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Received: 26 April 2023 | Revised: 12 September 2023 | Accepted: 19 January 2024

DOI: 10.1002/acp.4174

RESEARCH ARTICLE

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Characteristics and functions of predictive and directive memories and forecasts

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Funding information
Türkiye Bilimsel ve Teknolojik Araştırma Kurumu

Abstract

Earlier research focused on three functions of recollecting the past self, social, and directive functions, but few studies examined the characteristics of events serving these functions. Moreover, research has neglected the function of prediction, which refers to predicting the future by recollecting the past. The current study distinguished the predictive function from the directive function and aimed to characterize memories and future events serving different functions by employing function prompts as cues. In addition, the frequency of using function-cued memories for the other functions was measured. Results showed that predictive and directive function ratings of the predictive function cued events were significantly different. However, directive events served the predictive function as frequently as the directive function, indicating that the predictive function is a prerequisite for future planning conceptualized under the directive function. The results are indicative of a distinct predictive function and considerable overlap between functions of memories.

KEYWORDS
autobiographical memory, directive function, future thinking, predictive function

1 | INTRODUCTION

We often remember our memories for different purposes. The literature on the functions of autobiographical memory suggests three broad functions for remembering our personal memories. The tripartite model proposes self, social, and directive functions (Bluck et al., 2005). The self function refers to remembering the past to ensure that the sense of self has been stable and coherent over time. The social function refers to remembering the past to communicate with others. The directive function refers to remembering the past to plan the future and guide behavior. In addition to these, we recently examined a new function, the predictive function, which refers to using personal memories to predict the outcome of current or future behavior (Ay & Gülgöz, under review). Although the distinctions among these functions seem clear, they are not as clear-cut in the real world (Bluck, 2003), and they are not necessarily mutually exclusive (for a review, Sow et al., 2022). A memory may serve more than one function at a time, as well as different functions at different times (Berntsen, 2018). In this study, we aimed to investigate whether the characteristics of memories vary according to the dominant function(s) they serve. We primarily focused on the differences and similarities between the directive and the predictive functions to explore the predictive function further by delineating phenomenological features that distinguished memories and future projections serving directive and predictive functions.

Although the tripartite model is the dominant model, studies on autobiographical memory functions vary depending on the methodology and approach. Different approaches have proposed broader categories of functions (i.e., Hyman & Faries, 1992; Webster, 1993). For example, Hyman and Faries (1992) asked people to recollect personal

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memories and indicate the reasons for their recollections and they came up with 10 functions. These functions were reduced to one, social-sharing, which was the main focus because of the memory prompt. Webster (1993), on the other hand, developed an eight-factor scale to measure reminiscing functions (i.e., Reminiscence function scale, RFS). In this model, death preparation emerged as a dominant function as the sample included older adults. Bluck (2003) relied on the previous attempts to reduce multiple functions to a tripartite model. Self, social, and directive functions were theoretically driven functions based on previous debates in the field. Harris et al. (2014) conceptualized the functions of memories differently by integrating the functions of autobiographical memory with Webster's reminiscence functions. They specified four quadrants of functions: reflective, ruminative, generative, and social. Some argued that neither the tripartite model, which is the dominant in the field, nor the integrated model proposed by Harris et al. (2014) are sufficient in explaining the functional approach to autobiographical recollections (i.e., emotion regulation function, Öner & Gülgöz, 2018; predictive function, Ay & Gülgöz, under review).

1.1 | Defining the directive and predictive functions

Earlier research emphasized general knowledge about the world (Tulving, 1985), ongoing events rather than single occurrences (Neisser, 1985), schemas, and repeated events (Abelson, 1981), all components of semantic memory, to be more critical in guiding and directing behavior than personal memories. Pillemer (2003) argued that personal memories serve the directive function, people's tendency to use their personal memories to guide their behavior and plan their future, as much as they use semantic knowledge. In a situation where expectations or knowledge do not fit the current situation, the vast depository of personal experiences would serve the directive function. For example, in a study investigating the functions of episodic memories, counterfactual thoughts, and future projections, Özbek et al. (2018) found support for the prominence of the directive function in personal memories. Their results showed that the integrated model's reflective function category is the most prominent function compared to generative, ruminative, and social functions for all types of events. They also point to the new research line in which future projections serve similar functions to remembering the past, although the function ratings of future projections were lower compared to personal memories.

The early conceptualization of the directive function pointed out a variety of future thinking modes, including predicting the potential outcome, resolving the current problems, planning and guiding future behavior (Pillemer, 2003). The first step in directing future behavior is making a prediction about the trajectory of events. However, there is a chance that earlier experiences may not accommodate the requirements of the current problem because the circumstances have changed. In that case, there is a need to update beliefs for the purpose of resolving the problem and the uncertainty. Once the perceived uncertainty is clarified, the function of the memory would become more directive than predictive. In other words, an autobiographical memory would serve the predictive function before it directs the behavior. For example, consider a person who needs to change their restaurant beliefs after experiencing a heart problem. Before the symptoms begin, they can order whatever they want, including fast food that would affect the cardiovascular system negatively. The last time they visited this restaurant, they experienced some heart problems after eating the same food. That event mismatched what they expected because they had never experienced this kind of problem for years. Now, they need to update their expectations with this new memory. This updating part corresponds to the predictive function so that this memory serves to foresee that they cannot order the same food thereafter. After predicting the outcome of a particular future behavior based on the accumulation of previous knowledge and events (predictive function), an updated version of these beliefs can guide current or future behavior (directive function).

The idea that memory serves a predictive function is not an unfamiliar argument in the cognitive psychology literature (e.g., Clark, 2013; Hermann et al., 2021; Kim et al., 2014). Predictive cognition refers to any processing, including the information not just coming from the past or the present but also generated from the prospection of the future (Bubic et al., 2010). It has been widely studied in different domains, such as motor perception, decision-making, and theory of mind (i.e., Knoblich & Flach, 2001). Prediction is also considered a mode of future thinking (Szpunar et al., 2014) with planning, simulation, and intention. As a mode of future thinking, it is assumed to serve the function of adaptive behavior. The predictive function of the autobiographical memory we would like to add to the literature corresponds to a memory schematizing process that creates predictions about future events based on experienced events and that adapts them according to the characteristics of the current situation (Bar, 2007, 2009; Bubic et al., 2010; Gershman, 2017). The prediction of a future event relies on probabilistic extraction of information coming from repeated occurrences of similar events or identifying associations coming from novel events (Sherman & Turk-Browne, 2019). The process of prediction often requires little cognitive effort and is independent of whether this prediction would be used to adjust behavior. One of the important ways prediction is useful is to alleviate uncertainty regarding future developments. Because these predictions are correct more often than not, the individual has the comfort of repeating habitual behavior. However, when a prediction points to an undesirable outcome or the similarity of the current situation to experienced ones is below a threshold, there is a need for a more effortful process of gathering potentially useful memories to direct the behavior in the current situation. Thus, the predictive function is useful in eliminating uncertainty by drawing on past experiences, whereas the directive function is more about controlling the future on the basis of learned lessons of the past.

1.2 | Memory characteristics

Memories elicited for different purposes have different characteristics. Rasmussen and Berntsen (2009) have compared characteristics of memories elicited in response to the directive, self, and social

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functions. When they examined the characteristics of memories serving the directive function, they found those memories were mostly negative. Although the positivity bias was observed in memories related to all other functions as well as controls without any specific function, more than half of the memories serving the directive function were rated as negative. The contents of the memories associated with the directive function also differed from memories with other functions such that more stressful events were reported in this group of memories that aligned with the negativity of these memories.

Harris et al. (2014) found that reflective memories (corresponding to self and directive functions from the autobiographical memory literature and identity and problem-solving functions from the reminiscence literature) were less positive, more recent, and more significant than generative memories (corresponding to teach-inform and death preparation functions of reminiscence). In addition, the frequency of rehearsal was higher for reflective memories than generative memories. Although their study did not distinguish the directive function from the self function, the findings are considered consistent with Rasmussen and Berntsen's (2009) because of the similarity in the characteristics of the memories with the directive and self functions. However, the critical inconsistency between Rasmussen and Berntsen's and Harris et al.'s findings is that directive memories were found more negative in the former but rather neutral in the latter.

Studies focusing on the characteristics of memories elicited by function cues primarily emphasized valence. However, personal memories vary in other characteristics, such as importance, intensity, and frequency of rehearsal. A recent study investigated emotional intensity of memories cued by neutral words and its relation to autobiographical memory functions (Wolf et al., 2021). They replicated the association between directive function and negative valence, but memories associated more with directive function were not necessarily more emotionally intense. The other characteristics, such as importance, frequency of rehearsal, visual imagery, and reliving, are still open to investigation.

1.3 | Aim of the study

The present study had two major aims. First, we investigated the frequency of rehearsing memories cued by each function for the other functions in the tripartite model and the predictive function. Second, we investigated the convergent and divergent characteristics of memories cued by functions, especially the directive and predictive functions.

The directive and predictive functions serve diverging purposes. Directive memories serve to plan and guide future behavior, and predictive memories allow predicting future events and outcomes of those events. However, the way in which autobiographical memories help predict the future is understudied. As a starting point, we intended to examine the frequency of recollecting events to predict the future, and we aimed to investigate whether predictive and directive memories could be distinguished in terms of their characteristics and phenomenological features of remembering. We were interested in variables like the age which the event was experienced, the importance of the event, the event valence, and the emotional intensity of the event. We argued that the characteristics of the memories and the phenomenological features of remembering these events would be different according to the function of the memories.

The rationale for our study follows the distinction among the modes of forecasting proposed by Szpunar et al. (2014). We argued that the directive function in the autobiographical memory literature as a future-related function underestimates the constructive nature of remembering. As a preliminary step, we differentiated planning and predicting modes of forecasting in the TALE scale (Ay & Gülgöz, under review) because planning and predicting the future are mentioned in the conceptual definition of directive function but with a clear emphasis on planning as can be seen in the directive subscale of the TALE scale. We aimed to pursue this research line by differentiating the characteristics of those memories serving primarily the predictive function from memories serving primarily the directive function.

The relationship between memory characteristics and functions was studied in different ways. One line of research relates memory functions with characteristics by cueing memories with emotionally valenced cues (i.e., Wolf et al., 2021). We took the other method used by Rasmussen and Berntsen (2009), where they asked for events serving directive, self, and social functions. They found directive memories to be more negative and to consist of more stressful events than memories related to self and social functions. Our conceptual framework was that, whereas the directive function includes planning and guiding future behavior by deriving lessons from past experiences, the predictive function is about foreseeing future events and outcomes. Based on this conceptualization, we expected that the predictive and directive memories would be distinguished from other functions by valence and importance. They would be more negative and more important than self and social functions. We did not expect any difference between predictive and directive memories in terms of importance. However, we expected that the predictive and directive memories would differ in their event characteristics. The directive memories would be more about stressful events and more negative compared to predictive memories because the directive function includes learning lessons from past experiences. We reasoned that stressful and negative experiences were more likely to provide such learning opportunities.

In this study, we also examined future thinking and how simulations of future events would serve the same functions as personal memories of past events. For future projections and differences between memories and projections, Özbek et al. (2018) found that functions in the reflective category (i.e., self and directive; Harris et al. [2014]) were more prominent in future projections than in past events and counterfactuals. Besides, future projections were equally negative and important as past events. Findings about the reflective category preclude a direct conclusion about features of directive future projections because it captures both self and directive functions, but the integrative model of Harris et al. (2014) suggests that self and directive functions might correspond to similar phenomena. We expected to replicate the findings of Özbek et al. (2018), showing more prominent directive and self functions of future events compared to past events. We find it premature to argue for specific expectations about the predictive function of future events and the

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relations between different functions of those events. On the other hand, if future events serve self and directive functions more than past events, then the self and directive functions would be more prominent in all future events compared to the social function. Finally, we were interested in the other functions served by an event that participants recalled in response to a specific function's prompt. We expected that directive memories would be high on self and predictive functions. As Harris et al. (2014) indicated a commonality between self and directive functions, the events recalled in response to the directive function would be expected also to serve the self function. The events selected as serving the directive function would also be high on the predictive function. This expectation is based on our conceptualization of the predictive function, which is that the predictive function is inherent in the directive function because all decisions and plans require some form of a prediction of the consequences of actions. All other comparisons in this study will be exploratory.

2 | METHOD

2.1 | Design

To investigate how predictive and directive memories and how predictive and directive future projections differ from each other in terms of phenomenological features, memory characteristics, and the other functions of events, we designed a 2 × 4 mixed design experiment. Two groups of participants were asked to either recall past events or imagine future events in response to each function. The four functions were presented as memory cues and were treated within subjects. After every recall trial, they were asked to indicate characteristics of that specific past event or future projection, like age at the event, valence, importance, emotional intensity, visual imagery, reliving, and certainty. Valence, importance, and emotional intensity were asked twice, once for the time of the event, once for the time of data collection. They also rated the events for each function.

2.2 | Participants

Power analysis based on the main analyses showed that 36 participants would be required for an effect size of 0.25, power of 0.95 with an alpha level of .05. As we had past experiences of incomplete surveys in online studies, we distributed the survey widely to assure sufficient power. Participants were recruited from Koç University participant pool and from various social media platforms (i.e., Twitter, Instagram, Facebook, and LinkedIn). A total of 545 people accessed the online survey, but using the criterion of providing at least one event led to the final sample of 184 participants ($M_{age} = 30.96$, $SD_{age} = 9.83$), 106 in the past condition and 78 in the future condition. Our sample was predominantly female (82.6% female) and educated (88% bachelor's degree and higher). The expected number of events from 184 participants would be 1472 but many participants reported that they could not think of an event corresponding to the given function in 996 cases. This left us with 476 events and 36 events were removed due to meaningless content or responses. All analyses were conducted on 440 events, that is, 263 memories and 177 future projections.

2.3 | Materials

Memory prompts for self, social, and directive functions were selected from the Thinking about the Life Experiences (TALE) scale. The items having the highest factor loadings in Bluck and Alea's (2011) study were used as memory cues. For the predictive function, we used the items having the highest factor loadings in a study conducted in our lab (Ay & Gülgöz, under review) (see Appendix A).

TALE scale: We used a crafted version of the original TALE scale by adding five items for the predictive function. Overall, we had a 20-item TALE+1 scale. We asked participants how often they recalled a particular memory for a given purpose on a 5-point Likert scale (1: almost never; 5: very frequently). See Table 1 for Cronbach's alpha indices and Appendix B for the full TALE scale items.

2.4 | Procedure

Research participation was online using the Qualtrics platform. Participants who consented to participation were presented with two scale items for each function, asking for an event that matched that function in the form of "Do you have a memory (imagination) that you remember to *predict (also self, social, and directive functions)* what might happen next." They were requested to provide either two personal past events or two imagined future events in response to the scale items. The instruction given to participants was as follows:

> Please provide a brief summary of your past experience (future projection), which happened (will happen) in a specific time with a limited duration. That experience should be the one that you recall (imagine) to serve the presented function; also, it should (will) happen on a specific day in the past (future).

The presentation order of the prompts was random, with the restriction that items from the same function were not presented consecutively. Both past and future event groups were asked to produce eight events in total, two for each of the four functions. After they provided each event, they answered questions about the events. These questions included valence, importance, intensity, vividness, imagery, reliving (pre-living for future events), centrality, and event category. Valence, importance, and intensity questions were presented both for the time of the event and the time of the data collection. All questions were asked on a 5-point Likert scale, except for the event category and age at the event. Event categories from a previous study (Rasmussen & Berntsen, 2009) were presented, and participants were asked to choose the category that best fits the event they wrote (see Appendix C for the list of event categories). They also indicated their age when the event

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TABLE 1 Reliability measures and descriptive statistics for each function.

	Past			Future		
	Cronbach's alpha	*M* (SD)	*N*	Cronbach's alpha	*M* (SD)	*N*
Self	.82	2.79 (.35)	62	.83	2.77 (.3)	31
Social	.82	2.47 (.26)	73	.83	2.51 (.25)	43
Directive	.78	3.01 (.31)	64	.76	2.93 (.45)	48
Predictive	.84	2.84 (.13)	64	.82	3.31 (.26)	55

happened or forecasted the age when the future projection will happen. They also responded to the TALE+1 scale adapted to measure the specific functions for each event. To clarify the potential ambiguity of ratings, instructions indicated that they should answer the items based on how often they recollected the past event or future projection for a given aim. By providing this instruction, we ensured that they must think about the corresponding event or projection while rating the TALE+1 scale items. Participants were then debriefed and asked to submit their e-mail if they would like information about the results of the study.

2.5 | Analyses

The event function category (social, self, directive, and predictive) was the within-subjects variable, and time travel direction (past or future) was the between-subjects variable in our study. Because the participants could not produce memories for all conditions, we analyzed the data by assuming independence between memories recollected by the participants. The data were not sufficient for multilevel analysis because it requires at least five completed observations. Not all participants could recall at least five events or projections in our data. A mixed ANOVA was also not appropriate because of the same reason. Therefore, we considered events cued by four function prompts as a between-subject variable and included each recollection in the analyses. All the findings emerged from all appropriate events or projections recollected by the participants. The memory characteristics, phenomenological features, the ratings of the other functions, and the temporal distance of age at event from the data collection in months were dependent variables. Two-way between-subjects ANOVAs were conducted to test the hypotheses regarding the phenomenological ratings and explore the difference between events regarding temporal distance. We conducted a three-way mixed ANOVA by adding four function ratings as a repeated measure to test whether function ratings were different across function cues and temporal direction. The differences between predictive and directive memories and future projections were compared to test the directional hypotheses. All other comparisons were exploratory. We also conducted post-hoc analyses for the interaction effects. In terms of the event characteristics, we planned to conduct a chi-square analysis to see whether directive memories included more stressful events than the memories serving other functions, if we had sufficient data. Otherwise, we presented frequencies to interpret event categories tentatively based on descriptive data. Finally, we conducted several correlational analyses to see the relationships between memory characteristics and function ratings.

3 | RESULTS

3.1 | Hypothesis testing

Our first hypothesis indicated that predictive and directive memories would be more negative and important than self and social memories. We also expected that directive memories would be more negative than predictive memories. To test these hypotheses, we conducted (temporal direction: past vs. future) × 4 (Function cue: Self, Social, Directive, Predictive) between subject ANOVAs on four separate dependent variables for importance and valence ratings. We asked how important and positive these events were at the time they happened and at the time of recall. For valence at the time of the event, the results revealed a significant main effect of temporal direction ($F(1, 432) = 6.71$, $p = .01$, $\eta^2 = 0.015$), indicating higher positive valence for future events than past events. The main effect of function cue ($F(3, 432) = 2.50$, $p > .05$) and the interaction ($F(3, 432) = 1.95$, $p > .1$) were not significant. For valence at the time of recall, we observed a significant main effect of function cues ($F(3, 432) = 3.03$, $p = .03$, $\eta^2 = 0.02$), but the main effect of temporal direction ($F(1, 432) = 0.52$, $p > .1$) and the interaction ($F(3, 432) = 1.21$, $p > .1$) were not significant. Post-hoc analyses using Tukey's test comparing different function cues showed no significant difference. The ratings for importance at the time of the event did not reveal any significant differences ($p > .1$). For the ratings of importance at the time of recall, the main effect of temporal direction and the interaction were not significant ($p > .1$), but the main effect of function cue was significant ($F(3, 432) = 4.28$, $p = .005$, $\eta^2 = 0.029$). Tukey's post hoc tests showed that events provided for the self ($t = 3.05$, $p < .05$) and directive functions ($t = 3.09$, $p < .05$) were significantly more important than social events (see Table 2 for means and standard deviations).

We also expected that the predictive and directive memories would differ in event categories. Directive memories were expected to contain more stressful events compared to predictive memories. Participants themselves were asked to categorize memories by selecting a category from the list we provided. We had 17 categories. The number of observations within each category did not allow us to conduct a Chi-squared analysis. Therefore, we interpreted the distribution qualitatively. Table 3 shows the percentage of categories for predictive and directive events. These percentages did not point to a discernible difference in the number of stressful events between directive and predictive events. Events related to work and school life were the most frequent category in all event types although it was more than half of the events in the directive future events and one-

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TABLE 2 Means and standard deviations of valence and importance ratings.

		Variables of interests			
Temporal direction	**Event type**	**Valence-then**	**Valence-now**	**Importance-then**	**Importance-now**
Past	Self events ($N = 62$)	2.45 (1.41)	2.52 (1.51)	3.77 (1.32)	3.35 (1.51)
	Social events ($N = 73$)	3.08 (1.58)	2.88 (1.60)	3.75 (1.10)	2.96 (1.49)
	Directive events ($N = 64$)	2.83 (1.62)	3.05 (1.53)	4.02 (1.19)	3.22 (1.34)
	Predictive events ($N = 64$)	3.20 (1.40)	3.44 (1.36)	3.77 (1.22)	3.23 (1.32)
Future	Self events ($N = 31$)	3.06 (1.48)	3.06 (1.55)	3.71 (1.22)	3.65 (1.28)
	Social events ($N = 43$)	3.00 (1.46)	2.81 (1.44)	3.44 (1.22)	2.81 (1.38)
	Directive events ($N = 48$)	3.60 (1.33)	3.19 (1.58)	3.90 (1.28)	3.71 (1.27)
	Predictive events ($N = 55$)	3.38 (1.24)	3.24 (1.39)	3.96 (1.05)	3.31 (1.32)

TABLE 3 Percentage of event categories within each event type.

Directive past event ($N = 62$)	**Predictive past events ($N = 48$)**	**Directive future events ($N = 44$)**	**Predictive future events ($N = 43$)**
Work and School (29.03%)	Work and School (29.17%)	Work and School (54.54%)	Work and School (34.89%)
Conversation with others (25.81%)	Stressful events (29.17%)	Stressful events (18.18%)	Stressful events (20.93%)
Stressful events (24.19%)	Vacation (12.5%)	Events related to others (11.36%)	Romantic relations (11.63%)
Romantic relations (14.52%)	Events related to others (10.42%)	Conversation with others (4.55%)	Travel (11.63%)
Vacation (3.23%)	Leisure activity (6.25%)	Travel (4.55%)	Vacation (6.98%)
Events related to others (1.61%)	Romantic relations (6.25%)	Romantic relations (2.27%)	Events related to others (6.98%)
Self-related events (1.61%)	Conversation with others (4.18%)	Vacation (2.73%)	Conversation with others (4.65%)
Travel (0)	Self-related events (2.08%)	Self-related events (2.73%)	Leisure activity (2.33%)
Leisure activity (0)	Travel (0)	Leisure activity (0)	Self-related events (2.33%)

third of the events in the directive past, predictive past, and predictive future events. Considering the differences between predictive and directive events, we observed that predictive events included events belonging to leisure activity more than directive events in both the past and the future. Conversation with others category was 25% of directive past events but below 5% of the other event types. The percentage of events related to romantic relationships was higher in directive past and future events compared to predictive past and future events. On the other hand, the percentage of events related to others was higher in predictive past and future events compared to directive past and future events.

3.2 | Exploratory analyses

We were also interested in the other functions and characteristics of the events. We expected that directive memories would be high on self and predictive functions. We conducted ANOVAs on the ratings for the four function types with the function cues (Self, Social, Directive, and Predictive) and the temporal direction as between-subjects variables. Besides, we conducted analyses to further explore phenomenology and the absolute temporal distance of events. By doing this, we aimed to see whether function ratings, characteristics, and absolute temporal distance from the recall time of past events and future projections differed with respect to the function cue. In this section, we had three subsections showing exploratory analyses for the TALE ratings for each event type, phenomenology ratings, and temporal distance in the given order.

3.3 | TALE ratings

A 3-way mixed ANOVA revealed that the main effect of rated function ($F(2.57, 1108.22) = 56.25$), $p < .001$, $\eta^2 = 0.05$), and the interactions of rated function with function cue ($F(7.70, 1108.22) = 30.73$, $p < .001$, $\eta^2 = 0.08$), and rated function with temporal direction ($F(2.57, 1108.22) = 10.86$, $p < .001$, $\eta^2 = 0.01$) were significant. The main effect of function cue ($F(3, 432) = 1.44$, $p > .1$), the main effect of temporal direction ($F(1, 432) = 2.33$, $p > .1$) and the 3-way interaction between function cue, temporal direction, and rated function ($F(7.70, 1108.22) = 1.95$, $p = .05$) were not significant. All descriptive statistics can be found in Table 4. Post hoc tests with Bonferroni correction showed that directive and predictive function ratings were the most prominent ones, followed by self function. The social function was the least prominent when the results were averaged over temporal directions and function cues.

In order to understand the interaction between rated function and temporal direction and the interaction between function cues and rated function, we conducted post hoc comparisons with Bonferroni correction.

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TABLE 4 Means and standard deviations of function ratings.

		TALE+1 function ratings			
Temporal direction	**Event type**	**Self**	**Social**	**Directive**	**Predictive**
Past	Self events ($N = 62$)	3.30 (0.95)	2.52 (0.84)	3.02 (0.87)	2.66 (0.98)
	Social events ($N = 73$)	2.49 (0.74)	3.14 (0.81)	2.93 (0.78)	2.62 (0.95)
	Directive events ($N = 64$)	2.90 (1.00)	2.20 (0.96)	3.37 (0.84)	2.94 (0.93)
	Predictive events ($N = 64$)	2.52 (1.00)	1.91 (0.86)	2.74 (1.10)	3.17 (1.12)
Future	Self events ($N = 31$)	3.27 (1.07)	2.21 (1.12)	2.97 (1.00)	3.13 (1.09)
	Social events ($N = 43$)	2.63 (1.07)	3.33 (0.84)	2.83 (1.05)	3.06 (1.01)
	Directive events ($N = 48$)	2.69 (1.05)	2.23 (1.05)	3.00 (0.84)	3.47 (0.98)
	Predictive events ($N = 55$)	2.68 (0.83)	2.28 (0.88)	2.92 (0.83)	3.48 (0.80)

Interaction between rated function and temporal direction: These comparisons revealed that self function ratings of past events were more pronounced than social ratings ($t = 5.82$, $p < .001$) but less pronounced than predictive ratings of future events ($t = -5.23$, $p < .001$). In addition, social function ratings of past events were less pronounced than predictive and directive function ratings of both past and future events. Overall, predictive function ratings of future events were highest (all p's < .001) compared to the other functions, including the comparison between the directive function of future events and the predictive function of past events and except for directive function ratings of past events ($t = -2.90$, $p = .11$). This trend did not apply to the predictive function ratings of past events, potentially indicating that future events serve more to predict the future even if they were yet to happen.

Interaction between rated function ratings and function cues: Post hoc comparisons with Bonferroni correction revealed that self function ratings of self events were significantly higher than social ($t = 8.45$, $p < .001$) and predictive ratings ($t = 3.54$, $p = .04$) but not significantly different from directive ratings ($t = 2.62$, $p = 1.00$). Interestingly, self function ratings of directive and predictive events were not significantly different ($t = 1.57$, $p = 1.00$). The critical difference between predictive and directive memories in terms of the function ratings showed that directive and predictive function ratings of directive events were equally high ($t = 2.83$, $p = .57$), but predictive function ratings of predictive events were significantly higher than directive function ratings ($t = -5.38$, $p < .001$). The other comparisons between predictive and directive function ratings according to different function cues were insignificant (all p's > .1). We summarized the findings in Figure 1.

3.4 | Phenomenology ratings

Before conducting a MANOVA analysis, we conducted several Pearson correlations and observed moderate correlations among variables (Table 5). In addition Box's M value was 306.31 ($p < .005$), which allowed us to assume that the covariance matrices were equal among groups. We conducted a 2 × 4 MANOVA to explore the effects of temporal direction (past vs. future) and function cues (self, social, directive, and predictive) on thinking, talking, vividness, emotional intensity at the time of the event, emotional intensity at the time of recall, visual imagery, reliving, and certainty. Overall, MANOVA revealed significant effects of temporal direction ($F(8, 425) = 19.24$, $p < .001$; Wilk's $\Lambda = 0.73$, partial $\eta^2 = 0.27$) and function cue ($F(24, 1281) = 1.99$, $p < .05$; Wilk's $\Lambda = 0.89$, partial $\eta^2 = 0.36$) but the interaction was not significant ($F(24, 1233.23) = 1.03$, $p > .1$; Wilk's $\Lambda = 0.94$). We conducted post hoc Tukey's HSD tests to explore which phenomenology ratings differed across conditions. Tukey tests showed that people think about directive memories significantly more than social memories ($p = .003$, CI [0.15, 1]). To see an overall picture of the phenomenology ratings, see Figure 2.

3.5 | Temporal distance from the time of recollecting and forecasting

To explore how far from their past people recollect or how far into the future they forecast in response to different function cues, we conducted 2 × 4 between-subjects ANOVA. We calculated temporal distance in months by subtracting event time from the time of recollecting or forecasting. In other words, as we had birthday information, we calculated age at data collection and age at the event in months, and found the difference. If the difference was less than 1 month, we coded it as 1 month. The results revealed main effects of temporal direction ($F(1, 394) = 6.63$, $p < .05$, $\eta^2 = 0.02$) and function cue ($F(3, 394) = 3.99$, $p < .05$, $\eta^2 = 0.03$). The participants' future events were closer in time than past events. Regarding the main effect of function cue, social events were significantly closer than directive events (see Figure 3). We also observed a significant interaction between temporal direction and function cue ($F(3, 394) = 3.99$, $p < .05$, $\eta^2 = 0.02$). Tukey HSD tests showed that the interaction effect was due to the significant difference between future social and self events ($t = 3.39$, $p < .05$), future social and past directive events ($t = 4.41$, $p < .001$), and future predictive and past directive events ($t = 3.44$, $p < .05$). Future social events were closer than future

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FIGURE 1 Events' function ratings. Error bars represent the standard error of the mean.

TABLE 5 Correlations and descriptive statistics of ratings for recall phenomenology.

	1.	2.	3.	4.	5.	6.	7.	8.	*M*	SD
1. Think	-								2.97	1.31
2. Talk	0.51**	-							2.29	1.19
3. Vividness	0.57**	0.42**	-						3.19	1.26
4. Emotional intensity then	0.29**	0.15**	0.28**	-					3.85	1.15
5. Emotional intensity now	0.52**	0.41**	0.53**	0.35**	-				2.73	1.36
5. Visual imagery	0.29**	0.19**	0.51**	0.32**	0.33**	-			3.61	1.17
6. Reliving	0.39**	0.37**	0.53**	0.29**	0.58**	0.52**	-		2.63	1.27
7. Certainty	0.12*	0.11*	0.32**	0.18**	0.11*	0.58**	0.37**	-	3.52	1.18

**Correlation is significant at the .01 level (2-tailed).
*Correlation is significant at the .05 level (2-tailed).

self events and past directive events, also future predictive events were closer than past directive events.

4 | DISCUSSION

A relatively small number of studies examined the memories cued by the functions (e.g., Alea et al., 2013; Harris et al., 2014 study 3; Rasmussen & Berntsen, 2009; Wolf & Demiray, 2019). In the current study, we presented function cues to the participants, and they recollected or projected events from the past or future. We expected that predictive and directive memories to be different in valence and importance characteristics. Directive memories would include more stressful events and would be emotionally more negative. We also aimed to explore the other memory characteristics that have not been investigated in the context of autobiographical memory functions, such as emotional intensity, visual imagery, reliving, and certainty.

Our results showed that the predictive memories were more positive than self memories, but the differences among self, social, and directive memories were not significant. Future events were rated

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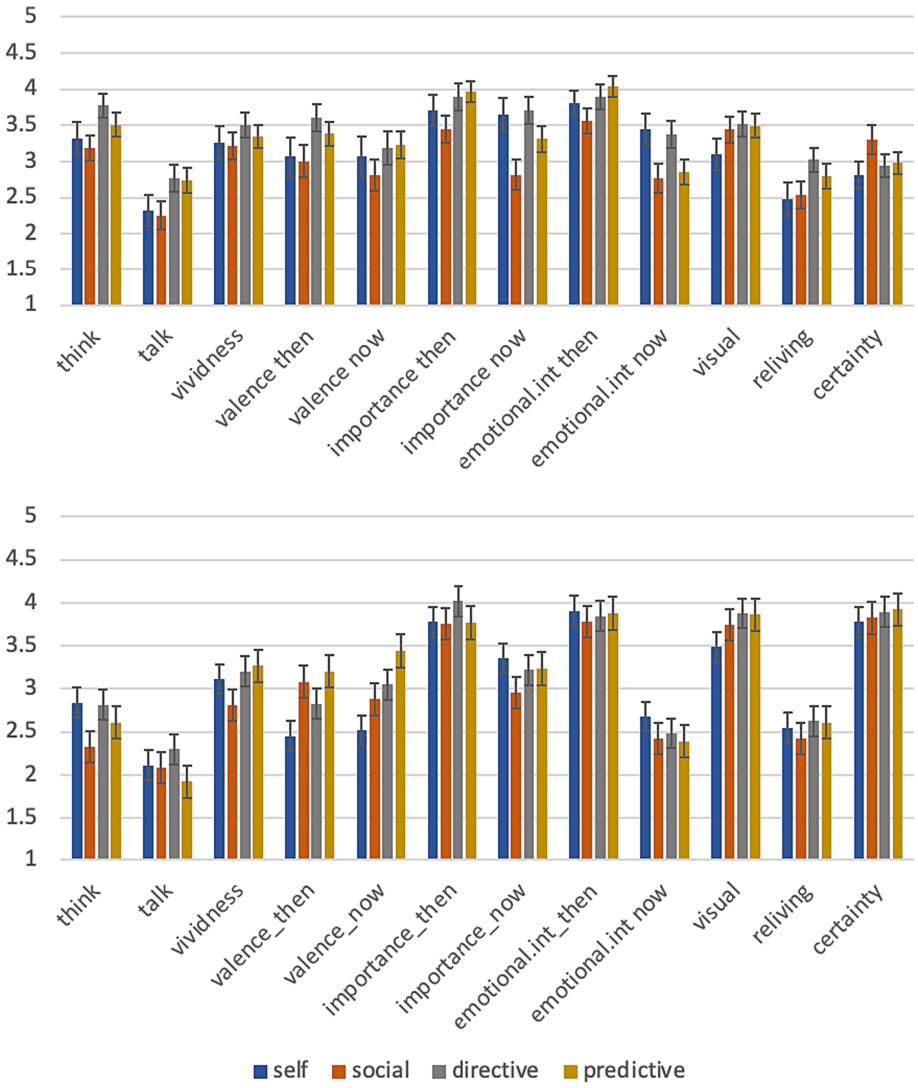


FIGURE 2 Phenomenology ratings of function-cued events. Above figure shows past events and below shows future events.

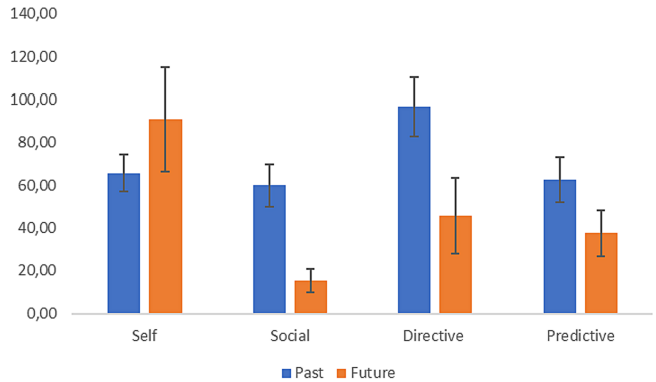


FIGURE 3 Monthly temporal distance according to the function cue and the time of the event.

more positively at the time of the event than past events. However, past and future events were rated equally positive or negative at the time of recall. When we looked at the perceived importance of events, the ratings for the time the event happened (or for future events, that will happen) showed no difference, but self and directive events were rated as more important than the social events at the time of recollection.

We were interested in the categories of events that were used for predictive and directive functions. Among the 17 categories, the most frequent category was work or school, indicating that people rehearsed events related to their work or school life more frequently than the other categories. Moreover, directive future events included twice as many events about work or school compared to directive past, predictive past, and predictive future. Another important finding regarding the event categories was the difference between predictive and directive events in both past and future events. We found that predictive events included more leisure time activity than directive events.

Overall, we observed that the most pronounced function was the predictive function. The comparison of the function ratings between past and future events revealed that while past events were used more for the directive function, future projections were expected to be used more for the predictive function. Critically, predictive and directive function ratings were not different in events reported in response to directive function cues, indicating that events guiding the future simulations serve the predictive function as much as they serve the directive function. However, predictive function ratings in

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predictive events were higher than the directive function ratings, indicating that predictive events were used less for the directive function than the predictive function.

The phenomenology ratings and temporal distance measures showed that the participants rehearsed directive events more than the events serving the social function, and they recalled more distant memories for the directive function. Although there seems to be a pattern in the temporal distance for different functions, we did not observe significant differences, possibly due to high variability.

4.1 | Overall interpretation of the key findings

We replicated earlier findings that people expect future events to make them feel more positive than past events (Berntsen & Bohn, 2010; D'Argembeau & Van Der Linden, 2004), but thinking about these events did not vary in valence at the time of recollection. This finding may indicate that people's belief in a positive future does not affect their current feelings. Emotions at the time of thinking about the events and at the time of experiencing them might be different, begging the question of potential predictors moderating this difference. It is possible that the respondents' current precautious emotional state did not allow the thought of a future positive event to change their mood. Contrary to the literature and our expectations, our data did not show a relationship between directive function and negativity. Previous studies have shown events with a directive function to be more negative (Harris et al., 2014; Lind et al., 2019). Harris et al. (2014) observed that the reflective function, which includes the directive functions, evoked significantly more negative events than generative, ruminative, and social functions. They argued that the directive function is more related to learning from past mistakes and, thus, negative events. In contrast, we found that predictive memories were associated with positive emotions as the future would be brighter. We speculated that because the time of recollecting events was during the COVID-19 pandemic, the perceived valence of past events and future events was affected by the current unusual circumstances. In addition, we found that self and directive events were more important than social events. The importance of self and directive events may indicate that the participants needed coherent self and sustainable plans for their important future.

In the current study the main difference between directive and predictive functions might lie in (1) whether the event has happened because prediction is also a mode of forecasting, including planning, simulation, and intention; and (2) prediction is a primary function that comes before the directive function. As prediction is a mode of projection, it is not surprising that all types of future projections in our study serve the predictive function more. Besides, we collected the data during the time of COVID restrictions when people needed to update their habits, daily routines, and lifestyles. Under these circumstances, memories of some events before the pandemic were no longer relevant to the current situation, and past memories could not serve the predictive function as much as future projections. Consistent with this claim, the absolute temporal distance between the time of the event and the time of recall was longer in directive events than in predictive events, but we did not observe the same difference in future events. For the past events, we speculated that relatively recent events were recollected for prediction because they were the most updated versions. If there are several similar events, the most predictive for the current context would be the most recent. However, this was not true for future events; therefore, future events for predictive and directive functions were equally distanced. Predictive function comes before the directive functions as predictive events were less used for directive function than predictive function, but directive events were equally used for directive and predictive functions. We argued that predictive memories do not serve directive function simultaneously and it is a prerequisite for directing (i.e., planning and guiding future events) the future.

Another interesting difference between predictive and directive functions was the mode of rehearsal, such that the directive function was thought about more than the predictive function. While directive memories were thought of more than social memories, such a difference was not present for predictive memories. The difference between the directive and social memories in the frequency of thinking indicates that people think less about the memories recollected primarily for social conversation than those recollected for future planning. Given that there was no difference between predictive and social memories, we can assume that recollection for social and predictive functions is more direct and automatic (e.g., Turk-Browne et al., 2012), whereas the directive function needs explicit intention as compared to events serving the social function. Without any direct evidence, this argument is highly speculative because we cannot be sure whether the high rate of drop-out is due to task difficulty or processing differences. We argue that direct retrieval of past experiences with a function cue is difficult because often, the recall and future projection of events are involuntary and seemingly unintentional. Participants' detection of their use of these memories and projections may not be possible. Moreover, recollecting a memory serving predictive function is a highly automatic process and it provides a survival advantage. The future direction of this research line should focus on this point and investigate the involuntary nature of functional thinking in autobiographical recall.

4.2 | Conclusion

Taken together, this study is the first to show that recollecting an autobiographical memory for prediction might have different cognitive processes because memories serving predominantly the predictive function should be the most updated version of similar memories and are processed more automatically than other functions. It was unique as it investigated the differences between memories and future thoughts using memory functions as memory prompts. In addition, this is the first study that differentiated the predictive and directive functions and examined memories produced for those functions. Investigating various autobiographical memory functions is crucial to understanding the fundamental question Baddeley (1988) asked: "What the hell is it for?" This study approached autobiographical memory functions with an emphasis on adaptivity and use (Beike

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et al., 2020) and showed the presence of a predictive function for memories in addition to the self, social, and directive functions. Furthermore, we showed that memories might serve more than one function. Future studies will need to explore how contextual factors influence the use of memories for different functions.

CONFLICT OF INTEREST STATEMENT

No conflict of interest was reported by the authors.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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How to cite this article: Ay, D., & Gülgöz, S. (2024). Characteristics and functions of predictive and directive memories and forecasts. *Applied Cognitive Psychology*, *38*(1), e4174. https://doi.org/10.1002/acp.4174

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APPENDIX A: MEMORY CUES FOR PAST AND FUTURE EVENTS FOR EACH FUNCTION

Self events

Past 1: When I worry about whether I am still the kind of person I was before.
Future: When I worry about whether I will be the same kind of person in the future as I am now.
Past 2: When I worry about whether my values change over time.
Future: When I worry about whether my values will change in the future.
Past 3: When I worry about whether my beliefs change over time.
Future: When I worry about whether my beliefs will change in the future.
Past 4: When I want to understand how I have changed from the way I was in the past to the way I am now.
Future: When I want to understand how things will change between the way I am now and the way I will be in the future.

Social events

Past 1: Trying to understand what kind of person someone else is.
Future: Trying to understand what kind of person someone else is.
Past 2: When I want to build more intimacy in my relationships.
Future: When I want to build more intimacy in my relationships.
Past 3: When I want to develop a closer relationship with someone.
Future: When I worry about whether my beliefs will change in the future.
Past 4: When I hope to learn more about someone else's life.
Future: When I hope to learn more about someone else's life.

Directive events

Past 1: When I want to remember something someone else said or did that might be useful to me now.
Future: When I want to think about something that someone else said they were going to do that might be useful to me now.
Past 2: When I believe that thinking about the past can shed light on the future.
Future: When I believe that thinking about the future will shed light on my life.
Past 3: When I have to make a choice about my life and I am not sure which path to take.
Future: When I have to make a choice about my life and I am not sure which path to choose.
Past 4: When I want to remember a lesson I learned in the past.
Future: When thinking about future events that I will experience and learn from.

Predictive events

Past 1: To think about possible outcomes when I experience something new to me.
Future: To reflect on the possible outcomes when I experience something new to me.
Past 2. Past: When I anticipate what kind of situation I will face without realizing it.
Future: Anticipating what situation I will face without realizing it.
Past 3: When I think about what it will be like before I try something I have never tried.
Future: When I think about what it will be like before I try something I've never tried.
Past 4: Visualizing a future event (item number: 52).
Future: When I visualize an event I will experience in the future.

APPENDIX B: CRAFTED TALE+1: SCALE ITEMS TO BE ASKED FOR EACH EVENTS

Self function

1. When I want to feel that I am the same person that I was before.
2. When I am concerned about whether I am still the same type of person that I was earlier.
3. When I am concerned about whether my values have changed over time.

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4. When I am concerned about whether my beliefs have changed over time.
5. When I want to understand how I have changed from who I was before.

Social function

6. When I hope to also find out what another person is like.
7. When I want to develop more intimacy in a relationship.
8. When I want to develop a closer relationship with someone.
9. When I want to maintain a friendship by sharing memories with friends.
10. When I hope to also learn more about another person's life.

Directive function

11. When I want to remember something that someone else said or did that might help me now.
12. When I think about my goals for the future.
13. When I want to try to learn from my past mistakes.
14. When I need to make a life choice and I am uncertain which path to take.
15. When I want to remember a lesson, I learned in the past.

Predictive function

16. When I want to consider the probability of my aims, before directing my upcoming behavior.
17. When I experience a new thing, in order to think about potential consequences.
18. When I want to anticipate things which would happen to me if I did something which I do constantly.
19. When I want to predict without awareness what type of situation that I face.
20. When I think about the event before experiencing it which I have not experienced yet.

APPENDIX C: EVENT CATEGORIES BORROWED FROM RASMUSSEN AND BERNTSEN (2009) STUDY 3

Event name	Description and Example
Person	Primarily about other people
Accidents/illnesses	Injuries & illness (physical stress)
Stressful events	Psychological stress (excluding physically stressful events)
Holiday	Events happened during holiday time
Conversations	Events describing conversations with others
Leisure/sports	Hobbies & games
Objects or places	Primarily about objects or places
Going out	Going to a pub & dancing
Work/university	Experiences at work or university
Romantic involvement	Being intimate, romantic dinners, receiving gifts for Valentine's Day
School	Experiences at school—including high school and folk high school
Deaths/funerals	Experiences at funerals
Special occasions	Birthdays, weddings, engagements, parties
Births	Memories from birth
Traveling/Journeys	
War/Army	
Other	

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