**Forgetting to remember to remember: Prospective memory in adults with dyslexia**

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The effects of developmental dyslexia are lifelong. Alongside continuing problems with reading and spelling, broader difficulties with cognition have also been found in adulthood. For instance, adults with dyslexia have been found to have problems with short-term memory, working memory and long-term memory under both laboratory and everyday settings (see Smith-Spark, 2017a, for an overview). While many studies have explored the effects of dyslexia in these areas of memory, prospective memory has not been investigated in dyslexia until very recently. Prospective memory is memory for delayed intentions or remembering to remember (see McDaniel & Einstein, 2007). This article summarises a recent programme of research which explored prospective memory in adults with dyslexia (Smith-Spark, Zięcik & Sterling, 2016a, 2016b, 2017a, 2017b).

Prospective memory is vital to our day-to-day lives. Indeed, much of our time is spent carrying out a range of prospective memory tasks. Some of these tasks are mundane, such as remembering to buy milk on the way home from work. Others are vital to the lives of ourselves and others, for instance remembering to check machinery in line with manufacturers’ recommendations. Often, our delayed intentions are habitual, such as remembering to take medication at the correct prescribed intervals or remembering to put out the recycling for collection on a scheduled day. However, they can also be one-off events, such as remembering to meet a friend at a certain café at an agreed time. In all cases, however, they involve a delay between forming an intention and being able to act upon it, even if this delay is of only a few seconds.

Cues (or reminders) to carry out our intentions can be either event-based or time-based (McDaniel & Einstein, 2007). Cues are event-based when we need to remember an intention when encountering a specific situation. In such cases, people or objects in our immediate surroundings should provide a cue to remember the task; for instance, walking by a post-box should remind us to post the letter in our bag. A cue is time-based when we need to remember to carry out an intention at a specified time in the future; for example, ringing a colleague back in 30 minutes’ time.

Prospective memory is a complex form of memory. Firstly, we must remember at the appropriate point that we need to do something. This is the prospective (or planning) component. Secondly, we must also remember what that “something” that needs to be done actually is. This is the retrospective component. The prospective and retrospective components need to work in concert for prospective memory to be successful. No doubt, we have all felt that odd sensation where we remember that we meant to do something but cannot remember what it actually was. In this case, the prospective component has worked correctly in alerting us to a delayed intention but there has been a failure of the retrospective component to access the information we needed to carry out the intention. Similarly, there is that sinking feeling that we feel when we remember that we meant to do something long after the time to do it has passed. Here, the prospective component has failed to trigger a reminder at the appropriate time and has “fired” too late to be of any use to us.

Prospective memory often requires contributions from the executive functions to ensure intentions are successfully remembered at the appropriate point in the future. The involvement of the executive functions is usually greatest when time-based prospective memory is required. In such cases, the individual must generate mentally his or her own cues to remember to carry out the intention. There are no obvious cues in the surrounding environment to support remembering; instead, strategies to help remember must be self-generated and executive functions are argued to be involved in this process.

It should not be a surprise that failures are common in everyone’s lives. We have all forgotten to post a letter in our bag as we intended, failed to attach a file to an email as we meant to do only seconds before or forgot to pay a bill on time as we intended! However, some literature from the late 1970s to early 2000s suggested that such errors might be more frequent in people with dyslexia (see Smith-Spark, 2017b, for a review). In this research, difficulties with planning, organisation, time management, and absentmindedness were all identified. These are areas that overlap with prospective memory and suggested that problems might also exist in this area. To see whether prospective memory was indeed affected by dyslexia, Smith-Spark et al. (2016a, 2016b, 2017a, 2017b) carried out a series of studies comparing groups of adults with and without dyslexia. In each study, the groups were matched for IQ and age but the group with dyslexia were worse than the group without dyslexia on reading and spelling measures.

Increased prospective memory failure has implications across work, educational, social, and personal settings. As a result, relative strengths and weaknesses need to be documented so that these can be recognised in support plans and reasonable adjustments made. Smith-Spark et al. therefore set out to explore prospective memory in adults across laboratory and everyday settings.

Self-report questionnaires tell us about the typical prospective memory experience of respondents over different periods of time (such as in the past week, month or year). Two well-established questionnaires were used by Smith-Spark et al. (2016b, 2017a) to assess how often different types of prospective memory failure occur.

Firstly, Smith-Spark, Zięcik, et al. (2016a) used the Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie & Maylor, 2000). The adults with dyslexia identified more frequent memory failures in prospective memory (retrospective memory, relating to memory for personally experienced past episodes, was also reported as being worse). Smith-Spark et al. (2016b) also asked close associates of the PRMQ respondents to rate them using the same set of questions. The proxy-rating respondents also rated the adults with dyslexia as having more frequent memory problems. Collecting proxy-ratings is useful in ruling out lowered metacognitive awareness or self-esteem problems as alternative explanations of self-reported difficulties.

Secondly, Smith-Spark et al. (2017a) administered the Prospective Memory Questionnaire (PMQ; Hannon, Adams, Harrington, Fries-Dias & Gibson, 1995). The adults with dyslexia again self-reported more frequent overall problems with their prospective memory. More specifically, they identified greater problems when an intention was a one-off and had to be remembered over a longer delay. The adults with dyslexia also reported more problems when they had to generate internal cues to remember a task. In contrast, when tasks were habitual and over the short-term, no differences in the frequency of self-reported prospective memory failure were found in the self-reports of the two groups.

Having found higher frequencies of self-reported prospective memory difficulties in adults with dyslexia, Smith-Spark et al. (2016b, 2017a) investigated whether dyslexia-related problems could be found under controlled laboratory conditions.

On the Memory for Intentions Test (MIST; Raskin, Buckheit & Sharrod, 2010), the participants were asked to carry out a 30-minute word search puzzle. They had to break out from this ongoing activity to perform the prospective memory tasks. Eight prospective memory tasks were presented to participants at set points during the 30-minute test duration. These tasks varied in whether responses were prompted by time or event cues, the delay between receiving a prospective memory task instruction and it needing to be performed (either two minutes or 15 minutes), and the type of response which needed to be produced (either verbal or action). Smith-Spark et al. (2017a) administered the MIST to the same participants who had completed Hannon et al.’s (1995) PMQ. Consistent with their self-reported difficulties, the adults with dyslexia were less accurate in successfully carrying out the prospective memory tasks overall. In addition, the adults with dyslexia were less accurate in making prospective memory responses when time cues were presented. However, they performed at the same level as the adults without dyslexia when event cues were used. There was also no difference between the groups in recognising the prospective memory instructions correctly when asked to recognise them after testing. This latter finding indicates that the prospective memory instructions were successfully encoded and retained in memory by the adults with dyslexia over the course of the task. As a result, dyslexia-related problems may be more related to remembering the task successfully at the point at which it is appropriate to respond.

Smith-Spark et al. (2016b) presented arrays of celebrity faces to their participants and asked them to decide whether more of the celebrities were living or deceased by pressing one of two keys on a keyboard. In addition to this ongoing 14-minute task, the participants were instructed every three minutes to press a specific key on the keyboard of a computer positioned behind them. The placing of the computer behind participants meant that there was no obvious cue to remind participants to make the prospective responses, making it a time-based task. They were also allowed to check a computer clock positioned behind them as often as they liked. These clock checks were recorded. The adults with dyslexia were less accurate at remembering to perform the prospective memory task than the adults without dyslexia. They also checked the clock provided less frequently during the experiment.

A further challenge to the research team was to see whether prospective memory deficits could be observed under naturalistic and semi-naturalistic conditions. Two time-based prospective memory tasks embedded in more naturalistic contexts indicated that deficits could be observed in less tightly controlled settings. One task involved a delay of 40 minutes and required the participants to remember to remind the experimenter to save an important computer file (Smith-Spark et al., 2016b). The second involved a delay of 24 hours and required the participants to leave a telephone message for the experimenter (Smith-Spark et al., 2017a). On both these time-based tasks, the adults with dyslexia were less likely to remember to carry out the task successfully and more likely to fail to perform it.

Naturalistic event-based prospective memory was also explored over a one-week delay (Smith-Spark et al., 2017b). The participants were asked to reply to a text message sent to them a week after a laboratory testing session. This text message was blank, meaning that there was no supporting information to help prospective memory beyond the event cue provided by the arrival of the text message itself. The adults with dyslexia were found to be more likely not to perform the prospective memory response than to perform it, while the adults without dyslexia were more likely to perform the prospective memory task than not to carry it out. After having the opportunity to make their responses, the participants were asked how important it was to them to complete the task, how many times they had thought of the task in the intervening week, and whether or not they had remembered the task instructions. No differences were found between the adults with and without dyslexia in how often they reported having thought about the task during the week’s delay, nor did they differ in self-reported levels of motivation to complete the task successfully. However, fewer adults with dyslexia reported successfully remembering the task instructions.

Over these studies, Smith-Spark et al. (2016a, 2016b, 2017a, 2017b) have found poorer prospective memory in adults with dyslexia. Similar patterns have emerged under both laboratory conditions and in everyday life. To summarise, dyslexia-related problems seem to occur mainly when performance is time-based, when it has to be self-initiated (meaning that there are no salient cues to remember being provided by the surrounding environment), when tasks are one-off (rather than being a habitual or customary prospective memory activity), and when instructions need to be remembered after a longer delay between forming an intention and being able to act upon it. Possible explanations for these problems are considered in Smith-Spark (2017b) with links being made to dyslexia theory.

Having found evidence of prospective memory problems in dyslexia, the question then becomes one of how to improve matters. There are several strategies which can be used. Based on the evidence described previously, the delay between task instructions being given to people with dyslexia should be reduced as much as possible (or, where there has to be a long lead-in time to carrying out a task, frequent externa reminders need to be given). Converting time-based tasks to event-based tasks (where many fewer dyslexia-related problems are found) would also be a good approach. For example, making use of visual cues (such as placing objects in prominent but unusual places) or auditory alarms (such as mobile phone or cooker clock alarms) can help in this regard. Repetition of task instructions several times, visualisation of oneself doing the task in the future, and forming detailed mental plans relating to the task (which consider the what, where, and when of the intended action) have all been found to be good general means of improving prospective memory performance. There is no reason to suppose that they would not be equally successful for adults with dyslexia; nor should this advice apply only to adults. Ideally, support with prospective memory needs to start earlier in life. Alongside support for literacy-based activities, instructing children with dyslexia in these approaches would also stand them in good stead for the responsibilities of adulthood.

In conclusion, less accurate prospective memory has been found in adults with dyslexia. These difficulties need to be recognised when making reasonable adjustments in work and educational settings. Doing so will help adults with dyslexia achieve their full potential.

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