Aging and the Stroop Effect: A Meta-Analysis

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In this meta-analysis, data from 20 studies comparing younger and older adults on the Stroop interference effect, contained in 15 articles, were analyzed. No significant difference was found in the Stroop interference effect, expressed as mean standardized difference, between the two age groups (for younger adults: $d = 2.04$; for older adults: $d = 2.17$). Moderator variables were present, but these did not produce age differences. Meta-analysis showed that a single regression line with a slowing factor of 1.9 described the data well ($R^2 = .83$) and confirmed that no Age × Condition interaction was present in the data. Likewise, no Age × Condition interaction was found when the data were fitted to the information loss model; the age ratio of decay rates was estimated to be 1.4. Consequently, the apparent age sensitivity of the Stroop interference effect appears to be merely an artifact of general slowing.

The Stroop effect (Stroop, 1935) is one of the best-known effects in cognitive psychology. Researchers typically take much longer to name the ink color of a color word depicting a color incongruent with the ink color (e.g., the word "green" printed in red) than to name the color of a patch of color, a string of X's or symbols, or of noncolor words. In his comprehensive review, MacLeod (1991) counted more than 700 articles dealing with this effect, either examining it directly or using it as a tool to study other cognitive processes, making the Stroop effect one of the most well-replicated phenomena in experimental psychology.

Explanations advanced for the Stroop effect invariably center around interference of two responses (viz., reading the word and naming the color) associated with the same input. Recent theories focus on the relative associative strength of the two response tendencies of reading and color naming (Cohen, Dunbar, & McClelland, 1990) or of the two task sets of reading and color naming (Monkell, 1996). What presumably happens is that when a color word is shown, the response tendency or task set of reading the word, through life-long experience with reading, is initially activated more strongly than the novel response tendency or task set of naming the color. Another way of formulating this mechanism is that in the Stroop task the participant has to inhibit the prepotent response of reading the word (i.e., decrease its activation level) in favor of increasing activation of the nondominant response of color naming. This process of decrease-increase in activation unfolds over time (Lindsay & Jacoby, 1994), and thus participants are typically slower when naming the ink color of an incongruent color word (the interference condition) than when naming the color of a neutral stimulus (the baseline condition).

Recently, the Stroop effect has attracted the interest of cognitive aging researchers because it seems a good measure of inhibitory processes, a construct recently invoked to explain cognitive deficits associated with aging (e.g., Hasher & Zacks, 1988). The inhibition theory of cognitive aging claims that the working memory problems exhibited by older adults find their origin in defective inhibitory mechanisms. According to this theory, defective inhibition either causes irrelevant information to enter into working memory, consequently limiting its functional capacity, or causes irrelevant material within the working memory not to be suppressed, resulting in distraction from the task.

Interestingly, only a limited number of studies have examined the Stroop effect in a younger versus older adult contrast (see Table 1). Nevertheless, scientists who study human aging typically appear confident that these studies have yielded age effects that are "almost universal" (West, 1996, p. 287) and that the Stroop interference effect is "highly robust and age-sensitive in that older adults have been shown to show more Stroop interference" (Kwong See & Ryan, 1995, p. 459). There is, however, a problem with the interpretation of the results found in most aging studies concerning the Stroop effect, and this has to do with the way the Stroop effect is traditionally measured. Usually, an interference score is calculated by simply subtracting reaction time (RT) in the baseline condition from reaction time in the interference condition. If this difference score is larger in older than younger adults (or if the Age × Condition interaction in an analysis of variance [ANOVA] is significant), researchers conclude that the interference effect is larger in older adults. However, general slowing theories (Cerella, 1990; Myerson, Hald, Wagnstaff, Food, & Smith, 1990) predict a larger interference effect in older adults when measured by the traditional...
### Table 1

**Sample of Studies, Along With Effect Sizes for Interference in Younger and Older Adults**

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Baseline latency (ms)</th>
<th>Interference latency (ms)</th>
<th>Interference effect size (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Younger</td>
<td>Older</td>
<td>Younger</td>
<td>Older</td>
</tr>
<tr>
<td>Cebre, Duttman, &amp; Bradford (1984)</td>
<td>20</td>
<td>40</td>
<td>412</td>
<td>574</td>
</tr>
<tr>
<td>Cornilli, Wagner, &amp; Werner (1982)</td>
<td>32</td>
<td>14</td>
<td>582</td>
<td>687</td>
</tr>
<tr>
<td>Duleman &amp; Rogers (1964), Exp. 1</td>
<td>20</td>
<td>20</td>
<td>536</td>
<td>704</td>
</tr>
<tr>
<td>Duleman &amp; Rogers (1994), Exp. 1</td>
<td>14</td>
<td>14</td>
<td>524</td>
<td>674</td>
</tr>
<tr>
<td>Duleman &amp; Rogers (1994), Exp. 2</td>
<td>14</td>
<td>14</td>
<td>453</td>
<td>571</td>
</tr>
<tr>
<td>Harriman &amp; Hasler (1991)</td>
<td>44</td>
<td>24</td>
<td>360</td>
<td>609</td>
</tr>
<tr>
<td>Heax, Jolles, &amp; Vrooming (1993), no BVE</td>
<td>42</td>
<td>26</td>
<td>528</td>
<td>580</td>
</tr>
<tr>
<td>Heax, Jolles, &amp; Vrooming (1993), BVE</td>
<td>18</td>
<td>14</td>
<td>528</td>
<td>656</td>
</tr>
<tr>
<td>Kiesler &amp; Hartley (1997), Exp. 1</td>
<td>16</td>
<td>16</td>
<td>557</td>
<td>593</td>
</tr>
<tr>
<td>Kiesler &amp; Hartley (1997), Exp. 2</td>
<td>43</td>
<td>45</td>
<td>712</td>
<td>771</td>
</tr>
<tr>
<td>Kwong &amp; Ryan (1995)</td>
<td>192</td>
<td>92</td>
<td>526</td>
<td>683</td>
</tr>
<tr>
<td>Li &amp; Bouma (1996)</td>
<td>35</td>
<td>35</td>
<td>589</td>
<td>697</td>
</tr>
<tr>
<td>Panek, Rust, &amp; Slade (1984), men</td>
<td>19</td>
<td>11</td>
<td>543</td>
<td>808</td>
</tr>
<tr>
<td>Panek, Rust, &amp; Slade (1984), women</td>
<td>31</td>
<td>20</td>
<td>521</td>
<td>784</td>
</tr>
<tr>
<td>Park et al. (1996)</td>
<td>44</td>
<td>131</td>
<td>416</td>
<td>469</td>
</tr>
<tr>
<td>Salihoua (1996)</td>
<td>40</td>
<td>64</td>
<td>492</td>
<td>603</td>
</tr>
<tr>
<td>Salihoua &amp; Mentz (1993)</td>
<td>49</td>
<td>85</td>
<td>495</td>
<td>631</td>
</tr>
<tr>
<td>Spieler, Baita, &amp; Faust (1996)</td>
<td>27</td>
<td>50</td>
<td>611</td>
<td>970</td>
</tr>
<tr>
<td>Weir, Brun, &amp; Barber (1997), Exp. 1</td>
<td>17</td>
<td>18</td>
<td>528</td>
<td>872</td>
</tr>
<tr>
<td>Weir, Brun, &amp; Barber (1997), Exp. 2</td>
<td>24</td>
<td>24</td>
<td>628</td>
<td>781</td>
</tr>
</tbody>
</table>

*Note. Dashes indicate that the effect size could not be calculated. Exp. = experiment, BVE = biological life events.*

Difference scores, even if merely general slowing is present. The reason for this is that the relation between younger and older adults' reaction times is typically not additive, but is much better described by a linear function with a slope larger than 1. In other words, the age difference in response time is not expected to be constant across conditions, but typically grows larger with increasing latency of the task, even if the data are governed by general slowing. Consequently, general slowing theories would predict the age difference in the Stroop task be to larger in the interference condition than the baseline condition, simply because participants need more time for processing in the interference condition than in the baseline condition. Thus, before it can be stated with confidence that there is true age sensitivity in the Stroop interference effect, one needs to demonstrate that the age difference exhibited in the interference condition is larger than the age effect predicted from general slowing. It is reassuring to see that some recent studies have attempted to do general slowing into account by relying on some form of ratio scores (Duleman & Rogers, 1994; Kwong See & Ryan, 1995; Panek, Rust, & Slade, 1984; Spieler, Baita, & Faust, 1996) in at least secondary analyses. However, ratio scores assume that the function relating reaction times of older participants to younger participants is merely proportional. This model has been found to fit data less well than the more sophisticated multilayered slowing model (Cerella, 1990) or the information loss model (Myerson et al., 1990). Consequently, we use these latter models in our attempt to model the meta-analytic data.

The goal of this meta-analysis was thus to bring together the available data on the age effect in the Stroop task and to examine whether age differences are truly larger in the interference condition as compared with the baseline. This hypothesis was investigated using two methods. First, traditional methods of data pooling (Hedges & Olkin, 1985) were used to calculate the Stroop interference effect (expressed as the mean standardized difference between the baseline and the interference condition) for both younger and older adults. We then examined whether this interference effect was larger for older than younger adults, as predicted by the inhibition theory. Second, data were subjected to Brinley analysis (e.g., Cerella, 1990), that is, we examined whether a single (general slowing) or two different (inhibition theory) curves were needed to describe the relation between the performance of younger and older adults in the baseline and the interference conditions. In order to minimize variance among studies, only data pertaining to the color-word effect were analyzed.

### Method

**Sample of Studies**

Studies were collected by consulting the PsychLit electronic database, through personal contacts, and by checking references found in the articles thus retrieved. One reference not thus retrieved was kindly pointed out by one anonymous reviewer. The search was concluded in April 1987. Criteria for inclusion: (a) the study included at least one sample of younger (mean ages 30 years or younger) and older adults (mean ages 60 years or older); (b) Stroop data, using the color-word task, were reported, including at least a baseline condition consisting of noncolor-word stimuli (color patches, symbols, or noncolor words) and an interference condition, consisting of naming the ink color of an incongruent color word; and (c) the data were reported in a format amenable to meta-analysis.¹ No study was excluded for reasons other than not

¹For the studies by Park et al. (1996), Salihoua (1996), and Salihoua and Maine (1995), data in the original articles were not reported for each age group separately. These authors were so kind as to provide us with the exact means and standard deviations for their younger (ages 30 and younger) and older (ages 60 and older) participants.
satisfying these criteria. Thus, to the best of our knowledge, this sample comprises the totality of the published literature on aging effects in the Stroop task. Studies, along with some of their characteristics, are listed in Table 1.

Data Pooling

The system for data pooling advocated by Hedges and Olkin (1985) was used for the first type of analysis. We calculated the Stroop interference effect for each age group (younger and older adults) for each study separately by subtracting the baseline condition latency from the interference condition latency and dividing this score by the pooled standard deviation, yielding a mean standardized difference, or $d$. This method is advocated for within-subject designs by Dunlap, Cortina, Vaslow, and Burke (1996): it yields smaller effect sizes than the method using the standard deviation of the difference scores. Moreover, the Dunlap et al. method allows for direct and precise calculation of effect sizes from means and standard deviations without recurrence to an estimate of the correlation between tasks. (One study, Comalli, Wagner, & Werner, 1982, did not report standard deviations for the separate age groups, and thus did not allow for a precise calculation of effect size. This study was discarded from our analysis.) As is usual in this type of analysis, we decided to keep independent groups within studies (viz., men vs. women in the Pastek et al., 1984, study; and biological and nonbiological life events vs. no biological life events in the Heuer, Jolley, & Welling, 1993, study) separate in the analyses. As a result, 19 effect sizes were calculated for each age group. A small-sample correction factor was applied to the individual effect sizes in accordance with the principles outlined in Hedges and Olkin (1985, p. 81), converting the $d$ values to $d'$. These 19 effect sizes were then averaged using a weighting factor for sample size (Hedges & Olkin, 1985, pp. 109–117) to yield estimates of the average interference effect ($d'$) in younger and older adults, respectively.

One advantage of the Hedges and Olkin (1985) approach is that a test statistic is available for between-groups comparisons. In this study, this statistic is the between-groups homogeneity statistic, $Q_w$, which is chi-square distributed with degrees of freedom equal to the number of groups minus 1. Hedges & Olkin (1985, pp. 154–155) was used to test whether the interference effect was larger in older as compared to younger adults. Moreover, Hedges and Olkin (1985, pp. 155–156) have proposed a within-group estimate of homogeneity ($Q_w$, chi-square distributed with the number of studies minus 1 as number of degrees of freedom), indicating whether the studies can be considered to be homogonous, that is, whether the effect size can be considered a good point estimate of a single population value.

Brinley Analysis

For the Brinley analysis, the mean latency data of the older adults were regressed on the mean latency data of the younger adults (20 data points for each age group). Mean latency data were expressed in seconds needed for responding to a single stimulus.2 Two popular general slowing models were applied to the data.

The first model applied is the multiplicative slowing model advanced by Cerella (1990). In this model, it is stated that aging brings about differential slowing in peripheral processes (i.e., input and output processes) and central processes. Cerella demonstrated that such a model yielded young-old data that can be described by a linear function:

$$R_{lt} = a + b \cdot \text{RT}_{young}$$

The $b$ parameter of the slope of the function, describes the ratio of older over younger central processing time and thus provides an index of age-related slowing in central processing.

In order to test whether different equations are needed for the two conditions in the Stroop task, an interaction analysis approach was used (Berry & Feldman, 1985; for a brief tutorial on using this technique in the context of young-old Brinley plots, see Myersen, Wagnafiff, & Mole, 1994). In this method, the data are fitted to the following regression equation:

$$R_{lt} = a_0 + b_0 \cdot \text{RT}_{young} + a_1 \cdot \text{Cond} + b_1 \cdot \text{Cond} \times \text{RT}_{young}$$

The Cond variable is a dummy variable, taking the value 0 in the baseline condition and the value 1 in the interference condition. If the $a_0$ parameter is significant, different intercepts, one for each condition, are needed. All equations were fitted using the Statistical Package for the Social Sciences (SPSS, 1996) weighted least squares algorithm, weighting for sample size. The reader may note that this theoretically guided use of Brinley analysis is quite different from the exploratory use of the technique that has recently generated much controversy (e.g., Fisk & Flacher, 1994; Perfect, 1994).

The second general slowing model used to fit the data was the information-loss model by Myersen et al. (1990). This model assumes that a constant proportion of information is lost during each processing step and that the amount of information lost is larger in older than in younger adults. This model is described by the equation:

$$R_{lt} = d \cdot \text{RT}_{young}$$

The $d$ term in this equation describes the ratio of the older over younger decay rates, that is, it gives the proportional age difference in the slope with which information is lost when propagated through the cognitive system. This equation was fitted using the SPSS nonlinear regression procedure, weighting for sample size. The interaction test used here was fitting Equation 1 separately for each condition and testing for the difference in $b$ and $m$ values using the confidence intervals given by the regression program.

Significance level of all statistical tests was set at .05.

Results

Data Pooling

Effect sizes for the individual studies are reported in Table 1. The average interference effect in the 19 studies was 2.04 for the younger adults (limits of the 95% confidence interval were 1.90 and 2.18) and 2.17 for the older adults (limits of the 95% confidence interval were 2.04 and 2.29). Thus, as expected, the interference effect was very large and significantly different from zero for both age groups. However, the effect size did not differ reliably across groups, as indexed by nonsignificant between-groups homogeneity, $Q_w(1) = 1.71, n.s.$, indicating that the interference effect was as large in younger adults as in older adults. Both effect sizes were significantly heterogeneous, $Q_w(18) = 60.55$ and 118.28, respectively, indicating considerable variance in effect size, even in this sample of very comparable studies.

The heterogeneity in the data was further explored by examining potential moderator variables. Three such variables were investigated: the use of patches of color versus colored nocolor words or colored symbols (usually X), the baseline condition, presenting items one at a time versus presenting more than
one item at a time, and using printed stimuli for presentation and a stopwatch for recording reaction times versus computerized testing and reaction time measurement. Results of this analysis are presented in Table 2. None of the moderator analyses resulted in the desired combination of between-groups heterogeneity and within-group homogeneity. However, two results are noteworthy. First, all of these moderator variables had an influence on the Stroop effect in both age groups, as indexed by significant between-groups heterogeneity according to the appropriate statistic. Thus, color patches produced a larger Stroop effect than colored nonword words or colored symbols, presenting more items at a time produced a larger Stroop effect than sequential presentation of items, and printed stimuli and stopwatch measurements produced a larger Stroop effect than computerized testing and recording. Second, none of the groupings of effect sizes according to these moderator variables resulted in a reliable age effect, as indexed by nonsignificant between-groups heterogeneity according to the appropriate statistic. Thus, no third order (Age × Condition × Moderator Variables) interactions appeared to be present in the data.

**Birnley Analyses**

A Birnley plot of the young-old data is provided in Figure 1. This figure illustrates how large the interference effect is: There is almost no overlap between the data clouds for the baseline and the interference condition. Mean latency (weighted for sample size) in the baseline condition was 556 ms for the younger adults and 669 ms for the older adults; weighted mean latency for the interference condition was 807 ms for the younger adults and 1180 ms for the older adults. The mean interference effect was thus 271 ms for the younger adults and 511 ms for the older adults.

The multilayered sloping model fitted these data quite well ($R^2 = .83$), with $a = -0.34$ and $b = 1.88$. Fitting Equation 2 to the data resulted in the following estimates for the parameters: $a_1 = 0.03$, $a_2 = -0.61$, $b_1 = 1.19$, and $b_2 = 0.59$. However, the $a_2$ parameter was not significant, indicating that there was no reliable intercept difference between the two conditions. Consequently, Equation 2 was refitted, this time omitting the $a_2$ term. This resulted in nonsignificance of the $b_2$ parameter ($a_1 = -0.27$, $b_1 = 1.74$, and $b_2 = 0.07$), indicating that the slope difference between conditions was not reliable once the intercept term was fixed to be equal across conditions. Consequently, a single regression was sufficient to describe the data. Largest Cook’s $D$ value for the individual data points was .007, suggesting that no outliers were present.

One extra analysis was undertaken to examine whether the slope estimated from the regression analysis might not be a systematic distortion of the effect present in the individual experiments. It is possible, for instance, that the data points for the baseline condition systematically tend to lie below the regression line, whereas the data points for the interference condition tend to lie above the regression line (for a discussion of this and related problems with Birnley analysis, see Perfott, 1994). In that case, the regression line is not a good estimator...
of the average within-study effect, and one would expect that the slopes of the lines connecting the baseline data point with the interference data point in individual studies would systematically be larger than the slope estimated from the regression analysis. When we calculated the slopes from all 20 individual studies and averaged these, weighting for sample size, the mean slope was equal to 1.83 (SD = 0.38), which is not larger than the slope of the regression line estimated on all 40 data points (viz., 1.88). Thus, the 1.88 slope of the regression line seems a good approximation of the mean interference effect in the individual studies.

From a purely statistical standpoint, this sequence of analyses suggests that the data are adequately explained by a single function, indicating that merely general slowing is present in the data. However, the reader may have noticed that although the relevant statistics are not significant, the intercepts and slopes obtained for the baseline and interference condition are quite different (for the baseline condition: \(a = 0.03, b = 1.19\); for the interference condition: \(a = -0.58, b = 2.18\)). This might suggest that the general slowing effect in the data may be a statistical artifact because of lack of power. There is, however, a theoretical reason for mistrusting the coefficients of these separate equations. This has to do with the point of intersection of the two lines. In interaction analysis, one theoretically expects this point of intersection to lie below and to the left of the two data clouds. If this is not the case, the implication would be that there exist viable younger adult latencies for which the latency of older adults in the condition with the largest slope (presumably the most complex condition) would actually be smaller than that of the younger adults. In our data, the point of intersection lies way to the right of the shortest latency of the younger adults, and in fact even to the right of the mean of the baseline distribution, namely at the point (616 ms, 764 ms). This implies that the regression line for the interference condition lies below the regression line for the baseline condition in a large part of the latency range of the baseline condition. Theoretically, this makes no sense because this amounts to claiming that a condition involving the color-naming process plus a reading-suppression process would yield a smaller age difference than a condition not involving the extra process of reading suppression, but then only for a particular range of reaction times. In fact, we think this situation might best be understood as an indication that some curvilinearity is present in the data.

Fitting the data to the information-loss model and weighting for sample size resulted in a slightly better fit \(R^2 = .84\); note that the significance of the difference in \(R^2\) with the linear regression analysis cannot be tested because this is not a nested comparison), with \(b = 1.58\), and \(m = 1.40\). When separate functions were estimated for baseline and interference conditions, the 95% confidence intervals for the \(m\) and \(b\) parameters overlapped \(R^2 = .65, b = 1.21, SE = .02, m = .95, SE = .13\); and \(R^2 = .60, b = 1.61, SE = .09, m = 1.50, SE = .13\), indicating that the age difference in decay rate was not different across conditions.

**Discussion**

The main result from this analysis is obvious: The interference effect in the Stroop task appears not to be age sensitive. Rather, the data seem governed by a general age effect, indicating that the apparently larger age effect in the interference condition (a 271-ms interference effect for the younger adults vs. a 511-ms effect for the older adults) is merely a side effect of general slowing. Three sets of analyses led us to this conclusion.

First, when data were pooled, the interference effect appeared to be as large in younger adults as in older adults, namely about 2.1 standard deviations. This is a very strong effect, indeed. The age effect (.13 SD, viz., .217-.204) was not significant and quite small in comparison to the size of the interference effect itself. The reader may also note that 9 out of 19 effect sizes (as close to 50% as possible) were smaller for older than for younger adults, further supporting the claim of no age difference. Moreover, although moderators of the Stroop interference effect could be identified in the data, grouping studies according to these moderator variables did not lead to a significant age difference in the Stroop effect in any of these groupings.

Second, when the multilayered slowing model was fit to the data, we found no evidence for an Age × Condition interaction, suggesting that the central slowing factor is equal across tasks. Central processing in the Stroop task was found to take about 1.9 times as much time in older adults than in younger adults. This analysis was corroborated when the slopes for individual studies were computed and averaged: a mean slope of 1.8 emerged. The slowing factor found in the Stroop data is quite large if one assumes that color naming is a lexical task; the typical slowing factor in lexical processing is about 1.5 (Luria, Hale, & Myerson, 1991). Rather, this central slowing factor of 1.8 or 1.9 falls within the 1.8--2.0 slowing range typically found in nonlexical tasks (Cerella, 1990). It can be debated whether this implies that color naming is not a lexical process or whether this demonstrates that more than one lexical slowing factor must be distinguished (Laver & Burke, 1993).

As is usual in young-old latency data, the intercept term in the equation was significant and negative, indicating that there is differential slowing in peripheral and central processes, and that central processes are slowed to a larger extent than peripheral processes. This result has implications for a good estimation of the Stroop interference effect in an age-comparison approach. First, the traditional difference score is not informative at all because one would expect this difference score to be larger in the slowest group even if merely general slowing is present. Second, a ratio score is also less than optimal because a more proportional model is not completely adequate for describing young-old differences in Stroop data. When one wishes to use the Stroop interference score as a predictor variable in a correlational analysis, one alternative to difference or ratio scores may be to use hierarchical regression, entering the data from the baseline condition first, and the data from the interference condition in the next step (for an example of this approach, see Saltmarsh & Meints, 1995). In this way, one can estimate whether the interference score explains additional variance over and above the variance explained by the baseline condition. Alternatively, one might use linear regression to predict the interference condition latencies from the baseline latencies; the residual latencies can be used as an estimate of the Stroop effect or, more precisely, as an estimate of the deviation of the interference effect from what can be expected knowing the individual's baseline speed and the mean interference effect.
ACROSS PARTICIPANTS. AN ADDITIONAL ADVANTAGE OF BOTH THESE METHODS MAY BE THAT IN THIS WAY THE RELIABILITY PROBLEMS ASSOCIATED WITH DIFFERENCE SCORES (CRONBACH & HURBY, 1970) IS CIRCUMVENTED. IF ONE IS MERELY INTERESTED IN THE QUESTION WHETHER GROUP DIFFERENCES IN THE INTERFERENCE EFFECT ARE PRESENT, ONE MAY RESORT TO INDIVIDUAL BRINLEY ANALYSIS (FOR APPLICATIONS OF THIS TECHNIQUE, SEE MAYLO & RABBIT, 1994, AND SIWINSKI, BUSCHKE, KUSLANSKY, SENIOR, & SCHEINBERG, 1994). THUS, WHEN THE INFORMATION-LOSE MODEL WAS FITTED TO THE DATA, A SINGLE EQUATION AGAIN PROVED SUFFICIENT TO ADEQUATELY DESCRIBE THE DATA. IT MAY BE NOTED, HOWEVER, THAT THE FIT OF THIS MODEL WAS ONLY SLIGHTLY BETTER THAN THAT OF THE LINEAR MODEL, SUCH THAT ONE MAY ASSUME THAT A LINEAR MODEL IS SUFFICIENT FOR EXPLAINING THE DATA. THE OLD YOUNG DECREMENT-RATE RATIO IN THE INFORMATION-LOSE MODEL WAS FOUND TO BE ABOUT 1.4. THIS MEANS THAT WHEN OLDER PARTICIPANTS ARE REQUESTED TO NAME COLORS, THEY LOSE ABOUT 40% MORE INFORMATION IN THE DIFFERENT PROCESSING STAGES THAN YOUNGER ADULTS. THIS RATIO IS SLIGHTLY HIGHER THAN THE RATIO FOUND BY MYERSON ET AL. (1990) FOR A VARIETY OF TASKS, WHICH LIE BETWEEN 1.21 AND 1.33.

AT FIRST SIGHT, THE CONCLUSION OF A GENERAL AGE EFFECT IN THE STROOP TASK RATHER THAN AN EXACERBATION OF AGE DIFFERENCES IN THE INTERFERENCE EFFECT MAY SEEM SURPRISING. MOST OF THE INDIVIDUAL STUDIES IN THIS DATA POOL CONCLUDE THAT THERE ARE INDEED LARGE AGE DIFFERENCES IN THE INTERFERENCE EFFECT, WITH THE INCREASE IN LATENCY IN OLDER PARTICIPANTS BEING MUCH LARGER THAN IN YOUNGER ADULTS. THIS IS TRUE IN ABSOLUTE TERMS, BUT WE HAVE EXPLAINED WHY WE BELIEVE THIS CONCLUSION TO BE SERIOUSLY FLAWED (P. 120), IN THAT THESE STUDIES FAIL TO TAKE THE GENERAL OR AVERAGE SLOWING PRESENT IN THE DATA INTO ACCOUNT. INTERESTINGLY, SOME RESULTS FROM THE PRIMARY STUDIES CITED ALREADY POINT AT THIS GENERAL EFFECT. FOR INSTANCE, SALTHOUSE (1996) FOUND THAT ALL STROOP CONDITIONS (INCLUDING A COMPANION COLOR-NAMING CONDITION, IN WHICH THE INK COLOR IS IDENTICAL TO THE COLOR DESIGNATED BY THE COLOR WORDS) LOADS QUITE HIGH ON A SINGLE SPEED FACTOR COMPRISING A TOTAL OF 20 MEASURES OF PERCEPTUAL AND REACTION TIME SPEED. THE STROOP INTERFERENCE CONDITION DID NOT HAVE ANY SPECIFIC VARIANCE ATTACHED TO IT, SHOWING THAT IT IS MERELY REPRESENTATIVE OF THE GENERAL SPEED FACTOR APPARENT IN THIS STUDY. SALTHOUSE AND MEINZ (1995) FOUND THAT THE AGE-RELATED VARIANCE IN THE INTERFERENCE CONDITION WAS REDUCED CONSIDERABLY AFTER CONTROL FOR LATENCY IN THE BASELINE CONDITION, NAMING FROM .323 TO .038, OR A REDUCTION OF 88%. THUS, IN THIS STUDY, ONLY A SMALL PORTION OF THE AGE-RELATED VARIANCE IN THE INTERFERENCE CONDITION COULD NOT BE EXPLAINED THROUGH THE SLOWING ALREADY PRESENT IN THE BASELINE CONDITION.


ANOTHER NOTE OF CAUTION CONCERNS CONTRARY EVIDENCE ADVANCED BY SPIELE (et al., 1996). THESE AUTHORS FOUND THAT THE SHAPE OF THE LATENCY DISTRIBUTION CHANGES FROM THE BASELINE TO THE INTERFERENCE CONDITION, AND MORE SO FOR OLDER THAN FOR YOUNG ADULTS. THE CHANGE WAS ESPECIALLY NOTABLE IN THE RIGHT TAIL OF THE DISTRIBUTION, INDICATING THAT OLDER ADULTS MAKE MORE EXTREMELY SLOW RESPONSES IN THE INTERFERENCE CONDITION. THIS SUGGESTS THAT IN OLDER ADULTS, A QUALITATIVE SHIFT IN PROCESSING OCCURS FROM THE BASELINE TO THE INTERFERENCE CONDITION, WHEREAS A GENERAL SLOWING ACCOUNT WOULD PREDICT A SIMPLY QUANTITATIVE CHANGE. (NOTE, HOWEVER, THAT WE DO NOT KNOW WHETHER THE SHIFT PATTER OBSERVED IS REALLY ATTAINED; THE FIELD LACKS EMPIRICAL DATA ON WHAT USUALLY HAPPENS TO AGE DIFFERENCES IN THE DISTRIBUTION OF LATENCY SCORES WHEN MEAN LATENCY INCREASES.) IN A PROCESS-DISASSOCIATION PROCEDURE, SPIELE ET AL. ALSO NOTED AN INCREASED INFLUENCE OF THE WORD-NAMING PROCESS WITH INCREASING AGE AND NO AGE DIFFERENCE IN THE COLOR-NAMING PROCESS. THUS, THIS STUDY DOES NOT POINT AT QUALITATIVE DIFFERENCES BETWEEN AGE GROUPS IN THE INTERFERENCE CONDITION. CLEARLY, MORE CANDID AND MORE DETAILED RESEARCH IS NEEDED BEFORE STRONGER CONCLUSIONS CAN BE REACH.

SUMMARIZED, OUR META-ANALYSIS STRONGLY SUGGESTS THAT THE PRE-ASSUMED AGE-RELATEDNESS OF THE STROOP INTERFERENCE Effect IS MERELY AN ARTIFACT OF GENERAL SLOWING. THIS IMPLIES THAT THE TYPE OF INHIBITION TAPPED BY THE STROOP INTERFERENCE EFFECT IS NOT VULNERABLE TO THE EFFECT OF AGING.

References

References marked with an asterisk indicate studies included in the meta-analysis.


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