

## Overview of the project

Forming and retrieving memories is a fundamental ability of all human being. Memory is defined as the ability using which the mind stores and remembers information. Memory of intentions that we want to complete in future are different from memories of our past experiences as most of them are generated from thoughts, imagination, and anticipation rather than composed of the details that comes from actually performing an activity. For this reason, research's done on memory have drawn a distinction between retrospective memory for experiences already undertaken and prospective memory for activities that we plan to initiate in the future. Contrary to retrospective memory, prospective memory includes- formation of an intention which needs to be performed in future (intent), what we plan to do (action) & when we want to do (retrieval). An important feature of prospective memory tasks is absence of any explicit cue for recall during retrieval. Thus, prospective memory is also termed as one's ability of "remember to remember" and is distinguished from retrospective memory which is always initiated by some external and explicit cue to recall past events. Despite being self-cued, each prospective memory task also consists of a retrospective component in it.

Prospective memory tasks are typically embedded in some attention-demanding ongoing cognitive activity, it is likely that the perceptual salience of a prospective memory cue would influence prospective memory performance. Salience in its literal meaning is known as "most noticeable or important". This saliency makes the cue more effective in terms of identification and therefore effect the performance. The more distinct the prospective memory cue is, the less strategic monitoring will be required. The cue characteristics can be manipulated on various grounds like emotions, familiarity, cue pattern, and cue presentation. Among all these cue properties, emotion had received the attention of many researchers. There have been numerous studies on effect of emotional valence and arousal on memory which suggests that as memory declines with age, its only emotional experience and emotional regulation that remains intact or even improves across adulthood (Blanchard-Fiels, 1998). Plenty of studies have examined the influence of emotion on PM performance, but the findings till date didn't provide any clear understanding of valence effect on prospective memory (e.g., Altgassen, Phillips, Henry, Rendell, & Kliegel, 2010; Clark-Foos, Brewer, Marsh, Meeks, & Cook, 2009; Rendell et al., 2011). So the first objective of the project was to find out effect of emotions on prospective memory. In our initial experiments we tried to evaluate whether both positive and negative valence cues affect prospective memory differentially and conducted a pilot study. Based on the results, the experiment 1 was initiated where the effect of emotional and neutral cues on different types of prospective memory (event based, time based and activity based) was examined. Since, most of the studies on prospective memory had focused mainly on event based and time based prospective memory, the activity based prospective memory type remains neglected. So this new type of prospective memory was incorporated in our initial experiment to examine the role of cue valence on all three types of prospective memory.

The result from experiment 1 (Singh,T & Kashyap,N, 2015(in press)) revealed better performance for emotional cues (positive and negative) compared to neutral, which clearly explains that similar to retrospective memory emotion also plays an important role in prospective memory. Also, responses for event based prospective memory were found to be most affected by

emotional cues in our studies. The reason for such clear difference between all three prospective memory tasks is due to difference in natures of processing.

Event based intentions are more externally cued whereas time based intentions are more relied on self-initiated. So to examine the effect of emotional valence as cue characteristics, event based prospective memory was selected as a main variable in future experiment and the other two types of PM was ruled out in further experiments of the project. Manipulation in presenting the emotional cue was done to investigate whether indirect cue presentation effect performance and produce better results. In relation to presentation of cue it has been observed that prospective memory positively correlates with performance embedded in implicit memory tasks like word-stem completion task (McDaniel and Einstein, 1993), which is an index of implicit memory function. Also using an autonomic measure, Kliegel et al. (2007) found that skin-conductance responses were greater to cues that were undetected than those which were easily detectable for the ongoing task stimuli. It has also been found that salient explicit cues can fail to remind of the intention (Einstein et al., 1998). Instead, unconscious stimuli may be non-negligible (Tsushima et al., 2006) and accessible to the maintained intention. In a study, Hashimoto, Umeda & Kojima (2011) used indirect/implicit cues to examine maintained intentions and found that implicit stimuli elicit weak but reliable effects both on behavior and neural activity, without awareness. But still there are very few studies available to demonstrate effect of indirect cuing on prospective memory. Hence it becomes important to find out whether prospective memory can be enhanced by indirect cue presentation. The result of experiment 2 had shown no clear difference between direct and indirect cue presentation. However, the study revealed that indirect cues can generate responses and enhance prospective memory especially in the case of positive valence. Also we had used words as emotional stimuli to measure effect of indirect and direct cue presentation in this experiment, but words being semantic in nature take more time for processing compared to pictures so, in the later part of study it was decided to change the stimuli type and investigate the effect of indirect cues across different type of stimuli's (words & pictures). In our previous experiments we had used only words as stimuli, so, it was important to examine the same variables with picture stimuli, as pictures are better recognized than words for several reasons. Pictures also are believed to be more salient, and to activate emotional responses more easily than words (e.g., Carr, McCauley, Sperber, & Parmlee, 1982). In this light, for pictures, the effect of emotion might be in evidence immediately and might be evoked relatively automatically, whereas activation of emotional responses for word stimuli may require more in depth and controlled processing. So in experiment three we compared the two different stimuli type (words and the pictures) and measured its effect on prospective memory by manipulating the cue presentation of the stimuli type and found significant difference event cued prospective memory performance across stimuli type (words and pictures). Performance was better for pictures compared to words.

In all three experiments only behavioral responses were recorded across short retention interval. Among the variables affecting the prospective remembering (Marsch & Hicks 1998), the retention intervals between intention formation and the time an action is to be carried out, has been widely studied (Hicks et al. 2000). Hicks et al. (2000), for instance, it was reported that in an event-based task (i.e. an environmental cue triggers fulfillment of the intention; see for instance Einstein & McDaniel 1990), the prospective memory improved over short (3 min) to long (15 min) delays. In the last section of the experiment, we tried to examine the effect of long

retention interval filled with sleep on prospective memory. There have been very few studies done on sleep and its effect on prospective memory with their own limitations. Our effort was to explore the effect of emotional valence across two different patterns of cue presentation and stimuli type on event cued prospective memory during sleep and wake conditions.