University of Strathclyde

Department of Psychology

Name: Roy Hunter

Class: 36 314: Research Methods in Psychology

Coursework: Class Report: A study into the effects of ageing on dominant hand and non-dominant hand finger tapping performance in men.

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Group:

I affirm that this report is my own work and does not contain any unacknowledged material taken from any other source.

Signed: Date:

Abstract

Two age cohorts of men aged under 25 (n=23) and over 60 (n=22) were tested by finger tapping with maximum speed for 60 seconds to establish if the dominant hand bias present in younger men (Schmidt *et al*, 2000) was still present in older men, despite their declining overall performance (York & Biederman, 1990) and interference from motor overflow (Bodwell *et al*, 2003). The results showed that overall performance was lower in the over 60 group than in the under 25 group, as was expected, but that the manual asymmetry observed in the under 25s was also present in the over 60s. According to Triggs *et al* (2000), this is not due to superior hand strength in the DH, but must therefore be due to some other factor.

Triggs, Calvanio, Levine, Heaton and Heilman (2000) assert that the term handedness can be used to refer to either: the phenomenon whereby a person will favour one hand over the other for the purposes of completing a skilful task like writing, tying a knot, finger-picking a guitar; or to an asymmetry in the levels of performance in a manual task. The hand chosen to perform these tasks, or the hand with the higher performance, has been characterised as the dominant hand (DH), the other as the non-dominant hand (NDH) (Schmidt, Oliviera, Krahe & Filgueiras, 2000).

Schmidt *et al* (2000) studied handedness using a finger tapping method: testing left-handers (sinistrals) against right-handers (dextrals); and testing women against men. They used two dependent variables: tapping speed (or number of taps in a set time); and intertap variability (the variation of the interval between taps). The study produced four significant findings:

1. That there was a significant difference between the tapping speed of women and men: men tapped faster than women.
2. That there was a significant difference between the intertap variability of women and men: men tapped more regularly than women.
3. That the DH in men tapped significantly faster than the NDH, but that no such significant difference existed between the DH and NDH in women.
4. That right-handed people display a greater overall bias to the DH than left-handed people.

For the purposes of their experiment, Schmidt *et al* (2000) defined the dominant hand as the preferred writing hand. Whilst they acknowledged that this approach

has its limitations (some sinistrals are encouraged or even forced to use their right hand, their NDH, to perform tasks that would normally be performed by the DH), it still produced a satisfactory result for them.

Other systems of assessment of handedness are more comprehensive: the Edinburgh Handedness Inventory (Oldfield, 1971) takes a variety of manual tasks into account; and the Purdue Pegboard Test of manual dexterity (Tiffin, 1968) measures comparative performance using mirror images of the same task for both hands.

Schmidt *et al* (2000) used undergraduate students as their participants; a population who, despite a lack of detailed information about them, we can reasonably assume were predominantly aged less than 25 years. These results do not therefore necessarily reflect the population in general, especially in terms of age distribution.

Studies have shown that age does affect motor control and movement. York and Biederman (1990) studied people across all age ranges, and found differences between men and women, and between different age cohorts, in the time taken to perform tapping tasks of varying complexities (Fitts's task). Using linear regression techniques, they reported that older participants appeared to sacrifice overall speed for accuracy in the task. This was particularly apparent in men aged from 40 upwards, and in women aged from 60 upwards.

Bodwell, Mahurin, Waddle, Price and Cramer (2003) found that older people suffered from a greater degree of motor overflow: muscles that were meant to be

at rest were stimulated into movement by voluntary movements of other parts of the body. In particular, they examined motor overflow across the centre line of the body and brain in participants in two age groups: between the ages of 25 and 30; and between the ages of 65 and 85.

Bodwell *et al* (2000) found that the older group of participants experienced a significantly greater degree of motor overflow than the younger group in a finger tapping task. This difference was most pronounced when performing the task at maximum speed. There was no significant difference between the genders in this respect.

There was also no significant difference between the overflow from the left to the right; and the overflow from the right to the left. From this it can be deduced that, since Bodwell *et al* (2000) used a participant group balanced for left- and right-handers, there would be no significant difference between the amount of motor overflow from the DH to the NDH; and from the NDH to the DH.

If the finger tapping task in older men is affected by both motor overflow and the sacrifice of speed for accuracy, would this affect the superior performance of the dominant hand in an older population? One obvious reason why you would expect that manual asymmetry would not be affected in an older population is superior strength in the dominant hand.

Triggs *et al* (2000) studied hand preference using a more unusual system. They ran tests like the Edinburgh Handedness Inventory and the Annett Handedness Inventory, as well as the Purdue Pegboard Test and a tapping test, but testing

their participants blind: the experimenters did not know the participants' hand preference in advance.

Triggs *et al* (2000) found a strong correlation with the tapping test and the Purdue Pegboard, but when measuring hand strength with a dynamometer they found no reliable correlation between hand strength and handedness. It may then be the case that hand strength does not affect performance in the tapping test when studying manual asymmetry.

The hypothesis for this study is that, in a simple tapping task undertaken at maximum speed, the dominant finger tapping speed of men younger than 25 will be significantly faster than their non-dominant hand, but that the dominant hand tapping speed of men older than 60 will not be significantly faster than their non-dominant hand.

Method

Design.

Two separate age cohorts of participants each performed a finger tapping procedure twice: once with each hand. This experiment therefore used two independent variables: age cohort; and DH or NDH used.

The experiment is of a mixed design: the age cohort aspect is a between groups measure; the DH or NDH aspect is a within groups measure.

The single dependent variable in all conditions is the number of finger taps recorded within the time period. The data recorded is discrete and on a ratio scale.

Participants.

There were two groups of participants: men under the age of 25; and men over the age of 60.

The ‘under 25’ age cohort were undergraduate students who were recruited from the student body and took part voluntarily A total of 23 men took part, all of whom consented to give their actual age. The mean age of participants in this group was 20.89 years (SD 1.23). Two of the participants were left-handed, the remaining twenty one being right-handed.

The ‘over 60’ age cohort comprised either students of the Senior Studies Institute within the University, or members of the experimenters’ families, all of whom also

took part voluntarily. Twenty two men took part in this group, of whom three declined to give an actual age. The mean age of the remaining nineteen of the 'over 60' age cohort was 68.53 years (SD 5.40). Two of the men were left-handed, the remaining twenty were right-handed. (Bodwell *et al* (2003) used 65 to 85 as their age criteria, however there was a convenient body of potential participants who were aged over 60, so this decision was more pragmatic than design-led.)

All the participants were categorised as either left-handed or right-handed for the purposes of establishing the DH or NDH. This was coded by asking about their writing hand preference, in a similar manner to that used by Schmidt *et al* (2000).

Materials.

The experiment used a computer-based psychology experiment package called ERTSLab (http://www.erts.de). The package features several different psychology experiments. The one used in this case was 'Tapping with maximum speed', part of the 'Motoric processes' battery of experiments.

The experiment took place in a well lit, occasionally busy computer laboratory in the Psychology Department at the University. The computers used were IBM PC compatible, fitted with standard PS2 alphanumeric keyboards. It should be noted that the left-hand shift key on these keyboards was smaller than the right-hand shift key.

The experimenters also provided the participants with a combination instruction and questionnaire sheet, which asked details of their age, writing hand

preference and gave instructions on how to perform the finger tapping task (see appendix A). A further sheet gave details of the study undertaken, references for the background literature and contact details for the experimenters and their supervisor (see appendix B).

Procedure.

Participants took part individually rather than in groups or all together. The experiment did not take place at a specific time of day, instead happening at a mutually convenient time for both participants and experimenters.

Participants were pre-screened to ensure they were male, and that they were within an appropriate age cohort. When they entered the laboratory they were given an individually numbered questionnaire / instruction sheet and asked to read the instructions and fill in the questionnaire about their age group, choice of writing hand and gender.

The instructions required the participants to use the index fingers of both hands to tap the shift keys on the computer keyboard as quickly as possible, using the left shift key for their left index finger, and the right shift key for their right index finger.

While they were reading the instructions and filling in answers to their questions, the experimenter set up the computer to run the first trial. Participants were free to start with whichever hand they chose, since the effects of practice or fatigue should not cross over from one side to the other.

The time period for each trial began the first time the participant tapped the shift key, and after 60 seconds of tapping at maximum speed, the screen instructed them to stop. The experimenter then reset the program for the other hand. At the conclusion of that trial, which was carried out using exactly the same technique except on the other side of the keyboard, the experimenter recorded the two scores on the questionnaire / instruction sheet.

The scores were obtained on the basis of which shift key was used in the trial: tapping the left-hand shift key recorded a response of 'LSH'; tapping the right-hand shift key recorded a response of 'RSH'. Failure to comply with the instruction to use the correct key with the correct finger would have produced an erroneous response.

The experimenter then thanked the participant, explained about the study they were undertaking, gave the participant their information sheet, and the experiment was concluded.

Results

The DH of the under 25 group produced a mean result 348.26 finger taps in 60s., standard deviation 41.46. The NDH of the under 25 group produced a lower mean result of 308.35 taps in 60s., standard deviation 34.19.

The DH of the over 60 group produced a mean result of 274.18 taps in 60s., standard deviation 34.19. The NDH of the over 60 group produced a lower mean of 237.95 taps in 60s., standard deviation 40.39.

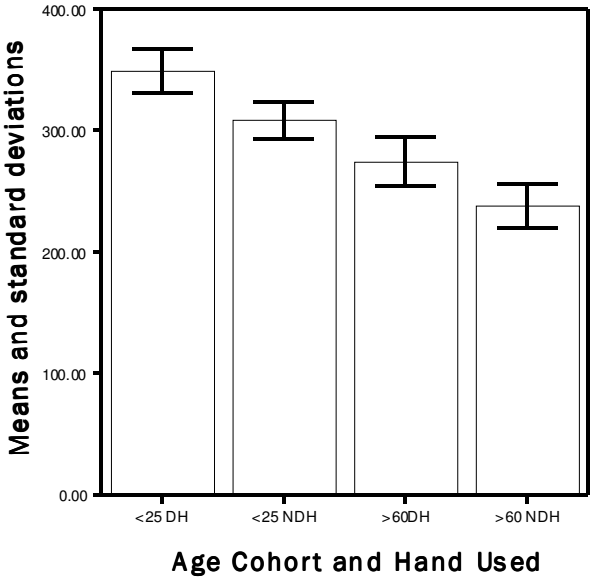
The overall mean for the under 25 group is 328.30 finger taps, standard deviation 42.65, and the overall mean for the over 60 group is lower at 256.07 finger taps, standard deviation 46.37. The overall mean for the DH is 312.04 finger taps, standard deviation 57.07, and the overall mean for the NDH is lower at 273.93 finger taps, standard deviation 51.28.

The mean values and standard distributions for this experiment are summarised in table 1, and illustrated in figure 1.

Table 1: Means and standard deviations for finger tapping experiment.

Under 25s (*n* = 23)		Over 60s (*n* = 22)	
DH	NDH	DH	NDH
348.26, SD 41.46	308.35, SD 34.19	274.18, SD 45.66	237.95, SD 40.39

Figure 1: Means and standard deviations for finger tapping experiment.



A mixed-design analysis of variance, with age cohort as the between groups independent variable, and DH/NDH as the within groups independent variable, was carried out on the dependent variable tapping scores. Table 2 shows the summary data for the ANOVA.

Table 2: Summary table for mixed design ANOVA.

Variance	df	SS	MS	F	*p*
DH/NDH	1	32,593.98	32,593.98	57.11	<.001
Interaction	1	76.38	76.38	. 134	.716
Error	43	24,540.85	570.72		
Age cohort	1	117,348.45	117,348.45	43.19	<.001
Error	43	117,027.04	2,721.56		

The main effect of DH/NDH was significant [F (1, 43) = 57.11, p<.001]. The main effect of age cohort was also significant [F (1, 43) = 43.12, p<.001]. The interaction between age cohort and DH/NDH use was not significant (p>.1). The calculations were made using SPSS for Windows V 11.5 (See Appendix C).

Discussion

The results of this experiment reject the alternative hypothesis that there would be a significant difference in finger tapping performance between the dominant and non-dominant hands in men under 25, but no significant difference in men over 60. The results show that there is a significant difference between the DH and NDH in both the under 25s and the over 60s.

In order for the hypothesis to be accepted, it would have been expected that the means for the over 60 group would not have been significantly different, and a significant interaction between the age cohorts and the DH/NDH would also have been expected.

The results do support Schmidt *et al* (2000), and indeed moves beyond the implicit limits of their study: the manual asymmetry they identified has now been observed in older as well as younger men, although they did use a balanced sample of left- and right-handed participants where this study did not.

The results are also consistent with the findings of York and Biederman (1990): there was a difference across the age cohorts, with younger men out-performing older men. There was no deliberate complexity element of the task in this study, however, and it is not inconceivable that the over 60s may find a computer-based experiment more complicated than the under 25s. That would mean that there may have been an unintentional difference in the relative complexity of the task across the two age cohorts.

The results are inconclusive with regard to Bodwell *et al* (2003) and the effects of motor overflow and age.

It could be argued that any difference between the age groups was maximised by the task requiring participants to tap at maximum speed. This would certainly produce motor overflow, which might slow older participants down, but that motor overflow did not seem to affect the manual asymmetry in the older group in the way that might have been expected.

Bodwell *et al* (2000) reported that their results supported hypotheses that brain function became more bilaterally arranged with normal ageing. That aspect of their study is not necessarily supported by these results, which still show a unilateral performance difference in an older population.

There are other possible reasons why the outcome of this experiment was not as expected. If the DH is used more often than the NHD, it may have a muscular or skeletal advantage over the NDH in older people. Triggs *et al* (2000) reported a correlation between the Purdue Pegboard task, tapping speed and choice of DH, but not with grip strength, which would have tended to support this possibility.

Triggs *et al* (2000) used participants between the ages of 21 and 57, so although the older group of participants is not within that age range there is no reason to assume that NDH strength deteriorates rapidly as soon as a man hits 60 years old.

There were two methodological concerns raised during the conducting of this experiment:

1. The left shift key on the computer keyboard used in this study was smaller than the right shift key. Since the majority of participants were right-handed, it may have artificially depressed the NDH scores (especially in the over 60 group, bearing in mind York and Biederman's (1990) findings about sacrificing speed for accuracy), raising problems with internal validity.

2. Some of the older participants complained that 60 seconds was a very long time to tap at maximum speed. Fatigue may have interfered with their performance, since they are less physically robust than the younger men.

In order to overcome these issues in future studies, different equipment and different sampling arrangements could be used.

Using simple buttons, like those found on fruit machines and arcade games, mounted on their own (*ie* not part of a keyboard) would remove any errors due to task complexity, concentrating on hitting the right button, or asymmetry of the equipment.

A shorter trial period, such as the 10 seconds used by Schmidt *et al* (2000) and Triggs *et al* (2000), would all but eliminate the possibility of fatigue during the trial in older participants. If more experimental data were required, participants could repeat it several times, for instance four ten-second trials on each hand over the

course of ten minutes. This would not cause too much more inconvenience to either participants or experimenters.

This study has examined the effects of age and hand preference on a simple tapping task in two age cohorts of a male population. Initially it was thought that the effects of motor overflow (Bodwell *et al*, 2003) and the sacrifice of speed for accuracy (York & Biederman, 1990) in older men would counteract the dominant hand bias observed in younger men (Schmidt *et al*, 2000) and make the dominant hand bias less significant. This has not proved to be the case.

The dominant hand bias in the older age cohort may be explained by greater strength and dexterity in the dominant hand, due to greater use (Triggs *et al*, 2000), or perhaps the effects of motor overflow and increased care in performing the task may not affect manual asymmetry in older men at all. Due to some unforeseen difficulties with this experiment, there is room for further experimentation, perhaps with shorter trial times and less complex equipment.

References

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