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SHIFT COSTS OF PREDICTABLE AND UNEXPECTED SET SHIFTING IN YOUNG AND OLDER ADULTS

Marieke VAN ASSELEN and K. Richard RIDDERINKHOF
University of Amsterdam, The Netherlands

The main purpose of the present study was to assess the extent to which mixing costs, predictable shift costs, and unexpected shift costs are subject to the effects of aging. To that end, a modified version of traditional task-shifting experiments was developed, which yielded several new findings. Consistent with the task-set reconfiguration view of set shifting, the costs of an unexpected shift were greater than those associated with a predictable task shift. Mixing costs, predictable shift costs, and unexpected shift costs were all observed to increase with age. The effects of age on predictable shift costs could be explained largely in terms of global slowing, whereas age effects on mixing costs and unexpected shift costs were substantially greater than could be expected on the basis of global slowing alone. Thus, when a more representative form of shift cost was studied, the efficiency of the control processes involved in set shifting turned out to be highly sensitive to the effects of age.

Set Shifting Paradigms: A Brief Overview

Adequate acting in response to the demands of the environment requires a set of adaptive control processes, central to which is the ability to shift rapidly between different daily-life actions. Task-shifting experiments allow us to study the basic set-shifting abilities as invoked in switching between different task sets. In these experiments, subjects shift rapidly between two or more speeded simple cognitive tasks. Task alternations are defined as trials in which the task differs from the task performed on the preceding trial, whereas task repetitions are trials in which the task is the same as the task performed on the previous trial. Since Jersild's (1927) seminal investigations, the costs of set shifting have come to be expressed in various ways (for a recent overview see Monsell, Yeung, & Azuma, 2000).

Initial task-shifting investigations examined response times (RTs) of continuous alternations of two tasks on successive trials (e.g., ABAB) and response times on successive trials of the same tasks (e.g., AAAA). Shift costs in this so-called *task-alternation procedure* are expressed as the difference in RT between repetition blocks and alternation blocks (Jersild, 1927;

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Correspondence concerning this article should be addressed to the second author at the Department of Psychology, University of Amsterdam, Roetersstraat 15, 1018 WB Amsterdam, The Netherlands. Electronic mail may be sent to richard@psy.uva.nl.

Allport et al., 1994). Rogers and Monsell (1995) used an adjusted procedure, termed the *alternating-runs procedure*, in which subjects shift every *n*th trial, instead of every trial (e.g., for $n = 2$ the sequence could be ABBA). In the alternating-runs procedure, shift costs are expressed as the difference in RT between shift trials and repetition trials within the same run. An advantage of this procedure over the task-alternation procedure is that the latter procedure may yield differential memory loads between repetition and alternation blocks. In alternation blocks, subjects need to maintain task instructions for both task A and task B in working memory while performing each task. Since only one task is maintained in working memory in the homogeneous repetition list, the resulting difference in demand on working-memory could contribute to the difference in RT that was attributed to the requirement to shift set. In the alternating-runs procedure shift costs are derived from trials within heterogeneous blocks, so that working-memory demand should be equal in repetition and alternation trials.

Meiran (1996) argued that a more representative picture of shift costs could be obtained if this working-memory demand (of having to keep track of the task sequence in order to decide which task to perform) was lifted altogether. Thus, instead of presenting two tasks in a fixed order, Meiran presented two tasks in random order, with a task cue preceding each task stimulus to indicate which task was to be performed on that task stimulus. In this procedure, termed the *two-stimulus procedure*, on one (randomly selected) half of the trials the task cue designated a task repetition, whereas on the other half the task cue signaled a task alternation. Shift costs are again expressed as the difference in RT between alternation and repetition trials.

Predictable Versus Unexpected Set Shifting

In each of the above-described procedures, subjects know in advance which task to perform on the upcoming stimulus, affording adequate preparation for the imminent task, even when that task is different from the task performed just before. Daily-life analogues of such situations occur, for instance, when a car-driver who is looking for direction signs to figure out which way to go spots a traffic sign indicating a crossing. The traffic sign then enables the person to (temporarily) abandon the direction-looking set and instead to prepare actions relevant to the new task (e.g., slow down, anticipate traffic coming from different directions, determine whether to take or yield priority, and so on).

However, other set-shift situations may occur in which advance preparation is not possible. For example, an animal suddenly crossing the road requires an immediate action on the part of the driver (e.g., braking, or steering around the animal, depending on other circumstances), in order to avoid an accident. This event could not have been foreseen, so that advance preparation for the new task was not possible; the shift of set was unannounced and unexpected.

These examples indicate that two different instances of set shifting can be distinguished, the first of which we call a predictable task shift, the second an unexpected task shift. Empirical studies of task shifting have typically examined the costs of predictable shifts. The costs of unexpected shifts, although at least as representative for adaptive control processes as predictable shifts, have up to now been neglected in the literature on task shifting. This omission is somewhat surprising in view of the large literature on the Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948), a neuropsychological adaptive-control test that draws heavily on set-shifting abilities in situations where an unannounced and unexpected shift of task set occurs frequently.

Thus, one purpose of the present study was to develop a variety of the task-shifting paradigm in which task shifts are sometimes unexpected, and in which shift costs for predictable and unexpected shifts can be disentangled. One explanation of shift costs is in terms of task-set reconfiguration (e.g., Rogers & Monsell, 1995). With predictable task shifts, task-set reconfiguration can be initiated as soon as implicit or explicit task cues indicate that a new task is coming up; with unexpected task shifts, by contrast, task-set reconfiguration cannot start until the stimulus itself designates the new task. Thus, task-set configuration processes are initiated earlier in predictable compared to unexpected shifts, rendering greater shift costs in the latter case.

An alternative view of shift costs is in terms of proactive interference (e.g., Allport, Styles, & Hsieh, 1994). In this view, that has recently been modified an extended (e.g., Wylie & Allport, 2000), when a task alternation requires the performance of a task that differs from the preceding one, there remains some residual activation for the task set associated with the preceding trial by the time that the task set associated with the present trial gets activated. This residual task-set activation then interferes with the activation for the new task for many successive trials after switching from the competing task (Wylie & Allport, 2000). This interference is expected to be stronger when a task set has been performed more often, and consequently has more strongly associated S-R bindings than the competing task. In this conjecture, since the predicted task is typically performed more often than the unexpected task, the task set associated with the unexpected task must be activated more strongly to attain the level of activation required for task performance. Thus, in case of a task shift, the task set associated with the unexpected task will produce greater interference with the competing task than vice versa. This will result in greater shift costs in shifting from the unexpected to the predicted task than in shifting to the unexpected task.

Thus, differential predictions can be derived from the task-set reconfiguration and proactive-interference accounts: the former would predict the costs of an unexpected shift to exceed those of a predictable shift, whereas the latter would predict the opposite effect.

Set Shifting and Neurocognitive Aging

Recent neuropsychological and neuro-imaging studies have started to identify frontal brain structures (especially the left dorsolateral prefrontal cortex) as the brain areas that are most prominently involved in set-shifting competence (Mecklinger, von Cramon, Springer, & Mattes-von Cramon, 1999; Meyer et al., 1998; Rogers et al., 1998). On the basis of PET and MRI studies (e.g., Coffey et al., 1992; Cowell et al., 1994; Loessner et al., 1995; Moeller et al., 1996; Murphy et al., 1996; Petit-Taboué, Landeau, Desson, Desgranges, & Baron, 1998; Raz et al., 1997), the effects of aging are generally thought to be most pronounced in these parts of the brain (for reviews see Raz, 2000; van der Molen & Ridderinkhof, 1998; West, 1996).

If set shifting involves the brain areas that are especially sensitive to the effects of aging, older adults can be expected to experience greater cognitive inflexibility compared to young adults. This decreasing adaptive control is expressed in an increase in shift costs as adults grow older, a finding first documented by Botwinick, Brinley, and Robbin (1958) and replicated more recently in many studies (e.g., Hartley, Kieley, & Slabach, 1990; Kramer, Hahn, & Gopher, 1999; Kray & Lindenberger, 2000; Mayr, in press; Ridderinkhof, 2000; Salthouse, Fristoe, McGuthry, & Hambrick, 1998). However, some studies report that these age effects are proportional to (and hence can be explained in terms of) age effects on processing speed in general (e.g., Brinley, 1965; Hartley et al., 1990; Salthouse et al., 1998). According to global-slowing theory, cognitive slowing is generalized and applies to all component processes to the same proportional extent (e.g., Cerella, 1985; Cerella & Hale, 1994; Myerson, Hale, Wagstaff, Poon, & Smith, 1990; Salthouse, 1996). Thus, as RT to task alternations is slower than to task repetitions, shift costs are predicted to be greater in absolute but not relative terms for older compared to young adults.

To examine whether the effects of Age Group on RT exceeded global slowing, several types of statistical tests have been proposed. One such type of test examines whether the age-related increase in the factor effect of interest is superproportional, that is, greater in magnitude than could be expected on the basis of global slowing alone. Several authors have argued that since the global slowing effect of age on RT is best described by an exponential increase, the natural logarithm of RT implicitly corrects for this general trend (e.g., Kray & Lindenberger, 2000; Mayr, in press). If factor effects still interact with Age Group after the log-tramsform, then it can be inferred that the Age Group by factor interaction is superproportional to global slowing. Another analytical approach examines the independence or covariance issue, that is, examines whether the variable of interest is subject to age-related variance independent of age-related variance in a global-speed control variable (e.g., ANCOVA, hierarchical regression, or structural equations modeling).

Salthouse et al. (1998) used structural equations modeling and obtained evidence to suggest that much of the age-related variance in shift costs could be accounted for by age-related variance in basic perceptual processing speed. Using structural equations modeling (and other converging techniques) we have recently shown, however, that the effects of aging on performance in speeded executive control tasks are captured better by a model that includes executive control factors in addition to a global slowing factor than by a model including only the latter factor (Span, Ridderinkhof, & van der Molen, 2001). Other studies have also reported that age effects on shift costs are independent of (Kramer et al., 1999) or superproportional to (Botwinick et al., 1958; Ridderinkhof, 2000) age effects on basic processing speed.

Kray and Lindenberger (2000) and Mayr (in press) tried to separate age effects on those components of set-shifting that were specifically related to the shift situation and those related to the dual-task situation in general, by differentiating between specific switch costs and general shift costs. General shift costs were defined as latency differences between heterogeneous and homogeneous blocks; specific shift costs were defined as differences between shift and non-shift trials within heterogeneous blocks. General shift costs were significantly greater than specific shift costs. Moreover, general shift costs were superproportional to global slowing, whereas specific shift costs were not. These authors concluded that the ability to efficiently maintain and coordinate two alternating task sets in working memory instead of one is more negatively affected by advancing age than the ability to execute the task shift itself. However, general and specific shift costs appear to be somewhat confounded: general shift costs are based on a comparison of homogeneous and heterogeneous blocks, where the latter include both repetition and alternation trials (and hence specific shift costs). A more conventional way to analyze the component of set shifting that is related to the general dual-task requirements is to examine *mixing costs*: the difference in RT between task repetitions in pure tasks and task repetitions in mixed tasks (cf. Los, 1996).

The Present Study

In the present study we set out to assess the extent to which mixing costs, predictable shift costs, and unexpected shift costs are subject to the adverse affects of age, and to assess which of these age trends exceed the general effects of global slowing. The costs of an unexpected shift may provide a window on the effects of age on adaptive control abilities that is more representative of daily-life examples of cognitive flexibility than traditional measures. From the task-set reconfiguration and proactive-interference accounts of task shifting differential hypotheses as to unexpected shift costs were derived, the former predicting them to be greater than costs of a predictable shift, the latter predicting them to be smaller.

In the experiment to be reported below, two simple response time tasks were performed, each of them associated with a separate set of stimuli. Within a given block of trials a task cue always signaled the same task to be performed on the upcoming stimulus. However, in some cases, the task cue (signaling, e.g., task A) is followed by a stimulus that is associated with the other task (task B). In that case, task B is to be performed on the stimulus, without the possibility of advance preparation. These task shifts are called the unexpected task shifts. When after an unexpected task shift the task cue for task A is presented, followed by a task A stimulus, the subject is to shift back to task A, this time with the possibility of advance preparation. These task shifts are called the predictable task shifts. Shift costs will be examined in both predictable and unexpected shifts by comparing the relevant alternation trials to the repetition trials (in this example the task A repetitions). Mixing costs are examined by comparing the repetition trials from the mixed blocks with the (repetition) trials from pure blocks. The effects of age on mixing costs, predictable shift costs, and unexpected shift costs are assessed by administering these tasks to groups of young and older adults.

Method

Participants. One group of 17 participants, between ages of 18 and 25 years, was recruited from among the first-year psychology students at the University of Amsterdam. The 14 women and 3 men received course credits for their participation and were tested individually at their university in a sound-attenuated room. The second group of 17 participants, between ages of 66 and 81 years, were all volunteers recruited through local networks. The 8 women and 9 men were tested at their homes and received a small gift for their participation.

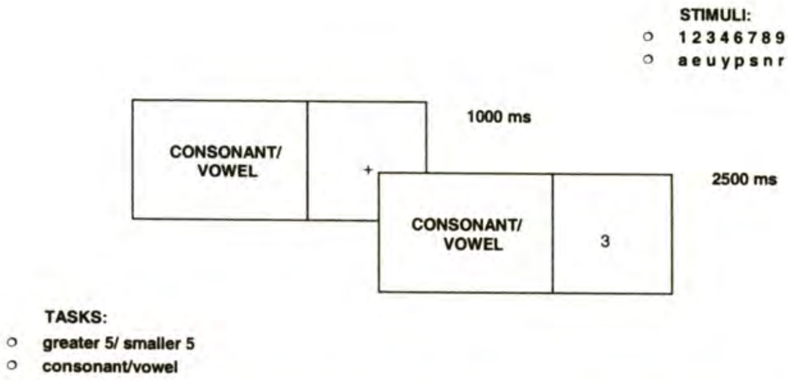

Figure 1. The task cues and stimuli used in the current experiment.

Stimuli and apparatus. An Apple Macintosh Plus computer was used for stimulus presentation and response registration. The permanently visible stimulus display consisted of two rectangles in which task cues and stimuli were presented. The right-most rectangle was presented in the center of the computer screen, and contained a small fixation cross in its center. Task stimuli replaced the fixation cross, which returned when the stimuli disappeared. The left-most rectangle could contain a task cue in its center. The display is illustrated in Figure 1. A task cue (either "CONSONANT /VOWEL" or "LESSER 5 / GREATER 5" in its Dutch equivalents) appeared during 1000 ms and indicated which of the two possible tasks should be performed. The first task was to decide whether a number was less than five or greater than five. The second task was to decide whether a letter was a vowel or a consonant. Next, the task cue disappeared and a central stimulus was presented, which was a number or a letter, depending on the task. The stimuli were selected randomly from the numbers 1, 2, 3, 4, 6, 7, 8, 9 or from the letters a, e, u, y, p, s, n, r. The task cues and stimuli were written in font Geneva, size 12. The stimulus remained on the screen until the participant pressed a key or until 2500 ms had elapsed. The next trial was presented after 500 ms. Numbers smaller than 5 and consonants required a key-press response with the index finger of the left hand on the 'z' key of the computer keyboard; all other stimuli required a right-hand response with the '/' key.

Eighty percent of the trials were 'regular trials', in which case the presented stimulus corresponded to the task cue presented just before. Twenty percent of the trials (selected randomly) were 'deviating trials'. In these trials the stimulus belonged to the task that was not prepared; the task to be performed was dictated by the stimulus, since stimuli were uniquely mapped onto the two tasks.

Design and procedure. Participants were instructed to respond as quickly as possible and to work accurately. After extensive task instruction, they first practiced during two 'pure' blocks with the two different tasks, after which they practiced during two blocks with mixed tasks. Mixed blocks contained task cues that always signaled the same task; in 20% of the trials a stimulus associated with the alternative task was presented. Half of the (pure as well as mixed) blocks contained the "CONSONANT/VOWEL" task cue, the other half contained the "LESSER 5 / GREATER 5" cue. Practice blocks consisted of 40 trials each. The sequence in which these practice blocks were presented was equal for all participants. The practice blocks were excluded from the data analyses.

In the experimental phase the two pure tasks and the mixed tasks were performed three times each; each experimental block consisted of 80 trials. The course of presentation of these conditions was counterbalanced over participants. The total experiment lasted about 75 minutes, including instruction, practice, and short breaks.

Results

Mean RTs and accuracy of the correct responses per condition (presented in Tables 1 and 2) were submitted to analyses of variance. Each of these ANOVAs included the between-subjects factor Age Group (young versus older adults). Mixing costs were analyzed by assessing the effects of the within-subjects factor Mix (pure repetitions versus mixed repetitions). Shift costs were assessed in several analyses. First, an overall analysis examined whether RTs from mixed blocks differed as a function of the within-subjects factor Shift (repetitions versus predictable alternations versus unexpected alternations). If this effect was significant, follow-up analyses zoomed in on predictable and unexpected shift costs. One analysis included the within-subjects factor Predictable Shift (repetitions versus predictable alternations); the other included the within-subjects factor Unexpected Shift (repetitions versus unexpected alternations). Predictable and unexpected shift costs were compared against each other in an analysis that included the within-subjects factor Shift Type (predictable versus unexpected alternations).

To examine whether the effects of Age Group on RT exceeded global slowing, the same analyses were performed on log-transformed RTs. It has been argued elsewhere (e.g., Kray & Lindenberger, 2000; Mayr, in press) that since the global slowing effect of age on RT is best described by an exponential increase, the natural logarithm of RT implicitly corrects for this general trend. If factor effects still interact with Age Group after the log-transform, then it can be inferred that the Age Group by factor interaction is superproportional to global slowing.

Table 1. *Mean RTs for Young and Older Adults in Each of the Conditions*

Group	Reaction Time (ms) per trial type			
	Pure repetition	*Mixed repetition*	*Predictable alternation*	*Unexpected alternation*
Young	466	470	493	526
Old	599	645	713	783

Table 2. *Mean Error Rates for Young and Older Adults in Each of the Conditions*

Group	Accuracy (%) per trial type			
	Pure repetition	*Mixed repetition*	*Predictable alternation*	*Unexpected alternation*
Young	5.3	5.8	6.3	6.8
Old	2.5	2.0	4.9	5.5

Mixing Costs

Older adults responded substantially slower than young adults (133 ms), as expressed in the main effect observed for Age Group ($F(1,32)=52.52$, $p<.001$). Significant mixing costs averaged 25 ms ($F(1,32)=14.24$, $p=.001$), replicating the typical finding that responses are slowed when the task is embedded in a context that contains other tasks as well. Importantly, these mixing costs were greater for older compared to young adults ($F(1,32)=10.32$, $p=.003$; see Figure 2). This interaction effect did not disappear when RTs were log-transformed ($F(1,32)=8.55$, $p=.006$), indicating that the effect of Age Group on mixing costs could not be explained in terms of global slowing.

On average, older adults responded somewhat more accurately than young adults ($F(1,32)=8.73$, $p=.006$), which suggests that the overall effect of Age Group on RT could be explained in part by older adults' tendency to trade speed for accuracy. Importantly, however, the factor Mix did not affect response accuracy ($F(1,32)=.01$), nor did it exert differential effects in the two Age Groups ($F(1,32)=1.40$). Thus, the finding that mixing costs on RT were greater for older compared to young adults could not be attributed to speed/accuracy trade-off.

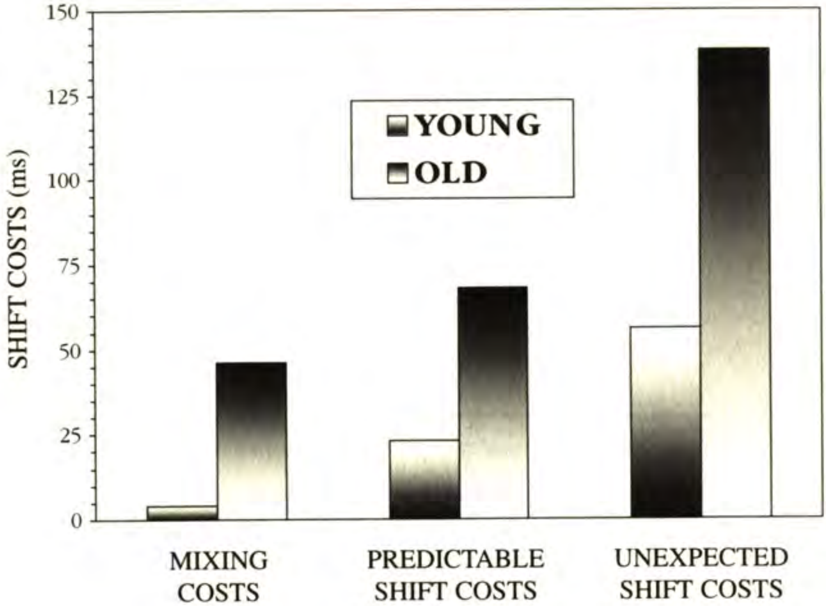

Figure 2. Shift costs of young and old adults for predictable and unexpected task shifts.

Shift Costs

Overall analysis. The overall Shift factor influenced mean RT significantly ($F(2,64)=33.35$, $p<.001$), and this effect was modulated by Age Group ($F(2,64)=6.02$, $p=.004$). This outcome warranted follow-up analyses to focus explicitly on predictable and unexpected shift costs.

Predictable shift costs. Consistent with the typical findings, Age Group influenced response speed ($F(1,32)=50.77$, $p<.001$). A main effect of Predictable Shift ($F(1,32)=17.88$, $p<.001$) confirmed that predictable task alternations were associated with a shift cost of 51 ms on average. Moreover, predictable shift costs were greater for older compared to young adults ($F(1,32)=4.40$, $p=.044$; see Figure 2). However, this interaction effect no longer obtained when RTs were log-transformed ($F(1,32)=2.92$); thus, the effect of Age Group on predictable shift costs could be explained largely in terms of global slowing, although a trend in the expected direction was still present ($p=.097$). The effects on RT did not result from speed/accuracy trade-off, since response accuracy was not influenced by any main or interaction factor (all Fs <2.70).

Unexpected shift costs. Age Group again exerted the typical effect on mean RT ($F(1,32)=43.82$, $p<.001$). Compared to task repetitions, unexpected task alternations slowed RT by 97 ms ($F(1,32)=47.47$, $p<.001$). Most important, these unexpected shift costs differed significantly between Age Groups ($F(1,32)=8.56$, $p=.006$; see Figure 2). This interaction effect obtained also when RTs were log-transformed ($F(1,32)=4.69$, $p=.038$), indicating that the effect of Age Group on unexpected shift costs could not be explained in terms of global slowing. The effects on RT did not result from speed/accuracy trade-off. The marginally significant effect of Unexpected Shift on accuracy ($F(1,32)=3.44$, $p=.073$) was in the direction as expected; the main and interaction effect involving the factor Age Group did not approach statistical significance (Fs <1.90).

Unexpected versus predictable shift costs. Compared to predictable task alternations, unexpected task alternations slowed RT by 52 ms ($F(1,32)=24.11$, $p<.001$). Age Group appeared to modulate this effect (33 ms for young adults versus 70 ms for older adults), but this interaction effect only approached statistical significance ($F(1,32)=3.16$, $p=.085$).

Discussion

Task-shifting experiments have demonstrated that cognitive flexibility and adaptive control abilities decline with age. The adverse effects of age have been studied by examining the time costs of predictable shifts between simple cognitive tasks. We argued that the costs of an unexpected shift may provide a more representative picture of age-related changes in set-shifting efficiency. The main purpose of the present study was to assess the extent to which mixing costs, predictable shift costs, and unexpected shift costs are subject to the effects of aging. Mixing costs were defined as the difference in RT to repetition trials from mixed and pure tasks. Predictable shift costs were expressed as the difference in RT to predictable alternation trials and repetition trials from mixed blocks, whereas unexpected shift costs were reflected in the difference in RT to unexpected alternation trials and repetition trials.

The finding that unexpected shift costs exceeded predictable shift costs is consistent with the prediction derived from the task-set reconfiguration view of set shifting (cf. Rogers & Monsell, 1995), but not with the proactive-interference view (cf. Allport et al., 1994). In the former conjecture, task-set reconfiguration is initiated as soon as it is clear which task is to be performed next. In case of predictable task shifts, the target task is indicated by the task cue, whereas in case of unexpected shifts, the target task is indicated only by the stimulus itself. In the latter case, task-set reconfiguration starts later and hence is completed later, resulting in greater shift costs. In the proactive-interference conjecture, residual activation for a preceding task set interferes with activation for the present task. This interference remains for successive trials and is influenced by the strength of the association between stimuli and responses. Since the frequency of occurrence for the predicted task was much greater than for the unexpected task, the task set associated with the unexpected task must be activated more strongly (and the competing task set suppressed more actively) to attain the level of activation required for task performance. Thus, in case of a task shift, the task set associated with the unexpected task will produce greater interference with the competing task than vice versa. Hence, the proactive-interference view would predict greater shift costs for predictable compared to unexpected shifts in the present study. The data showed the opposite pattern, as predicted by the task-set reconfiguration view.

Allport et al. (1994; Wylie & Allport, 2000) based their theory in part on the finding that it is easier to switch to a weaker task than to a stronger task. However, Monsell et al. (2000) have recently argued against the universal validity of this finding, and proposed two possible explanations. First, in special cases of extreme inequality of association strengths, inhibition of the stronger task set might be a special strategy. Second, if there is a proactive interference effect, it might be masked by slower post-stimulus control operations for more complex tasks.

A factor that might provide an alternative account of the present findings pertains to the particular implementation of unexpected task shifts in the present experiment. A stimulus not belonging to the task set that was just prepared, nor to the task set of recent trials, might induce some form of surprise and result in a brief arrest of action. Such a period of arrest might explain the observed difference in shift costs. However, subjects were instructed about the occurrence of infrequent unexpected task shifts, and received practice blocks to familiarize them with this procedure. Across the whole experiment both tasks occurred equally often and were equally well practiced. Therefore, in our interpretation, it was not some arrest factor but rather the lack of advance preparation for the new task that caused the costs of unexpected shifts to be greater than those associated with predictable shifts.

Effects of Aging

Mixing costs, predictable shift costs, and unexpected shift costs all increased with age. When examining log-transformed RTs, these age effects on mixing costs and unexpected shift costs were still present, whereas age effects on predictable shift costs were strongly attenuated. These observations were taken to indicate that the effects of age on predictable shift costs could be explained largely in terms of global slowing, whereas age effects on mixing costs and unexpected shift costs were substantially greater than could be expected on the basis of global slowing alone.

The finding that mixing costs but not predictable shift costs are superproportionately affected by aging replicates previous reports (Kray & Lindenberger, 2000; Mayr, in press), even when mixing costs were (in the present definition) not contaminated with shift costs. Older adults' performance appears to deteriorate in tasks that require them to maintain two task-sets in working-memory. A new finding, however, is that unexpected task shifts are associated with costs that are substantially larger than the costs of predictable task shifts, and that unexpected (as opposed to predictable) shift costs increase with age beyond global slowing. Thus, when a more representative form of shift cost was studied, the efficiency of the control processes involved in set shifting turned out to be highly sensitive to the effects of age. This conclusion is in agreement with a recent study from our lab, in which the effects of aging on perseverative errors in WCST-like tasks was attributed to age-related declines in basic set-shifting abilities (Ridderinkhof, Span, & van der Molen, in press).

Conclusion

The costs of an unexpected task shift were found to be greater than those associated with a predictable shift. Both predictable and unexpected shift costs increased with age, but only the latter age effect was greater than could be explained by global slowing effects. These findings provide new insights into the effects of aging on set-shifting abilities, and pave the way for examining more representative processes of task-set configuration.

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