of the person. One can see that public "flashbulb"-type memories fail on all three accounts, so I subsequently consider only vivid personal events and calendar reference points as possible temporal landmarks.

**What Are the Landmarks in One's Life?**

It is interesting to note that no one has ever asked individuals directly for the landmarks in their lives. Rubin and Kozin (1984) probably came closest, although they worded their question to ask for the most "vivid" events for study participants. To ensure that the events considered to be landmarks were indeed of the types that were mentioned in the previous section, I ran two pilot studies in which groups of Introductory Psychology students (primarily freshmen) were administered questionnaires that asked them to list a number of landmarks from the previous year (Shum, 1997, as cited in Tourangeau, Rips, & Rasinski, in press). Each participant was asked to list from four to five landmarks, and their responses were compiled and tabulated. The most frequently mentioned events are listed in Table 1.

All the frequently reported events meet the three "requirements" for landmarks mentioned in the previous paragraph, in that they all personally involve the participant, are important events, and are significant points of reference in life themes,
The first involves reaction time studies using landmarks as cues, which usually show that cues containing temporal information elicit events quicker than cues that represent just general activities. The second involves cued recall of memories from the lives of older individuals, a paradigm I call long-term sampling. The third line of research is short-term sampling, which involves cued or free recall of events from a limited and specified period of time. Both long-term and short-term sampling studies have resulted in findings that violate a null hypothesis called the equal-sampling hypothesis (Conway, 1990), the idea that during recall experiments, individuals sample events from each period of their lives equally.

### Reaction Time Studies

Reiser, Black, and Abelson (1985) presented individuals with different cues and measured how fast they were in retrieving an event from autobiographical memory. Two main types of cues were used: activities and actions. Activities were script-type headers such as “going to a movie.” Actions were items that could be components of different scripts, such as “buying a ticket.” Cues were presented in pairs, with either an activity cue first and then an action cue, or vice versa. They found that individuals responded more quickly with an event when they were presented with an activity–action cue rather than an action–activity cue. This finding was used as evidence to support the activity-dominance hypothesis (i.e., Barsalou, 1988) that script-type activities are the primary way in which autobiographical memory is organized (see Kolodner, 1983). Unfortunately, Reiser et al. did not use as cues anything other than activities and actions.

Conway and Bekerian (1987) used Reiser et al.’s (1985) design to provide evidence that activities may not be privileged cues after all. In addition to using the same types of cues as Reiser et al. (1985), Conway and Bekerian also elicited from individuals salient lifetime periods and presented these as cues. They found that priming initially with a lifetime period and then an action resulted in faster times than priming with an activity and then an action. They argued that the priming effect found in Reiser et al. was due to individuals being able to access a relevant lifetime period easier when cued with an activity initially rather than an action and thus was not a result of the activity cue itself. Further evidence against the activity dominance hypothesis was offered in a related study by Barsalou (1988), who cued individuals with participant, activity, location, and time; he found that when measured under a time deadline, they retrieved the least number of events to activity cues as compared to the other three types of cues. Rather than being organized around activities, then, Conway and Bekerian argued that autobiographical memory is structured by lifetime periods. Similarly, Lipman, Caplan, Schooler, and Lee (1995) demonstrated that their older individuals recalled more life events when given cues in a temporal period (year)-event category (activity) order than they did when given an activity-year order.

In general, then, it seems that Kolodner’s (1983) model has to be at least amended to account for some organizing temporal component of autobiographical memory. I address in a subsequent section alternatives to Kolodner’s model that are predicated on situating autobiographical events in a temporal context.

### Table 1

**Landmark Events Most Frequently Reported by Two Groups of Northwestern University Students**

<table>
<thead>
<tr>
<th>Event</th>
<th>% students reporting event as landmark SEP</th>
<th>% students reporting event as landmark JAN</th>
<th>Ranked frequency of report</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school graduation</td>
<td>55</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>Acceptance at Northwestern</td>
<td>30</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>Went on a vacation</td>
<td>21</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Birthday</td>
<td>20</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Left home for Northwestern</td>
<td>19</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>High school prom</td>
<td>16</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>First day or night at Northwestern</td>
<td>15</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>Broke up with significant other</td>
<td>13</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Arrived at Northwestern</td>
<td>11</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Moved in to Northwestern</td>
<td>9</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Events in JAN Top 10

<table>
<thead>
<tr>
<th>Event</th>
<th>Rank</th>
<th>% students reporting event as landmark SEP</th>
<th>% students reporting event as landmark JAN</th>
<th>Ranked frequency of report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death of relation or friend</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Met significant other</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Note. Two hundred fifty-five students answered the questionnaire in September at the beginning of the school year (SEP), and 262 answered the questionnaire after they had completed a quarter of study (JAN). Differences are those that can be expected from administering the questionnaire at different times of the year (i.e., less mention of high school events and more mention of college-related events).

### Evidence of Landmarks in Access to Autobiographical Memory

Three lines of research suggest that temporal landmarks may mediate access to and retrieval from autobiographical memory. The first involves reaction time studies using landmarks as cues, specifically academic and relationship-based ones. The picture painted by the responses indicates that the academic theme is particularly important to our participants at this point in their lives, which is not surprising considering the questionnaire was administered during the first week of their classes at Northwestern. One can see that the listed events include those that are predictable based on a calendar (e.g., Birthday, Prom, Graduation), and those which are less predictable (e.g., Broke up with significant other, Accepted to Northwestern, Death of a friend). It is important to keep this delineation between predictable and unpredictable events in mind, because it is a basis for classifying landmarks later in this article.

In addition, several first experiences are on the list, including “First day at Northwestern” and “Met significant other (for first time).” Finally, in support of Rubin and Kozin (1984), only 2 out of over 1,300 responses were of public events in which the individual was not personally involved, suggesting that indeed public events do not belong in a discussion of temporal landmarks. I now turn to evidence that these kinds of personal landmark events play a crucial role when accessing autobiographical memory.
**Equal-Sampling Hypothesis**

Before I examine data from experiments that have sampled events from participants' lifetimes, it may be useful to mention Conway's (1990) equal-sampling hypothesis. This null hypothesis is based on two assumptions: an equal number of memories are encoded in each period of a person's life, and a person when recalling memories samples from each of these periods equally. The equal-sampling hypothesis predicts that the distribution of memories recalled across a lifetime is flat; any peaks or troughs in recall violate this and call into question the validity of the second assumption. If individuals do not sample from each period of life equally, do they at least sample from each period in a systematically different fashion? The answer is yes, and this violation of the equal sampling hypothesis may reflect in some sense the underlying structure of autobiographical memory.

**Long-term sampling.** Long-term sampling typically involves administering Galton–Crovitz type cues to older individuals (usually 50 years of age or older) and asking them to recall memories from any time in their lives. They are then asked to go back and date their events. A distribution plot of frequency of the elicited memories by age of the memories gives an indication of how many were recalled from each period in their lives. Rubin, Wetzler, and Nebes (1986) reviewed a decade of research using this long-term sampling technique and found that despite a number of methodological differences (including type of cues used), the experiments in general showed very similar trends. Figure 1 shows the typical overall recall distribution curve for "older" individuals (Rubin et al., 1986; see Rubin & Schulkind, 1997, for a similar figure). As one can see from the graph, there are very powerful recency effects in these types of experiments. Moreover, there is a reminiscence peak for memories in the second and third decades of life.2

I propose to explain this violation of the equal-sampling hypothesis by invoking the notion that there are more temporal landmarks during this period of life than any other. Because retrieval from autobiographical memory is mediated by these landmarks, the distribution of recall actually reflects the distribution of the landmarks. Most of the personally important events in life occur in the second and third decades: one goes to school, graduates, gets a job, gets married, has children, and so on. In addition, an incredible number of first experiences occur: first time driving a car, first romantic kiss, first job interview. Evidence shows that the proliferation of these types of events cause the reminiscence peak (i.e., Jansari & Parkin, 1996). In effect, most of the crucial moments in one's personal history occur at this time. The question of how these temporal landmarks may aid in retrieval from autobiographical memory are examined later in this article.

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2 It is important to note that Rubin et al.'s (1986) study looked at experiments that used the standard-cued procedure only (i.e., elicit the events and then go back and date them). Holding, Noonan, Piau, and Holding (1986) provided evidence that the early reminiscence peak is diminished when a serial-cued procedure is used (i.e., elicit and date the events individually).
Short-term sampling. One problem with long-term sampling studies is poor resolution over specific time periods. This can be seen in Figure 1 where responses are delimited by 10-year periods. Because individuals are allowed to give responses over such a long response period (up to 70 years), the studies are not sensitive to smaller trends. This problem can be remedied by limiting individuals to very specific and short response periods (i.e., “only recall events that happened during your first year in college”). In the past decade, there have been a number of such studies, and the distribution of recall in such experiments also reveals patterns of peaks and troughs that are telling for organizational theories of autobiographical memory.

There are two main methodological differences between long- and short-term sampling procedures. The Galton–Crovitz cue word technique is typically used in the former, whereas free recall is used in the latter. In addition, individuals in short-term sampling procedures have usually been undergraduates. When given unrestrictive cues and a short and relatively recent response period such as “recall events from the past year,” these students tend to retrieve more events from around the beginnings and ends of academic terms than from any other time. This calendar effect (Kurbat et al., 1998) was initially discovered in independent studies by Pillemer, Rhinehart, and White (1986) and Robinson (1986). When asked to recall and date four events from their freshman year, Pillemer et al. found that their upperclassmen recalled three times as many events from September (the beginning of the fall semester at Wellesley) than from any other month during the year.

Robinson (1986) provided additional evidence for the existence of the calendar effect. He asked students to recall as many events as possible from each month of the preceding year. Figure 2 shows the frequency distribution of events across the year. The graph indicates that the peak recall months were August, December, and May, coinciding with the beginning of fall semester, the end of fall semester, and the end of spring semester, respectively, at Louisville. Despite a number of methodological differences, Kurbat et al. (1998) replicated the finding with students from the University of Chicago and Cornell College, as well as with students from two different high schools (Kurbat, Shevell, & Rips, 1992). The calendar effect appears to be robust over a variety of methods and participants, ranging from high schoolers to college freshmen to upperclassmen. Even middle-aged alumni show a similar effect when they are asked to recall events from their first year in college (Pillemor, Goldsmith, Panter, & White, 1988).

As was the case for results from long-term sampling procedures, the distribution of temporal landmarks can explain the calendar effect. In the Pillemer et al. (1986) study, the initial month of college is loaded with many first experiences, especially because students may be away from home for the first time in their lives. Robinson’s (1986) and Kurbat et al.’s (1998) results can be explained by the importance of academic calendars in students’ lives: It structures their year and determines when and where they will be at any particular moment of time. The most salient points in these calendars are the beginnings and ends of school terms; it is no wonder, then, that there are recall peaks at these temporal landmarks.

Explanations of Sampling Effects

Classes of Explanations

The most obvious explanation for these long- and short-term calendar effects is that more events happen around temporal landmarks than at other times. However, this claim is not really plausible because arbitrarily many events occur each day, depending on what one chooses to define as an event. Kurbat et al. (1998) suggested that “we participate in events continuously; there are no chunks between events in which ‘nothing happens.’ Even months that seem slack consist of astronomical numbers of personal occurrences” (p. 532). I consider more complex explanations for these calendar effects, of which there are two main classes:

1. Encoding explanations propose quantitative or qualitative differences in the ways in which recalled memories are encoded or stored as compared to memories that are not recalled. Typically, these differences involve characteristics of the events themselves.

2. Retrieval explanations suggest that calendar effects are due to retrieval strategies that are biased toward recall from certain periods of time over others. Included in this class of explanations are theories concerning narrative bias, the desire of individuals to relate a coherent story.

Encoding and Storage Explanations

Encoding explanations are storage-related in the sense that the characteristics that distinguish memorable versus nonmemorable events are reflected in their underlying structure in autobiographical memory. This organization dictates what is recalled and predicts that the pattern of events that are retrieved should be relatively unchanging under different conditions. Galton’s early studies provide some evidence that retrieval patterns may be static over long periods of time. Generally, explanations of this sort propose some sort of factor or feature that memorable events possess to a greater degree than nonmemorable ones. Three such factors that have garnered research attention are importance, emotionality, and pleasantness.

Personal importance. Although it might not be the case that more events occur around temporal landmarks, it is plausible to suggest that more significantly important events occur at these points. If individuals are biased toward recalling important events over nonimportant events, then this factor could be the basis of the calendar effect. The results regarding this hypothesis are equivocal. As mentioned before, Rubin and Kozin (1984) discovered that when asked to free recall three flashbulb memories, individuals retrieved events that were very highly rated on personal importance. On the other hand, short-term sampling procedures that have displayed calendar effects (i.e., Kurbat et al., 1998; Robinson, 1986) have shown a weak positive correlation at best between personal importance ratings and the distance of an event to the nearest temporal landmark.

Results such as these are ambiguous for a number of reasons. First, one can conceive of there being two kinds of importance for every event: the importance at the time of encoding and the importance of the event in retrospect. Effects of the former kind are due to encoding processes, whereas effects of the latter kind are due to storage processes. Second, there is usually no record of importance ratings for events that individuals do not recall, which would be the appropriate comparison group in these studies. However, experiments that have addressed these issues have shown that the influence of personal importance on the calendar effect is minimal at best. For example, Shum and Rips (in press) ran two marathon diary studies in which events were randomly

sampled from subjects’ lives for a 10-week period (using a procedure similar to Brewer, 1988); individuals were asked to describe events as well as rate them in terms of importance. They were then asked to free recall as many of the events they described during the response period as they could. Although there was an overall calendar effect, there was no difference in importance at encoding between recalled and nonrecalled events. In addition, other studies have shown no difference in importance in terms of retrieval reaction times between relatively important and relatively unimportant events (Burt, Mitchell, Raggatt, Jones, & Cowan, 1995). Although landmark events are more personally important than nonlandmark events, this factor does not seem to drive the recall biases for events around landmarks.

Emotionality. A second factor that has received its own share of attention in the literature is emotionality. Pillemer in his series of studies (i.e., Pillemer et al., 1986, 1988) explained the recall peaks found for events during the first month of college as occurring because many highly emotional events occur during this time. As mentioned previously, Pillemer (1984) also found that flashbulb memories were rated as high in emotionality. Perhaps the strongest evidence for an emotionality effect comes from the diary studies run in the Thompson and Skowronski labs, which have consistently shown that “evaluatively intense” events (e.g., highly emotional) are better recalled than less intense ones (see Thompson, Skowronski, Larsen, & Betz, 1996, for review). The idea that highly emotional events are encoded differently from neutral events is similar to R. Brown and Kulik’s (1977) notion of a “Now Print!” mechanism, wherein the primary difference between intense and less intense events occurs at the point of encoding.

Significantly, there is evidence that importance and emotionality are not independent of each other: Wright (1991), as cited in Wright & Gaskell, 1992) found that retrospective personal importance and emotionality ratings were significantly correlated and that this correlation increased over time. That is, events in memory that are personally important are also emotional and vice versa; moreover, this relationship becomes stronger as the event becomes older. However, emotionality and importance are not the same: A highly emotional event could be unimportant, or vice versa. In addition, it is necessarily the case that there be some variance between the two factors because emotionality appears to be more static than importance. That is, a highly emotional event tends to stay that way even in retrospect (i.e., imagining one’s most embarrassing moment), whereas the importance of an event could change greatly from how important one felt the event was at the time it occurred. Overall, emotionality may play a larger role than importance in determining the types of events a person is likely to recall.

Pleasantness. A related concept to emotionality is pleasantness of an event. Thompson et al. (1996) described how both the intensity (emotionality) and valence of an event may have an effect on recall. Generally, their studies show that positive valence (pleasant) events are better recalled to a certain extent.
than unpleasant ones. Similarly, Wagenaar (1986) conducted a long-term memory study using Linton’s (1975) general design, which involves recording one’s own events daily for a number of years and testing recall for these events periodically with a cue task (Wagenaar used as cues “who” participated in the event, “what” happened, “where” it happened, and “when” it happened). Wagenaar discovered a pleasantness effect in which memories that had been rated as very pleasant were much more apt to be recalled than memories rated as very unpleasant. Although this provided evidence that pleasantness may be a factor in an event’s memorability, Wagenaar (1992) himself discarded this notion and suggested that the pleasantness effect was just an artifact of interplay between more important factors. These factors are involved with one’s conceptual self, or self-image. Similar to schema and script theory, one’s conceptual self biases recall toward those events that violate self-image. As confirmation, Wagenaar (1992) found that he recalled best those events that were unpleasant and self-related (i.e., he was responsible for the actions in the event), because these were the events that violated his positive self-image the most. Wagenaar proposed that encoding is responsible for his findings: “Some aspects of the results suggest strongly that the better recall of self-related unpleasant events is secured in the encoding stage, and not in the subsequent stages of storage and retrieval” (p. 263). However, the generalizability of his results are a bit questionable, as Wagenaar himself admitted, because he was the only participant in the experiment.

Another concern regarding the applicability of Wagenaar’s results is raised by the cue loading hypothesis proposed by Brewer (1988). In a series of ambitious studies, Brewer gave individuals devices to wear in the field that were set to beep randomly, with an average rate of one beep every 2 hr. Every time the beeper went off, they were required to write down aspects of the event that were occurring at the time of the beep. In this way, he was able to randomly sample events from their lives for a period of several weeks. Their recall of these events was subsequently tested using a cued-recall procedure, with the given cues being ones of the sort used by Wagenaar (e.g., action, location, thought, and time). Brewer found that for physical events, thought cues (what the individual was thinking at the time of the beep) were much more effective in eliciting recall of the desired event than either location cues (where the individual was) or time cues (when the beeper went off). On the basis of this evidence, Brewer formulated the notion that the effectiveness of a particular cue is related to how distinctive the cue is in terms of how many memories are accessed by the cue. Cues that are distinctive have fewer memories associated with them and are thus more effective in eliciting specific events. If this is indeed the case for experiments where aspects of an event are used as cues (as in the Linton–Wagenaar–Brewer-type of recall tasks), then it is unclear how relevant this research actually is for free recall paradigms such as the short-term sampling procedure, where the cues (if any) are very indistinct.

Summary. In general, research on differences between recalled and nonrecalled events (or better- vs. worse-recalled events) has resulted in confusing and often contradictory findings. Emotionality appears to be the event-related trait that has most frequently been shown to influence quality of recall, both for personal events (the Thompson diary studies) and public events (Bohannon & Symons, 1992). The reason that emotional events occur near landmarks is straightforward. Temporal landmarks represent critical junctures in life themes and personal reference systems, and these points embody event series that are invariably highly emotional. Consider, for example, the landmark of graduation from college. The occurrence of this landmark involves not only the event of graduation itself but many related events that are high in affective content, including saying goodbye to teachers and friends, perhaps moving, starting a job, and so on (notice that these events can be either pleasant, unpleasant, or a combination of both). Many times, these events are landmarks themselves.

This conclusion that emotionality plays a role in which events are recalled (and which are not) is quite intuitive but must be qualified for two reasons. First, there has been no evidence that events that are recalled are greater in emotional content than events that are not recalled; emotionality effects have typically shown only that highly emotional events are recalled better than less emotional ones, in terms of factors such as detail and accuracy. For example, many of the effects in the Thompson studies are based on participants’ subjective ratings of how well they think they remember a presented event. The second qualification involves the act of retrieval itself. Retrieval is a process that does not occur in isolation; rather, the context of retrieval may play a very important part in what is actually retrieved. Consider the rememberer: He or she does not often play a passive role, thinking of only whatever events happen to come to mind. Rather, by initiating the retrieval process, the rememberer is committed to a certain strategy for recalling particular events. It is proposed that memorial effects such as the reminiscence bump occur not so much because of the encoding factors mentioned in this section but the retrieval factors investigated in the next.

Retrieval-Based Explanations

In addition to encoding and storage, the reminiscence bump and the calendar effect can be accounted for by activity during the retrieval process. This is especially the case when results are based on retrospective ratings, because one can never be sure whether the retrieval itself caused the rating or vice versa. For example, the emotionality effect found by Pillemer (1984) when asking for recall of flashbulb memories may have resulted because individuals thought (in retrospect) that these types of events should be highly emotional. A similar notion to this was presented 50 years earlier by Bartlett (1932/1964). He invoked a concept called attitude, which can be conceived of as the emotional stance of the individual while recalling events. Bartlett believed attitude to play a role in both object perception and autobiographical remembering and likened events recalled to the “general impression” one gets when perceiving an object:

Ask the observer to characterize this general impression psychologically, and the word that is always cropping up is “attitude” . . .

A verbal learning analog of this idea is called cue overload theory (i.e., Mueller & Watkins, 1977), wherein cues that are associated with many test items inhibit rather than help performance on recall tasks.
This passage illustrates two kinds of retrieval-based explanations. The first kind of explanation suggests that retrieval is a local situation-based process in the sense that retrieval at different times and in different contexts elicits different results. The rememberer plays an active role in terms of the specific retrieval strategies that are used; these strategies are determined by the goal of a particular retrieval attempt. The second class of explanation is retrieval as a reconstructive global process. Retrieval attempts may use different sets of cues or be dependent on factors such as mood or state that are beyond the rememberer's control (e.g., Bower & Mayer, 1985). The process itself, however, remains relatively unchanged; it is the output of retrieval that is marked in some way and consequently altered. Bartlett's idea of attitude can accommodate both types of explanations. Attitude can induce certain types of retrieval attempts like searching memory for the purpose of finding an unpleasant event, for example. When an event is retrieved, its trace may be updated to indicate that it has been recalled as an unpleasant experience. In this way, retrieval-based theories can explain both the effects caused by varying search strategy and the obtained differences between events that are remembered and those that are not.

The cueing hypothesis. When one examines the events that are recalled in an autobiographical memory experiment, one must also consider the cues that were used to elicit those events. These cues are specified in studies using the Galton–Crovitz technique, but what are the cues that are used in free-recall (short-term sampling) procedures? In these cases, there are typically no explicit cues given other than the general instruction to "recall events from the past year." The participant is forced to internally generate a set of cues with which to search memory. I propose that participants use temporal landmarks as self-generated cues. Robinson (1986) coined the term temporal reference systems to describe externally instituted calendars that organize our lives, such as academic calendars. He suggested that we use reference points (synonymous with my use of temporal landmarks) as cues in accessing autobiographical memory. In this way, recall biases such as the calendar effect occur because events associated with the cues are more likely to be retrieved than those that are not.

In a verbal learning context, calendar effects for students are essentially classical serial position effects within school terms. The recall peaks at the beginnings and ends of terms correspond with primacy and recency effects found in recall tasks. Not surprisingly, then, a similar "cueing hypothesis" has been proposed by Roediger and Crowder (1976) to account for serial position effects in a semantic memory test. They found that when college students are asked to recall the names of the U.S. presidents, performance was best for those from the beginning and the end of the series. They explained their data by suggesting a hypothesis that "end points of a series serve as distinct positional cues around which memory search is begun" (p. 275).

One testable prediction of this cueing hypothesis is that different calendar effects should be elicited if one manipulates which temporal reference system the individual is using in retrieval. Because the temporal landmarks in these reference systems act as cues for retrieval, shifting reference systems should also shift the set of cues that are used and result in different recall distributions. Kurbat et al. (1998) provided evidence that this is indeed the case. They had one group of study participants write down descriptions of events in booklets that showed academic term break dates; a second group received a booklet that showed the dates of holidays (e.g., Thanksgiving, Valentine's Day). Although no explicit instructions were given to use these dates as cues, the patterns of recall in the two conditions were clearly disparate with a strong bias toward academic landmarks in the first condition and moderate biases toward both academic and holiday landmarks in the second condition. Clearly this evidence speaks against calendar effects being the results of encoding: If events that occur near temporal landmarks are more "strongly" encoded than events from other times (in terms of the factors that I have already mentioned), it is not apparent why shifting the cues used in retrieval would result in different patterns of recall.

Narrative bias. A different sort of retrieval-based explanation is not dependent on cues but is concerned about the narrative bias of the individual recalling events. That is, recall peaks may be the result of attempts by the individual to relate a "life story" in a coherent manner. Because temporal landmarks are usually pivotal points in a person's life, it is no surprise that more memories are recalled from these times. Narrative thought (thinking about one's life as a story) is a notion that has garnered much attention lately from diverse fields (e.g., Bruner, 1994; Howard, 1991; Robinson & Hawpe, 1986; see Sarbin, 1986, for a review).

Fitzgerald (1992) considered this thinking in terms of a personal narrative as the ideal explanation for reminiscence peaks in long-term sampling studies (i.e., Rubin et al., 1986). Interestingly enough, these experiments used the Galton–Crovitz cue-word technique, a method that was intended to reduce response bias. In an effort to maximize narrative bias effects, Fitzgerald asked older individuals to list five events that they would include if they were writing an autobiography. As expected, the reminiscence peak around the adolescent–young adulthood age was even more exaggerated than normal (using the Galton technique); moreover, the recency effect was entirely eliminated.

No wonder some psychologists have gone as far as to propose that all knowledge takes a narrative form (i.e., Howard, 1991; Rubin, 1995). If this is indeed the case, one needs to know exactly what constitutes "good" narrative form. This topic was addressed by Robinson and Hawpe (1986), who discovered that, according to their study participants, life stories should include protagonists, predicaments, and resolutions of these predicaments. The idea that these types of stories occur more often
around temporal landmarks is intuitively appealing, because first experiences often seem to be "stories" of this sort. In addition, struggles for students occur around the beginnings and ends of academic terms when they must deal with such events as moving into a dorm and taking finals. Recall biases for these times come as little surprise, then, and indeed there is evidence (Kurbat et al., 1998) that overrepresentation of these types of events in recall is what produces calendar effects for school term breaks.

**Confabulations.** One advantage of retrieval-over-encoding- or storage-based explanations is that they can account for occasional recall of confabulations, or events that did not actually occur. Confabulations are an obvious example of the reconstructive aspect of memories (i.e., Roediger, Wheeler, & Rajaram, 1993) and can be readily explained by both kinds of retrieval hypotheses that I have mentioned. As an example, when using the end of a school term as a cue, individuals may mistakenly "retrieve" events that are typically associated with such times that did not actually happen in this particular instance (e.g., "taking a final" when the one had only papers to write). Likewise, narrative bias may elicit confabulative responses in similar fashion. For instance, I was wondering today (the Fourth of July, 1996) whether or not a past girlfriend had visited me on last year's Independence Day. In relating a story about the relationship, it is highly likely that I would recall that she had (even though I am not positive about it), simply because she had visited previous times around holidays. These two examples are difficult for encoding- and storage-based theories to explain, as confabulations should never exist as events in memory. Rather, they may be created "on the fly" by retrieval demands. This suggests that reconstruction of our memories cannot occur independently of the retrieval process; in fact, reconstruction may very well occur because of it. The decision as to whether an event is real or not must be left for a postretrieval process (i.e., Johnson & Raye, 1981).

**A Compromise**

It is probably the case that both the aforementioned classes of explanations (encoding vs. retrieval) have some validity to a certain extent. It is almost certainly the case that encoded properties of events themselves influence whether they are subsequently recalled. The most likely candidate for this trait is the emotionality of the event. The greater the emotional content of an event (regardless of valence), the more likely it is to be recalled, all other things being equal.

**Retrieval strategies.** The problem with just an encoding explanation, however, is that rarely are all other things actually equal. What may be more important in recall than the encoding of the event itself is the structure of autobiographical memory in which the event is encoded and the retrieval strategies the individual is likely to use to access the event. I propose that personal reference systems play a role in both the retrieval of events and in the structure of autobiographical memory itself. By the time individuals are old enough to be in the sorts of experiments I have mentioned, they have had a lifetime of experience in attempting to retrieve events. It seems right to think that when they are presented with a free recall task, they use the most efficient method available to access memory (although Loftus & Futhi, 1985, provide evidence that this is not always the case). Efficiency, by my definition, must be related to both the strategies used and the underlying structure of the memory system itself. When these two factors coincide, retrieval is maximally efficient.

There is, in fact, evidence from protocol studies that individuals are not naive and spontaneously use strategies that involve temporal landmarks to aid retrieval. For example, Whiten and Leonard (1981) proposed that individuals use a cognitive landmark identification strategy involving generation of temporal landmarks as search cues when attempting to recall events. Reiser, Black, and Kalamardis (1986) suggested a similar strategy called select time era: from recall protocols, Reiser et al. discovered that when asked for a specific type of event (e.g., "tell me about the time you went to a birthday party"), individuals often select a salient time period ("when I went to high school") as a starting point for the memory search. Reiser explained the effectiveness of this retrieval strategy in terms of a structural aspect of autobiographical memory, that individuals use time eras to categorize experiences. This compromise between contributions from structural (encoding and storage) and retrieval factors is well-accepted, as is evidenced by the organizational models I examine at the end of this article, which combine aspects from both these classes of explanation.

**The development of use of landmarks.** People acquire the knowledge that using temporal landmarks as cues is an effective strategy for retrieval. Children, as novice rememberers, may be especially poor at using landmarks because (a) their knowledge may not be organized in terms of these landmarks, and (b) they have not had enough experience to realize the strategy is useful. Although little work has been done on the developmental career of temporal landmarks, once again one can invoke the useful analogy provided by research involving spatial landmarks. Presson (1987) has shown that first- and fifth-graders do not spontaneously use spatial landmarks to help in a spatial memory task; however, when forced to do so, their performance on the task improves. Similarly, Lynch (1960) proposed that reliance on "systems of landmarks" (p. 78) increases as one becomes more familiar with one's spatial memories. However, developmental differences cannot be due simply to lack of knowledge of the effectiveness of a particular retrieval strategy, as the very organization of one's landmarks changes over time. Hutton-locher, Sandberg, and Newcombe (1994, Experiments 2 and 3) used participants of similar age as Presson's and found that the older their children were, the more categorical structure they imposed on their spatial memories. Taken together with Presson's results, these studies suggest both structural changes in the organization of memories and experience-influenced changes in what sorts of strategies are used to access these memories.

**Temporal Landmarks and Dating Accuracy**

**Dating Bias**

In both long- and short-term sampling procedures, individuals are asked to recall a number of autobiographical events and then to go back and date them. Results from a large number of event-dating studies (see Friedman, 1993, for a review) indicate that it is difficult for individuals to provide accurate dates for their
personal experiences. For example, Thompson (1982) showed that participants sometimes misdate an event occurring in the past 4 months by as much as 3 months! Skowronska, Betz, Thompson, Walker, and Shannon (1994) wrote that their respondents “often spontaneously express a great amount of dismay (sometimes quite vehemently) when they are asked to provide exact dates for their autobiographical events” (p. 218). Brewer (1986, 1988) suggested that there is very limited information about absolute time in autobiographical memory, and that when an exact date is requested, individuals have to generate rather than simply retrieve the answer. Friedman (1993) similarly conceived of event dating as a complex “reconstructive” process.

The calendar effect could be the result of the use of one such strategy to alleviate some of the inherent difficulty of dating personal experiences. Temporal landmarks are very salient events, as evidenced by the fact that their actual dates are remembered quite precisely (Loftus & Marburger, 1983; Shum, 1994). When attempting to provide less well-known dates, individuals may use temporal landmarks to aid in the task. It is possible that this bias could produce the calendar effect if events are dated closer to temporal landmarks than they actually should be. One problem with exploring this hypothesis is that often one has no idea of what the “real” dates of the recalled events are. The dilemma posed by the typical autobiographical memory experiment, then, is twofold: Not only must experimenters take the word of individuals that events they are recalling actually happened, they must also assume that the dates of the events are accurate to a certain extent.

One obvious way to address this problem is to ask individuals about events with known dates. For example, Huttenlocher, Hedges, and Prohaska (1988) had University of Chicago students date all the movies they had seen on campus during the academic year. In this way, the dates given by the students could be compared with the actual dates on which the movies had been shown. If the basis of the calendar effect is a bias to push events in time toward temporal landmarks, then the difference between the given date of a movie and its actual date should increase the farther the actual date is from a landmark. Moreover, one would expect the signed difference between the given and actual date (i.e., given date – true date) to be negative for movies whose nearest landmark is before the actual date of the movie and positive for movies whose nearest landmark is after the actual date of the movie. In other words, a graph of signed difference should show an upward slope within each academic term, if individuals are indeed pushing events toward the nearest temporal landmark. Figure 3, however, shows that this was not the case: Huttenlocher et al. found a general downward slope within terms, which would be the case if students were moving events toward the center of the academic terms rather than the borders (i.e., the temporal landmarks). Kurbat et al. (1998) obtained a similar effect using other social activities on the University of Chicago campus in addition to movies. In addition, personal diary studies have also exhibited this effect to a certain degree (see Rubin & Baddeley, 1989, for a review). Obviously, these results are contrary to what would be predicted with a dating bias theory. In the next section, I show that instead of drawing events toward them, using temporal landmarks as cues in dating may actually improve overall dating accuracy.

**Effects of Using Landmarks on Dating**

In an oft-cited article, Loftus and Marburger (1983) showed that providing individuals with landmarks helped to reduce the forward telescoping effect, the tendency for people to push events forward in time (i.e., to date events as more recent than they actually were). They conducted a series of five experiments with more than 1,600 participants using a variety of temporal landmarks including both public “flashbulb”-type memories (e.g., the eruption of Mt. St. Helena), holidays (e.g., New Year’s Day), and personal events provided by the participants themselves (e.g., birthdays). All the landmarks significantly reduced forward telescoping of accounts of crime victimization. Loftus and Marburger concluded that the temporal landmarks served as reference points for individuals when attempting to date retrospective events.

N. R. Brown, Shevell, and Rips (1986) examined whether providing appropriate temporal landmarks would facilitate retrieval (or reconstruction) of temporal information. They found that couching the retrieval question in terms of a political public landmark (“did this occur during the Carter or Reagan administration?”) reduced responding time for other political events (e.g., assassination of Anwar Sadat); conversely, couching the question in terms of a personal landmark (“did this occur during high school or college?”) reduced responding time for nonpolitical public events (e.g., assassination attempt of Pope John Paul II). Brown et al. felt that these latter type of events were more often encoded within a “personal context.” Neisser (1982) proposed a similar account that the memorability of flashbulb events to their being an intersection of public and personal events (see also Conway, 1990, 1995). Providing this kind of context for their retrieval, then, facilitates quickness of response.

Perhaps the most compelling support for the idea that individuals spontaneously use temporal landmarks as “reference events” or “anchors” when dating other events was supplied by Thompson, Skowronska, and Betz (1993). Over a 2 1/2 month period, individuals were asked to keep diaries in which they recorded one unique event per day; subsequently, they were given their own events and asked to recall the dates on which they occurred. In addition, they were also required to report strategies they used to date the events. The two most frequent strategies were to use “reference events” or “reference periods”; moreover, these two strategies provided the most accurate dating when the precise date of the target event was not known.

As further evidence, Thompson et al. clustered each individual’s events by “theme” (similar to Barsalou’s, 1988, extended events) and analyzed whether the dates given for all events in a
theme (e.g., "attending college" or "being a parent") were related to a single event in that theme that they called the "most datable (landmark)." In fact, their results support the contention that events within a theme were dated on the basis of an "anchor" or landmark of which the precise date was known (or thought to be known).

These studies suggest that it may be quite useful to use temporal landmarks in retrieval strategies to improve both accuracy and speed of dating. For example, Larsen, Thompson, and Hansen (1996) suggested that temporal landmarks are one of the two main sources for information when one makes temporal judgments. Strategies using landmarks work to the extent that they tap the underlying structure of autobiographical memory. One can infer from the effectiveness of these strategies and also the search strategies mentioned earlier two organizational aspects of autobiographical memory:

1. There is some temporal basis to the system, in that two events can be differentiated in terms of when they occurred. Events are not marked in terms of their exact dates of occurrence (Friedman, 1993), but people are accurate to an extent as to the day of the week, month, or year when an event occurred (Larsen et al., 1996).

2. Temporal landmarks are represented in the system in a quantitatively or qualitatively different way than regular episodes. Evidence for this latter aspect is provided in the general improvements shown in efficiency of retrieval and accuracy of dating when individuals are either given temporal landmarks as cues or spontaneously generate them on their own.

Organization of Autobiographical Memory

I now examine two influential models of the structure of autobiographical memory that have been proposed by Barsalou (1988) and Conway (Conway, 1992; Conway & Rubin, 1993). Both of the models meet the two requirements outlined in the above paragraph for a strong temporal component in memory and representation of temporal landmarks (notice that activity-based models such as Kolodner, 1983, meet neither of these requirements). I explore each of these models individually.

Extended Event Time-Lines

In response to the activity-based dominance hypothesis (that autobiographical memory is organized around hierarchies of types of activities), Barsalou (1988) conducted a series of studies that showed that individuals recalled events on the basis of theme-related extended events (e.g., vacationing in Italy) more than activities (e.g., going to movies). For example, when asked to free recall personal events from summer vacation, individuals would often use a strategy of initiating memory search with
an extended event. They would then go through these events chronologically, describing related specific (subordinate) events along the way. After they were done with one extended event, they would move on to another and repeat the process. Temporal landmarks come into play because they are the salient reference points that demarcate extended events (i.e., when to start, what points to hit along the way, and when to end). Using cluster analysis, Barsalou found that this search strategy on the basis of extended events was the most frequently used by subjects and was greater than clustering on the basis of activities, strict chronology, specific events, participants, and location. On the basis of this examination of individuals' protocols, Barsalou formulated a model of autobiographical memory hierarchically structured in terms of extended event time-lines, with specific autobiographical memories nested within progressively more summarized and abstract levels of events. At a superordinate level in this model, extended events collect all specific (subordinate) memories that are thematically related. In addition, extended events are not mutually exclusive in terms of time: Overlap occurs, for example, between extended events such as “first semester of sophomore year” and “my relationship with Sue.” Barsalou suggested that autobiographical memory consists of a collection of extended events running concurrently and in parallel. Figure 4 displays a portion of autobiographical memory involving the extended events of “School,” “Work,” and “Relationships.” Moreover, Barsalou argued that extended events are not independent; connections between events in different extended events are enabled by the goals of the rememberer. He proposed that “goal attainment structures” are superordinate over extended events and have as functions the specification of the composition of extended events and the interrelationship between extended events. Barsalou's “goal attainment structures” are closely related to some of the concepts mentioned above such as personal and narrative histories, because these are the overarching structures that provide some coherence to the many different events that happen in one's life.

**Conway's Model**

A model very similar to Barsalou's has been proposed by Conway and his colleagues (e.g., Conway, 1992, 1996; Con-
way & Pleydell-Pearce, 1998; Conway & Rubin, 1993). In this model, autobiographical memory is conceived as consisting of three separate subsystems: the phenomenological record, thematic knowledge, and the self-system. According to Conway (1992):

The phenomenological record consists of many individual units or records which retain knowledge about moment-by-moment conscious experience. . . . The units of the phenomenological record represent transitory fluctuations in the stream of consciousness and as the content of consciousness changes so new records are created. (p. 170)

The phenomenological record (changed to "event-specific knowledge" in later accounts), then, contains all the precise sensory detail of events one experiences. Storage of this event information, according to Conway, is "essentially random," although he suggested that temporally contiguous units are stored in physically close locations. More abstract organization of the units in the phenomenological record occurs not in the record itself but in the thematic knowledge structure, the second subsystem of memory.

The thematic knowledge structure proposed by Conway closely approximates Barsalou's (1988) concept of extended event time-lines. According to Conway (1992), thematic knowledge is hierarchically organized in terms of lifetime periods. Figure 5 shows a portion of the thematic store for the "Work" and "Relationship" themes (notice how closely this parallels Barsalou's model). The theme collects lifetime periods that are related to either work or relationships; subordinate to these periods are general events that occurred during them. Notice that there are pointers from these general events to both other themes and lifetime periods and to the phenomenological record. Access to and from events occurs through these pointers. In this way, particular themes may intersect if they both reference the same events.

The determination as to what themes are important to a person

![Figure 5. Portion of autobiographical memory as conceived of by Conway (Conway, 1992; Conway & Pleydell-Pearce, 1998). From Of the Construction of Autobiographical Memories: The Self-Memory System and Its Neuroanatomical Basis, by M. A. Conway and C. W. Pleydell-Pearce, 1998. Adapted by permission.](image-url)
and, as a result, how their memory is organized is within the aegis of the self-system. Again, this system is synonymous with
a number of previously mentioned concepts, all of which propose that as individuals, we attempt to fit the disparate events
of our lives into some sort of coherent story or history or narrative that is compatible and reconcilable with our conceptual self.
The analog in Barsalou’s (1988) model is his goal attainment structure.

A Comparison

Although Conway’s (1992) model is more systematic and perhaps more complete than Barsalou’s (1988), the two models are essentially the same. Both propose a hierarchy in autobiographical memory consisting of very specific event information at the lowest level, general or summarized events at the intermediate level, extended events or lifetime periods at the superordinate level, and an overarching scheme that “makes sense” of the whole affair. They both possess a strong temporal component in that specific event information is stored in the sequence in which they were experienced (although this storage in Barsalou’s case is mediated by thematic relationships).

Furthermore, both models can account for evidence that temporal landmarks (either explicitly or implicitly given) improves efficiency of retrieval, as these landmarks provide direct entry into the appropriate extended event–lifetime period that must be searched. The mechanism by which this occurs is cuing: The cues that are effective are those which are represented as either extended events and lifetime periods. In this way, these cues supply direct indices into autobiographical memory. When one is asked to recall events, the most efficient cues are those that are associated with the greatest number of memories (Shum & Rips, in press). Landmark events as opposed to nonlandmark events should provide access to a wide range of events as they cross-cut and demarcate beginnings and ends of thematic timelines. Nonlandmark events, on the other hand, may be isolated to single themes; in addition, their removal would probably not affect the structure of that particular theme, whereas this is certainly not the case for landmark events (i.e., imagine a “My High School Years” theme with and without “High School Graduation”).

Landmarks and Memory Processes

The Cuing Hypothesis Revisited

The cuing hypothesis describes how landmarks may mediate access and retrieval of events from autobiographical memory and also provides an explanation for both short-term calendar effects and long-term reminiscence peaks. It is predicated on the idea that the same landmarks that are effective as cues are also those that organize the structure of autobiographical memory. One prediction of the cuing hypothesis is that nonlandmark event cues should be less effective than landmark cues in eliciting memories, a notion that has received indirect support from a number of studies (i.e., Conway & Bekerian, 1987; Kurbat et al., 1998). Moreover, the effects of using landmarks as cues are found for both recall (Robinson, 1986) and dating (Thompson et al., 1993) experiments.

Regulated Dominance Hypothesis

Another question that remains to be answered is how landmarks are related to encoding: Why are certain events selected and encoded as landmarks, and others are not? My initial division of landmarks into flashbulb memories, first experiences, and reference points in calendars does little to illuminate the matter, because any of the two latter types of events seem capable of serving as landmarks.

Conceiving of potential landmarks in different ways may help to provide answers. I have already examined a number of factors that may differentiate events that become landmarks and those that do not: personal importance, emotionality, pleasantness, number of rehearsals, and so on. Two factors I will consider are related factors that I have chosen to call regulatedness and predictability. A regulated event is one that takes place as part of a sequence of events as predetermined by a calendar. Highly regulated events include the kinds of events that demarcate the important themes in our lives, such as School (First day at Northwestern, High School Graduation) or Relationships (First anniversary, Valentine’s Day). Notice that the dates of these events can be determined prior to their occurrence. These events, then, in addition to being regulated (i.e., entrenched in a calendar) are also highly predictable.

Predictability refers to the potential for accurately gauging (a) if an event will occur and (b) if so, when it will occur. It is the case, though, that events can be predictable without being regulated or part of a salient calendar in our lives. For example, one can predict to some degree when an annual dental checkup is; however, it is probably not the case that this event is a landmark. Thus, personal salience does appear to play a role, in that regulated events are often both predictable and situated in personal reference systems and calendars.

It could be the case, then, that regulated, predictable landmarks are more useful than unpredictable ones in aiding recall and dating, because they are the kind that are usually involved with ongoing themes and extended events. This may not necessarily be true for unpredictable events, as it is unclear as to what themes unregulated occurrences like “getting in a car accident” fall under. If so, there may be more of a reliance of the autobiographical memory system on regulated than nonregulated events. The regulated dominance hypothesis states that regulated events are differentially preferred over unregulated events as cues in memory tasks such as recall and dating, because they are the kind that are usually involved with ongoing themes and extended events. Because regulated events are more closely connected with the ongoing themes in autobiographical memories (by definition, regulated events are parts of those themes), using them as cues leads to quicker and greater access to the body of one’s memories; on the other hand, unregulated landmarks oftentimes are singular, isolated occurrences that do not possess the interconnectivity of their regulated brethren.

Closely bound to this regulated dominance hypothesis is the concept of “preparedness”; that is, does memory have to be “prepared” to accept an event as a landmark? The weak version of the hypothesis explains the greater reliance of memory on regulated over nonregulated events as simply being an artifact of frequency of occurrence. If Type A events occur more frequently than Type B events, all things being equal, there are more landmarks of Type A than Type B. On the other hand, the
strong version of the hypothesis suggests that the advantage for regulated events occurs because memory must be in some way "primed" or "prepared" for an event to be encoded differentially as a landmark. Because this process takes time, those events for which the time of occurrence is known or can be predicted should have more of a chance of being encoded as a landmark than events that occur unexpectedly. In many ways, this strong version of the hypothesis is similar to Bransford and Frank's (1972) idea that having a priori knowledge about a domain enhances processing of domain-related events at the time of their exposure.

For example, consider the most frequently reported landmarks in students' lives as displayed in Table 1. There are more regulated than unregulated events in the list. Moreover, the unregulated events on the list tend to be those that are less frequently mentioned, relatively speaking, including "Broke up with significant other" and "Death of a relation/friend." As the regulated dominance hypothesis would suggest, individuals seem to rely to a great degree on the calendar reference points of their related landmarks in terms of usefulness as cues in recall and converging evidence for an advantage of regulated over unregulated predictable events over unregulated ones.

This change for students may typically involve changes of locale; for instance, academic term breaks usually indicate times in which the student moves from campus to home and vice versa. As evidence of this, Kurbat et al. (1992) found that the calendar effect was much smaller for high school students, because their academic term breaks signify much less change (i.e., the students lived at home whether they were in school or not). This could explain why some events that are considered landmarks (such as the assassination of John F. Kennedy) may not be that important after all; one's life may be very little affected by major public events. Other bases of change are varied, but it is probably the case that the more change that an event initiates, the more chance that it becomes a landmark. Typically, one has a good idea of when events of great change are about to occur; for example, one knows well in advance when he or she is to get married, move to another city, have children, change jobs, or retire. On the other hand, unexpected events of great change (usually tragedies such as the stock market crash, losing a limb in an accident, etc.) are extremely striking but occur far less often. This difference in frequency of occurrence may, as mentioned before, drive the advantage for regulated predictable events over unregulated ones.

There is reason to believe, however, that it may be correct to adopt a stronger version of the regulated dominance hypothesis. Shum (1998) conducted a series of four studies that provided converging evidence for an advantage of regulated over unregulated landmarks in terms of usefulness as cues in recall and dating. This advantage was shown in a reaction-time paradigm (Experiment 2) where individuals were quicker to recall events to regulated than unregulated cues, in a total production paradigm (Experiment 3) where individuals recalled more events given regulated than unregulated cues, and in a dating paradigm (Experiment 4) where individuals were more accurate in dating school events that they had attended, given a set of regulated versus a set of unregulated cues. The sets of regulated and unregulated cues used in the experiments controlled for a number of factors that could bias their efficacy as memory cues, including frequency of occurrence, frequency of mention and self-report by the individuals, and personal importance and distinctiveness ratings. That an advantage for regulated cues was found in these disparate cases despite this stringent control suggests that autobiographical memory may in fact be strongly influenced by and structured around these kinds of predictable or regularly occurring events. As has been mentioned previously, it is likely that these kinds of events comprise the salient points of ongoing life histories.

The recurring notion I have attempted to emphasize in writing this article is the idea of a personal history or personal culture that influences the way in which memory is organized and how future events are encoded. One intuitively thinks that these histories control the kinds of themes or extended events one constructs in memory, and thus the types of events one encodes as temporal landmarks. The control of these themes over one's life is direct and apparent. For example, academic or work calendars not only influence what one does on a daily basis but also determine the kinds of things one is apt to recall. These themes comprise the basic structure of autobiographical memory, and they provide the context in which one's very own personal history is recorded; it is natural, then, to carve up these histories in terms of landmarks. As point of fact, I was speaking to a fellow graduate student this morning, and in passing I asked her how she felt that she organized her own memories for the previous year. "Oh, that's easy," she replied. "Before I went to Guatemala, and after I went to Guatemala."

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