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# Social strain and executive function across the lifespan: The dark (and light) sides of social engagement

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## Abstract

We investigated how the association between social strain and cognitive efficiency varies with task demands across adulthood, from latencies on simpler speeded tasks to tests involving executive function. Participants (N= 3280) were drawn from the MIDUS survey, a large, diverse national sample of adults who completed cognitive tests including speeded task-switching (Tun & Lachman, 2008). After controlling for demographic and health variables, we found that higher levels of reported social strain were associated with slower processing speed, particularly for the complex task-switching test relative to simpler speeded tests. Effects of strain were greatest for those with the lowest general cognitive ability. Moreover, those with very high levels of social strain but low levels of social support gave the poorest task-switching performance. These findings provide further evidence for the complex relationship between the social environment and cognition across adulthood, particularly the association between efficiency of executive functions and negative social interactions.

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The human brain has not evolved to function in isolation from others; rather, we are social creatures, with a special ability for communication and higher order cognitive processes. Indeed, some would suggest that these higher order abilities may have evolved at least partly out of the need to keep track of relationships and guide complex social behavior (e.g. Adolphs, 2003). However, our propensity for forming social networks carries with it both the benefits afforded by social support, and the negative consequences associated with social conflict and strain with partners, family and friends (Kiecolt-Glaser & Newton, 2001; Rook, 1998; Stansfeld, Bosma, Hemingway & Marmot, 1998). Previous research has shown effects of social engagement on cognition in later adulthood and old age (e.g. Seeman, Lusignolo, Albert & Berkman, 2001). In the current research our goal is to extend our understanding of the complex interaction between cognition and the negative aspects of social environments, across the lifespan from young adulthood through old age. In particular, we focus on the efficiency of executive control functions and their association with social strain, as well as possible interactive effects of social strain and social support. An important question is whether the effects of social strain across adulthood vary depending on cognitive task demands, and whether these effects may be more pronounced for complex executive function tasks than for simpler cognitive tasks.

On the positive side, social engagement in older adults has been shown to be associated with better cognitive, physical, and emotional status and less risk of mortality, morbidity, (Bassuk, Glass, & Berkman, 1999; Berkman, 1995; Hughes et al., 2008; Seeman, 1996;

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Seeman, et al., 2001) and dementia (Fratiglioni, Paillard-Borg, & Winblad, 2004). Greater social engagement in older adults is associated with better performance in several domains of cognitive function including memory, (Bosma, et al., 2002; Ertel, Glymour, & Berkman, 2008; Hultsch, et al., 1999; Richards, Hardy, & Wadsworth, 2003), verbal fluency (Bosma, et al., 2002; Hultsch, et al., 1999), executive function (Bosma, et al., 2002) and processing speed (Hultsch, et al., 1999). Although most findings are based on observational studies, statistical techniques such as the dual change score model have been used to support the position that social participation affects change in perceptual speed in older adults (Lovden, Ghisletta, & Lindenberger, 2005).

The reasoning behind these findings is that humans have evolved to have a "social brain" that facilitates living in groups, and that an individual's cumulative history of social interactions has important adaptive consequences for the brain. These effects are reciprocal, in that our social experiences impact physiological responses in the brain and downstream in other systems (McEwen, 2007). At the same time, these cumulative physiological effects shape the brain and the cognitive and emotional systems that are responsible for our perceptions of incoming stimuli, determining how we process new experiences. Thus, our social experiences help shape our brains, even as our social history serves as a lens through which we filter new experiences. In this constructive, dynamic process our experiences modify our brains, and our brains modify our experiences – by shaping how we perceive, interpret, and remember. Thus, social relationships may have their effects through physiological factors that have known associations with cognition, including reduced reactivity of neuroendocrine and cardiovascular systems, levels of stress hormones such as cortisol (Seeman, McEwen, Singer, Albert, & Rowe, 1997), and allostatic load (Seeman, et al., 2004).

The negative interactions that represent the dark side of social engagement can also impact a range of health outcomes, morbidity and mortality (Kiecolt-Glaser & Newton, 2001; Rook, 1998; Stansfeld, et al., 1998), as well as cognitive function. However, these aspects of social engagement have been less well studied than the positive aspects (Krause, Newsom & Rook, 2008). Engaging with others brings the likelihood of negative interactions including demands, criticism, and perceived isolation (Krause, Newsom & Rook, 2008). For example, Walen & Lachman (2000) reported that social strain predicted negative outcomes in health and well-being of middle-aged women. In another study, high-functioning older adults who experienced more cognitive dysfunction reported more negative social interactions (Gurung, Taylor & Seeman, 2003). Research has shown that negative social perceptions such as perceived social isolation can affect a range of cognitive functions, particularly executive function (Cacciopo & Hawkley, 2009).

These findings are consistent with research showing that negative social interactions are associated with heightened physiological reactivity (Seeman & McEwen, 1996), which has been further linked with risk of cognitive decline (Lupien et al., 1998; Seeman, et al., 1997). Negative social experience can result in chronic metabolic disturbance (Landsfeld, et al., 1998) and alter cortisol patterns, which modify the brain and thus may affect subsequent learning and cognitive function (McEwen, 2007). Similarly, animal research demonstrates that stressful experiences can produce negative changes in the brain, particularly in areas such as the hippocampus and medial prefrontal cortex, with reductions of synaptic density and neurogenesis that are associated with impairment of learning, executive function, and memory (Ferragud, et al., 2010; Magarinos, McEwen, Fluge, & Fuchs, 1996). In both younger and older adults, daily stress has been associated with slower responses on complex working memory tests (Sliwinski, Smyth, Hofer & Stawski, 2006), and in laboratory studies stressful interracial situations have been associated with poorer inhibitory control (Richeson & Trawalter, 2005). Overall, these findings make it plausible that social strain would have deleterious effects on the health of the brain and on cognition, particularly for more complex executive functions.

An additional question of interest is whether effects of social strain might vary across individuals with different levels of mental ability. Recently Stawski and colleagues (2010) found that older adults with better fluid cognitive abilities showed less reactivity to negative interpersonal stressors. Also, some researchers have suggested that higher levels of cognitive engagement and education may provide a cognitive reserve that makes individuals more resilient to the typical age-related declines seen in many mental abilities (Stern et al., 2005). Here we investigate the possibility that greater mental fitness might be associated with less vulnerability to effects of social strain.

A third question of interest is the extent to which social support might buffer the effects of social strain on cognitive performance. Some theorists have emphasized how the quality of social relationships (Rook, 1990) or the balance of support and strain affect physical and psychological health (Burman & Margolin, 1992), while other have proposed a stress-buffering role for social support (Landerman, George, Campbell & Blazer, 1989; Thoits, 2010). For example, social support can buffer effects of financial strain, particularly among older adults (Krause, 2005), although the interplay of negative interactions and social support for life stresses in later life is complex (Jay & Krause, 1991). There is some evidence that supportive social networks are related to better cognitive function in middle-age and later life (Holtzman et al., 2004; Bassuk, Glass, & Berkman, 1999; Seeman, et al., 2010) Also, laboratory studies have shown that greater spousal support is associated with lower cortisol responses to stress (Heffner, et al., 2004), and, more specifically, that social interactions have positive effects on executive function tasks in young adults (Ybarra et al., 2010). Neuroimaging studies demonstrate that social interaction activates a frontoparietal network that subserves executive function, and that cooperative interactions are associated with specific involvement of this region (Decety, Jackson, Sommerville, Chaminade, & Meltzoff, 2004). Taken together, these findings suggest that social support may help offset effects of stress on executive functions.

In examining the association between social strain and executive function in participants from the MIDUS II survey (Radler & Ryff, 2010) we have a unique opportunity to carry out a focused investigation across the adult lifespan in a large, diverse national sample of adults ranging in age from 30 through 80. The current study extends previous findings showing associations of social engagement with two general cognitive factors reflecting episodic memory and executive function, and of social strain with the executive function factor (Seeman, et al., 2010).

In the current work we refine and extend this line of investigation in three ways. First, the earlier study used a broader measure of executive function, a general factor that was derived from accuracy on several tests. In the current study we focus specifically on efficiency of executive function in terms of processing speed, using latencies on speeded measures drawn from the Stop and Go Switch Task (Tun & Lachman, 2008), which provides a fine-grained index of both simple speed of processing measures and complex function. These give a more focused index of executive function than the broader measure of intellectual function analyzed in our previous work (Seeman et al., 2010), and allow us to compare effects of social strain across a range of complexity of speeded tasks.

Our primary question is whether the effects of social strain vary with task demands on these speeded tests, which range from simple choice reaction time to complex task-switching. The task-switching component of the test assesses two important components of executive function – switching and inhibitory control -that have been identified by theorists as key control functions of the central executive component of working memory (Baddeley, 2002; Miyake et al., 2000) linked with activation of prefrontal cortex of the brain (West & Schwarb, 2006). Thus, this analysis focuses on processing efficiency as indexed by response times measured in milliseconds, which can provide a more sensitive measure than accuracy measures alone (Eysenck et al., 200; Tun, Benichov, & Wingfield, 2010).

Specifically, we hypothesize that latencies on the task-switching test of executive function should be especially sensitive to negative social interactions, as compared to latencies on simpler tasks. Neuroimaging work has demonstrated that task-switching is associated with brain activation in a network of regions in the prefrontal cortex (Gold et al., 2010; Hyafil, Summerfield, & Koechlin, 2009; Shomstein & Yantis, 2004), areas that may be especially vulnerable to effects of heightened reactivity from situations that are stressful (Oin, et al., 2009) and anxiety-producing (Derakshan & Eysenck, 2009). Similarly, we suggest that processing efficiency on the complex executive function task should show a larger negative association with social strain than simple processing speed measures.

An additional contribution of the current work is to examine whether effects of social strain on speed of processing and task-switching might vary depending on an individual's general level of mental functioning on other domains. Epidemiological research has suggested that those who are disadvantaged in educational background or attainment are most vulnerable to effects of stress (Thoits, 2010). Because the MIDUS sample also includes a general cognitive battery, we have the opportunity to investigate whether individuals with lower global cognitive ability will show larger associations between social strain and performance on a speeded test of executive function.

Finally, this paper extends previous work by investigating the interactive effects of social strain and social support. An unresolved question is whether higher levels of social support can buffer the association between social strain and executive function. Social support has been proposed as a efficacious buffer of chronic stress and strain (Thoits, 2010), and laboratory studies (Decety et al., 2004; Ybarra et al., 2010) have suggested that positive social interactions can engage executive function, which may help offset effects of strain over time.

Our goal is to shed light on how these negative and positive features of the social environment interact with task complexity and with efficiency of executive function across the adult lifespan.

## Methods

### Participants

Participants were drawn from the Midlife in the U.S. Study (MIDUS), which at Time 1 (1994/1995) included a national probability sample of 7,108 community-dwelling adults (Brim, Ryff, & Kessler, 2004; see Radler & Ryff, 2010 for details) representing a wide range of geographic, age, education and socio-economic status. Respondents were recontacted in 2005/2006 (MIDUS II), with a retention rate of 75% adjusted for mortality, including 949 siblings and 1913 twins. At Time 2 the participants completed a cognitive battery as well as a telephone interview and questionnaire. Table 1 shows the characteristics of the total sample, as well as the analytic sample of 3,280 who had complete and valid data for our measures of interest at Time 2. As compared to participants who did not have complete data, those included in analysis were more likely to be older, female, college educated, and married.

### Cognitive testing

Approximately 3 months after the MIDUS interview and questionnaire, participants completed a brief hearing screening followed by the Brief Test of Adult Cognition by Telephone (BTACT: Lachman, Agrigoroaie, Murphy & Tun, 2010; Lachman & Tun, 2008; Tun & Lachman, 2006). This battery yields a composite index of general cognitive function based on domains of memory, reasoning, speed and verbal fluency, administered by telephone (Lachman, Agrigoroaie, Tun & Weaver, under review).

Our analyses are based primarily on latency data from a subtest, the Stop and Go Switch Task, (SGST; Tun & Lachman, 2008). This is a dual executive-function task that provides performance latencies (in milliseconds) on speeded tasks: two baseline choice reaction time tasks and a more complex task-switching test that taps executive control functions including task-switching and inhibitory function (Baddeley, 2002). Participants carried out 2 single-task blocks of 20 trials each, first following a congruent ("Normal") response rule (say "STOP" to "RED", and "GO" to "GREEN"), then an incongruent ("Reverse") response rule that requires inhibitory control (say "GO" to RED", and "STOP" to "GREEN"). The mixed-task required alternating between the congruent and incongruent response rules each time a cue to switch was given; cues were not given on each trial, and thus the block of 32 trials included both nonswitch trials (no change of response rule), as well as switch trials that required a change of response rule. Criterion for inclusion was 75% accuracy on all conditions. We calculated each participant's median latency for correct trials in each condition, after removing outliers greater than 3 SD, then calculated group means across individuals. These measures have been validated on over 4000 people, showing good psychometric properties of reliability and validity (Lachman, Agrigoroaei, Tun, & Weaver, under review; Tun & Lachman, 2008). They provide an index of executive function and allow us to compare effects of social strain across a range of complexity of speeded tasks.

### *Social Engagement Measures* were collected from a self-administered questionnaire

*Social strain/conflict* represented the average of responses regarding how often spouse, other family, and friends were reported to be sources of demands, criticism, tension, or annoyance (see Walen & Lachman (2000) for details). Response on a 4-point scale ranged from, "1= often" to "4=never". *Social support* represented the average of responses regarding how much spouse, other family, and friends are sources of understanding and caring, and provide emotional support, using the same 4- point scale with 1 = "a lot" and 4 = "not at all". Items were recoded so that higher scores reflect higher levels of strain and support. These scales have demonstrated good reliability, with Cronbach's alphas for strain .79 – .81, and for support ..82 – .88 (see Walen & Lachman, 2000). Average levels of self-reported social strain and social support are shown in Table 1.

### Covariates

Socio-demographics included age (in years), sex, education, (based on a 6-category, degree-based measure ranging from "less than high school" to "Ph.D., ED.D. MD, or other professional degree"), and marital status. Health status included a measure of chronic problems, including heart problems, cancer, and stroke, with a range from 0 to 5, and a mean for this sample of 0.44, SD= .70.

## Results

### Analyses of effects of social strain on latencies from the Stop and Go Switch Task

Our primary goal in these analyses was to examine how effects of strain vary across four different speeded task conditions of the SGST. This included correct responses (in milliseconds) for baseline trials in the normal and reverse response modes, mixed-task nonswitch trials, and mixed-task switch trials. These were analyzed with analysis of covariance (ANCOVA) in order to detect interactions between the task conditions and effects of strain, as well as differences in age, cognitive ability and social support. Based on the distribution of the scores on social strain at testing time 2, we created four strain groups: low (mean = 1.43, SD= 0.20), medium (mean = 1.83, SD= 0.07), high (mean= 2.11, SD = 0.10), and very high (mean = 2.59, SD = 0.24). Thus, our analyses included a between-subjects factor of social strain (4; low, medium, high, very high) and a within-subjects factor of task condition (4: normal baseline, reverse baseline, mixed-task nonswitch trials, mixed-task switch trials). Factors that might be expected to impact cognitive performance were included as covariates: age, sex, marital status (married or not married), level of education, and health status.

A total of 3280 participants had complete data including demographic and health data, measures of social strain and support, and valid speeded task measures. In order to check on possible dependencies due to family membership of participants (twins or siblings from the same family), for each of the analyses described below we ran additional analyses in which we randomly selected one member from each family, then another member from each family. Because the pattern of significant results from these subsamples (N = 2654) was the same as for the full sample with regard to the effects and interactions of interest, we present the analyses of the full sample. The only exception, noted below in the section on social strain and social support, was that the significance of one 3-way interaction was reduced.

## Effects of social strain on speeded performance across age

We first examined the association between varying levels of social strain and performance on the speeded tasks across the age range. In order to examine possible interactions of strain with age we grouped participants into four age groups: 32–44, 45–54, 55–64, and 65 and older. Table 2 presents the complete data on all four conditions for these four age groups, grouped by level of strain. We analyzed these data in an ANCOVA with between-subjects variables of age (4) and strain (4), and Task condition (4) as a within-subject variable. Covariates were sex, level of education, marital status, and health status.

As expected based on previous work (Tun & Lachman, 2008), we found significant slowing of responses across age groups, $F(3, 3272) = 94.35$, $p < .001$, Partial Eta squared =.08, as well as significant effects of education, sex, marital status and health status. Figure 1 shows the performance of each of the age groups across the four conditions. Latencies increased across the task conditions with the fastest latencies on the simplest normal baseline condition, and the longest latencies for the mixed-task trials that required switching. As Figure 1 shows, this increase in latency across tasks was most pronounced for older adults, Task condition X Age group, $F(9, 9789)= 24.01$, $p< .001$, Partial eta squared = .022.

The overall effect of social strain was significant, $F(3, 3263) = 3.16$, $p<.05$, Partial eta squared = .003. However, the nonsignificant interaction of strain with age group suggests that the effects of strain were similar across adulthood ($F(9,3263) = 1.09$, n.s.).

Most importantly for our hypotheses, we found a significant interaction between Task condition and strain group, $F(9, 9789) = 2.058$, $p < .05$, Partial eta squared = .002. Differences between the four strain groups were most pronounced in the most complex condition - the mixed-task switch trials. On the switch trials the group with the highest social strain was about 55 ms slower than those with low social strain, a difference that was relatively small but significant. The effect size of strain was similar to those of sex, marital status, and health status. However, we found no evidence for age differences in this pattern, indicating that the association of strain with task-switching appears to be stable across the age range studied.

### General cognitive ability

Another question of interest was how associations between strain and task latencies might vary for individuals who differed in global mental ability. In order to control for general cognitive ability, we used a composite of the accuracy measures from the BTACT, which includes tests of episodic memory, working memory, reasoning, speed and verbal fluency. Participants were divided into tertiles based on the composite of standardized scores on these measures, in order to provide a general index of mental ability. We performed an ANCOVA with between-subjects groups of Strain (4) and General cognitive ability (3), a within-subjects variable of Task condition (4), and covariates including age, sex, level of education, marital status, and health status.

An interesting pattern emerged when we controlled for general cognitive ability in this way. As in the previous analysis we found a significant main effect of strain on task latencies, $F(3, 3130) = 7.74$, $p< .001$, Partial eta squared = .007. Also as expected, those with higher levels of general cognitive ability were faster on the speeded tasks, $F(2, 3130) = 150.08$, $p< .001$, Partial eta squared = .088, consistent with earlier findings (Tun & Lachman, 2008). Most interesting was the interaction between strain and cognitive ability, $F(6, 3130)= 2.38$, $p< .05$, Partial eta squared = .005. As Figure 2 shows, the effects of strain were most pronounced for those with the lowest general cognitive ability. In this group, those with the highest level of strain were about 67 ms slower in responding than those with low strain. Bonferroni comparisons showed that the high strain group was significantly slower than the medium-high, medium and low strain groups, all $p< .01$. By contrast, in the groups with better cognitive ability, there were no significant differences among strain groups.

Again we found a significant interaction between strain and task conditions, with the differences between strain groups largest in the more complex mixed-task conditions. Also, the effect of general cognitive ability was most evident in the more difficult conditions, as shown by the Task condition X General cognitive ability, $F(6, 9390)$ 13.48, $p< .001$, Partial Eta squared = .009. For the entire sample the three-way interaction of Strain X General cognitive ability X Task condition reached significance, $F(18, 9390) = 1.643$, $p< .05$, Partial Eta squared = .003. Bonferroni comparisons showed that the effects of strain were most pronounced on the most complex switching condition, $p<. 05$, especially for those with low cognitive ability, $p < 01$. Also, when we carried out the analyses of subsamples controlling for family membership, the planned comparisons still showed this same pattern of significance, although we must note that the three-way interaction no longer reached significance, ($F(18, 7590)= 1.41$, $p = .11$).

### Association between task latencies, social strain and social support

The next analysis addressed the question of whether the association between social strain and speeded performance might be buffered by effects of social support: specifically, whether adequate levels of social support might be especially crucial for maintaining speeded performance in those who have high levels of social strain. Based on an examination of the distribution of social support scores, we divided participants into two groups: one had low levels of support (mean = 2.89, SD= 0.36, N= 979), and the other had moderate to high levels of support (mean = 3.70, SD= .21, N = 2311).

We performed an ANCOVA with Social Strain (4) and Social support (2) as between-subject variables, Task condition (4) as a within-subject variable, and covariates of age, sex, level of education, marital status, and health status. As in previous analyses there was a significant main effect of strain group, $F(3, 3267) = 4.46$, $p < .05$, Partial eta squared = .004, that was similar in effect size to effects of sex, marital status and health status. The main effect of social support was not significant, nor was the interaction of strain and support groups. However, we found a significant interaction between Task condition, Strain, and Support groups, $F(9, 9801) = 2.44$, $p < .01$, Partial eta squared = .002.

The association between strain and speeded performance was evident in the complex task-switching conditions, not in the simple baseline tasks; moreover, the association depended on both level of strain and level of social support. Figure 3 presents latencies for the mixed-task nonswitch and switch conditions that showed this pattern, broken down into groups representing lower and higher levels of social strain and social support. Specifically, there were significant differences among strain groups only when social support was low, but not when social support was higher. For those with low social support, we see that the group with very high social strain was significantly slower than the groups with low and high strain, $p < .05$. By contrast, for those with higher social support, there were no significant differences between strain groups.

## Discussion

These findings from the MIDUS national survey extend our understanding of the links between cognition and social relations with spouse, family and friends across the adult lifespan in several ways. Most notably, they demonstrate the association between greater social strain and slowing of executive control functions for adults ranging in age from the 30s to 80s. These results were based on response latencies on the Stop and Go Switch Task (Tun & Lachman, 2008), which provided sensitive measures of processing speed on both simple choice reaction time tasks, and a complex task-switching test that requires switching and inhibitory control, which are key components of executive control (Miyake et al., 2000).

A primary goal of this work was to examine whether, across adulthood, the effects of social strain vary over a range of task complexity of speeded performance, with a particular focus on tasks involving executive function. After controlling for a range of demographic and health variables, we confirmed this hypothesis. Not only was social strain associated with longer response latencies overall, but the effects of level of strain were greater for the complex task-switching test relative to simpler speeded tests. Participants with higher levels of social strain were differentially slower in their responses on the mixed-task test of task-switching, than participants with lower levels of strain. These findings are consistent with research showing the deleterious effects of stress on cognitive performance (Seeman et al., 1997) and on the brain (Lupien et al., 1998), particularly frontal regions that are associated with executive function (McEwen, 2007). It is also interesting to note that our findings parallel findings on the negative effects of daily stress on complex working memory tasks (Sliwinski et al., 2006) and of short-term, situational strain and anxiety on task-switching performance (Derakshan & Eysenck, (2009), which have been attributed to reduced attentional control (Eysenck et al., 2007).

Our findings showed significant age differences in speeded performance between younger, middle-aged and older adults, consistent with previous findings for the SGST (Tun & Lachman, 2008). Also, age differences varied with task complexity: age differences in response latencies were smallest for the simpler baseline tests of choice reaction time, and greater for the task-switching test, with longer times for trials that required switching response modes than for nonswitch trials. However, we found that the effects of strain appeared relatively stable: across the age range from 32 to 85 studied here, we found similar differences between groups reporting low, medium, and high social strain. These findings are consistent with those of Seeman et al., (2010), in showing a generally stable association between negative social interactions and broader cognitive factors across adulthood.

Another research question concerned whether effects of strain on speeded performance, especially the complex executive function task, might vary for individuals who differed in general cognitive function. Theorists have suggested that those with limited resources tend to be most vulnerable to effects of stress and strain (Thoits, 2010). Consistent with this reasoning, a recent study found that those with higher fluid cognitive abilities showed less reactivity to stress related to interpersonal tension (Stawski, et al., 2010). In the current work we were able to address this question using a global cognitive composite drawn from the BTACT; our measure of general cognitive ability was based on measures of performance accuracy in cognitive domains other than those tested in the task-switching test, such as memory and reasoning.

Thus, the question was whether those with low general ability would show differentially more slowing in speeded performance, even after controlling for their scores in other domains such as memory, and whether these deficits would be exacerbated by high strain. Our results confirmed this hypothesis with a striking interaction between general ability and level of social strain. Specifically, the group with the lowest general cognitive ability showed the greatest effects of strain on response latencies, with differentially greater slowing. Moreover, these differences were greater for the more complex task-switching conditions that involve executive function, than for the simpler baseline tasks. The group with low general cognitive ability not only showed the greatest decrement in processing speed overall on the complex conditions, but this difference was further exacerbated for those with high strain. These findings are in line with suggestions that the effects of stress are greatest for those who are disadvantaged in terms of education, attainment, and background (Thoits, 2010). In the current study, even after controlling for educational background and other demographic variables, those with the lowest general ability still showed larger differences in processing speed associated with higher levels of social strain. Importantly, the decrements in speeded performance shown by this group went above and beyond their decrements in other cognitive domains such as memory. This suggests that processing speed, particularly in tasks that involve executive function, may be especially vulnerable to effects of social strain in those who are least mentally fit.

We also found some evidence for our third prediction: that higher levels of social support tend to buffer the association between high levels of social strain and speeded performance, particularly for executive function tasks. However, this was true specifically for the group with the highest level of strain, and for the more complex task-switching conditions but not for the simpler speeded tasks. Among the group with very high social strain, we found that those with low social support were slower in responding than those with higher levels of social support, on both the nonswitch and switch trials in the task-switching test. These findings raise the intriguing possibility that even when individuals are faced with a very stressful social environment, the opportunity for supportive, caring interactions with others may serve as a buffer for cognitive function (cf. Landerman et al., 1989; Krause, 2005).

A unique contribution of the MIDUS data is the large size and diversity of the national sample in terms of sociodemographic characteristics such as age, education, and geographic location. It must be noted, however, that the sample is not strictly representative of the U.S. population, and this analysis of participants remaining in the longitudinal sample would be expected to be positively selected, as with all longitudinal studies. Another caution is that the engagement measures were based on self-report. sThe major limitation is that the cognitive data were collected at one time of testing, and so analyses of cognitive data are cross-sectional; future work should include longitudinal assessment of these measures, which will allow us to examine temporal sequencing of changes in social engagement and cognition. Nevertheless, this work demonstrates the relationship between social strain and cognitive efficiency across the lifespan, in younger and middle-aged as well as older adults.

In particular, these findings demonstrate that the relationship between the social environment and cognitive efficiency varies with task demands, such that effects of social strain are magnified for complex executive control processes as compared to simpler processing speed. Abilities such as the switching and inhibitory control functions examined here are critical to independent functioning across adulthood, as they allow the individual to allocate and maintain attention across the multiple demands of daily life. The current results demonstrate a negative association between social stress and efficiency of these executive control processes across adulthood, which is magnified for those of lower general cognitive ability and for those with low levels of supportive relationships combined with high social strain. These findings underline the complexity of social influences, and the need to study a range of social and cognitive variables in context, across the lifespan.

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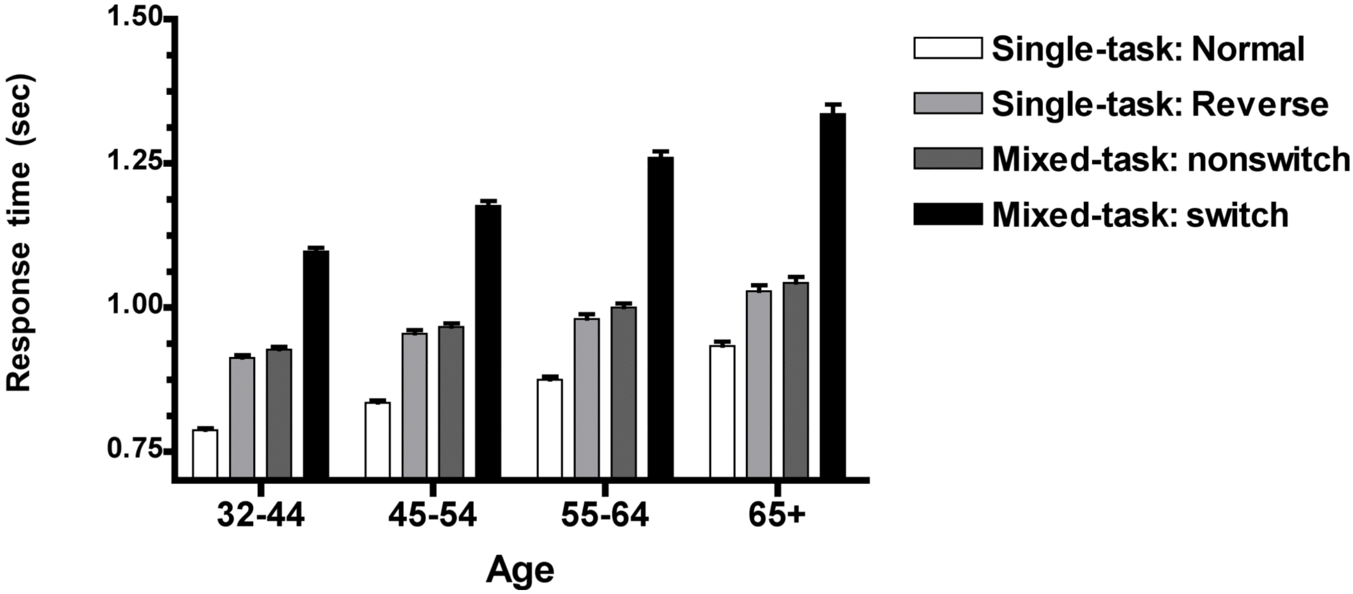


**Figure 1.**
Latencies (seconds) on four speeded task conditions (normal baseline, reverse baseline, mixed-task nonswitch, mixed-task switch) for four age groups.

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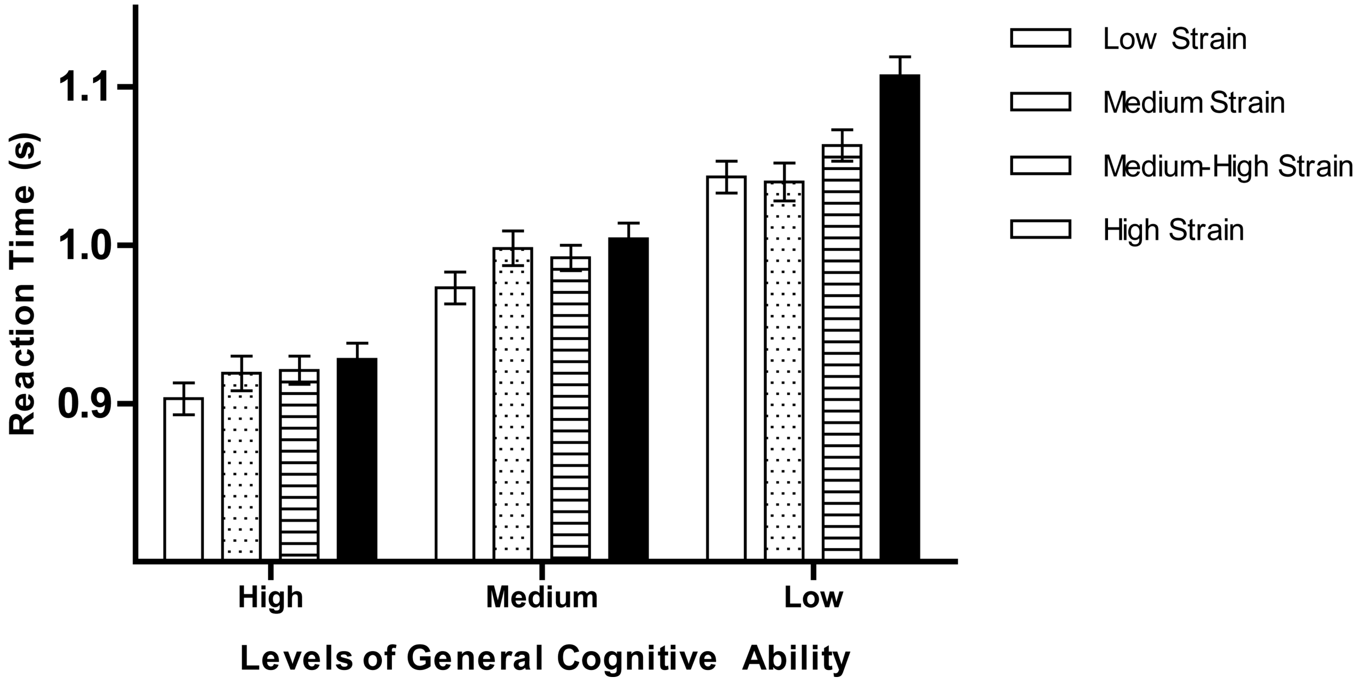


**Figure 2.**
Mean latencies (seconds) for three groups of general cognitive ability (low, medium, high): bars show four levels of social strain low, medium, medium-high, high strain).

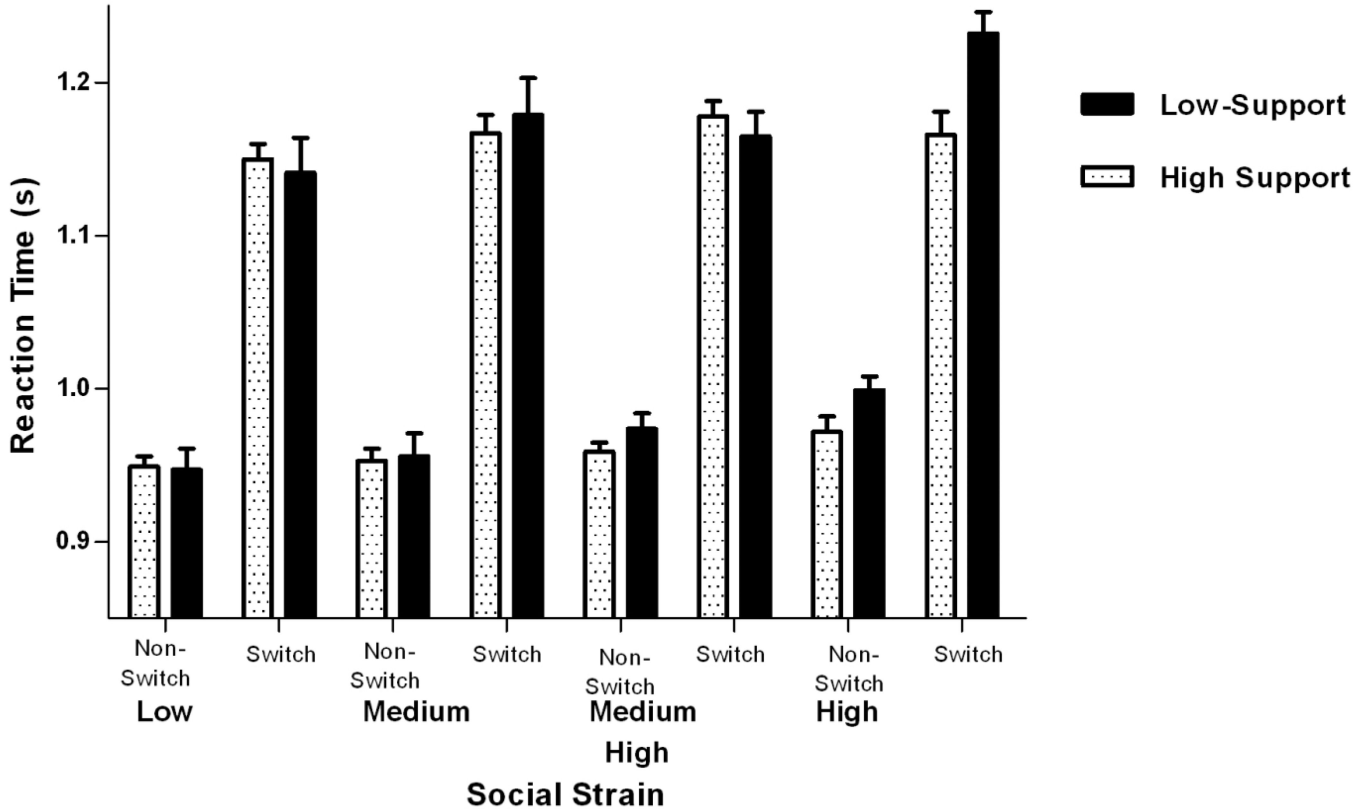


**Figure 3.**
Mean latencies (seconds) for mixed-task nonswitch and switch trials, across four levels of social strain (low, medium, medium-high, high): bars show groups with low and higher social support.

## Table 1

MIDUS analytic sample characteristics

| Characteristics | Total M1/M2 sample (n=4,963) | Analytic sample at M1 and M2 (n= 3,280) | Excluded sample (n = 1,683) | p-value for the difference between analytic sample and excluded sample |
|---|---|---|---|---|
| Age (mean)[a] | 55.45 (12.43) | 55.98 (12.14) | 54.43 (12.93) | < 0.001 |
| Female (%)[b] | 53.34 | 54.45 | 51.16 | 0.03 |
| Education (%)[b] | | | | < 0.001 |
| *<= high school* | *33.00* | *31.13* | *36.69* | |
| *Some college* | *22.05* | *21.16* | *23.80* | |
| *>= College grad* | *44.95* | *47.71* | *39.51* | |
| Married (%)[b] | 70.74 | 72.87 | 66.57 | < 0.001 |
| Health status | 0.43 (0.70) | 0.46 (0.71) | 0.38 (0.65) | < 0.001 |
| M2 strain (mean)[a] | 1.98 (0.45) | 1.98 (0.44) | 1.98 (0.50) | 0.88 |
| M2 Support (mean)[a] | 3.45 (0.46) | 3.46 (0.45) | 3.44 (0.50) | 0.43 |

[a] t-test of group mean differences;

[b] chi-square test

**Table 2**

Response latencies for four conditions, shown by age groups subdivided by level of social strain. (Mean latency in seconds, standard deviation shown in parentheses).

| | | Age | | | |
|---|---|---|---|---|---|
| **Task Condition** | **Level of social strain** | **32–44** | **45–54** | **55–64** | **65+** |
| Baseline –normal | | | | | |
| | Low | 0.765 (0.114) | 0 829 (0.122) | 0.884 (0.149) | 0.937 (0.162) |
| | Medium | 0.774 (0.126) | 0.821 (0.130) | 0.882 (0.141) | 0.912 (0.134) |
| | Medium-High | 0.780 (0.110) | 0.843 (0.126) | 0.865 (0.116) | 0.969 (0.151) |
| | High | 0.803 (0.137) | 0.837 (0.123) | 0.900 (0.165) | 0.968 (0.159) |
| Baseline – reverse | | | | | |
| | Low | 0.892 (0.190) | 0.937 (0.171) | 0.981 (0.209) | 1.047 (0.228) |
| | Medium | 0.891 (0.169) | 0 958 (0.191) | 0.996 (0.194) | 1.024 (0.221) |
| | Medium-High | 0.900 (0.175) | 0.965 (0.176) | 0.980 (0.169) | 1.048 (0.196) |
| | High | 0.933 (0.208) | 0.951 (0.196) | 1.005 (0.203) | 1.045 (0.200) |
| Mixed-task – nonswitch | | | | | |
| | Low | 0.900 (0.149) | 0.949 (0.164) | 1.002 (0.186) | 1.049 (0.205) |
| | Medium | 0.901 (0.145) | 0.950 (0.177) | 1.021 (0.180) | 1.043 (0.186) |
| | Medium-High | 0.915 (0.164) | 0.980 (0.182) | 0.990 (0.158) | 1.074 (0.222) |
| | High | 0.952 (0.194) | 0.973 (0.173) | 1.043 (0.187) | 1.073 (0.201) |
| Mixed-task – Switch | | | | | |
| | Low | 1.058 (0.204) | 1.144 (0.231) | 1266 (0.328) | 1.322 (0.316) |
| | Medium | 1.059 (0.185) | 1.186 (0.299) | 1.277 (0.300) | 1.357 (0.389) |
| | Medium-High | 1.088 (0.250) | 1.179 (0.286) | 1.250 (0.270) | 1.390 (0.388) |
| | High | 1.123 (0.272) | 1.187 (0.285) | 1.338 (0.377) | 1.397 (0.410) |
| Total N | | 1448 | 885 | 626 | 324 |