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Investigation of 13 of the Widely Used Hand Preference Items Concerning Their Total-Scale Validity and Relationship With Familial Sinistrality

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After having published the results of investigation on a large sample of apparently healthy Bulgarian secondary school students (264 right, 246 mixed and 360 left handers), we present here a more detailed picture of their handedness, based on the separate assessment of the 13 widely used items, included in the applied hand-preference questionnaire. Investigation of their total scale validity showed that writing, usually considered the best item, is in fact the worst item in both the left and mixed handers. This is explained by the presence of a hidden pressure towards right-hand writing. At this stage, it is difficult to explain two of the results: the strong modulation of the familial sinistrality in the mixed handers, and the very low proportion of the answers "with either hand" in them. Thus, the present study works out in detail some problems, but raises new questions, which need further investigations to be answered.

Key words: handedness, items, validity, familial sinistrality.

Introduction

The most important and the most investigated functional asymmetry in man has always been the handedness. The latter distinguishes humans from other primates, since the great majority of humans, about 90%, are right-handed. Investigators differ in their opinions on whether handedness is predominantly a matter of skill or a matter of preference. A n - n e t t [1] adopted the view that handedness is, in general, a matter of skill rather than preference. Other authors consider that inter-manual differences in skill are a secondary consequence of a more fundamental dichotomy of preference for one or the other hand. The tests of unimanual performances on skills showed that the differences in performance between the hands tended to conform to a bell-shaped distribution, shifted to the right. Preference-based measures typically result in a J-shaped distribution. Nevertheless, there is a close relation between the two kinds of measure and people identified as right- or left-handed on the one are nearly always classified in the same way on the other. Regardless of whether handedness is fundamentally a matter of skill or of preference, it is supposed that its biological basis is essentially dichotomous or at most trichotomous [1] and that the biological component is genetic [6].

Interestingly, although there is a little agreement as to how handedness should be defined and measured, yet nearly all people readily identify themselves as being either right- or left-handed. Along with this simplest manner of self-identifying, M c M a n u s [11] proposed that handedness is best measured in terms of which hand is preferred for writing. Such an approach is seriously disputed by other authors because of the existence of social and/or educational pressures to write with the right hand. Indeed, such pressures are much less pronounced today than they were two or three generations ago, especially in the Western countries [3, 5]. However, it would be hardly denied that such a pressure still exists and its intensity is probably different not only in different countries because of differences in ethnic and religious tolerance towards left-handedness but also in different social classes and strata. Therefore, the writing hand is not trustworthy enough as a criterion of handedness. Much more common approach is to base preference measures on a number of different unimanual activities and to sum these activities to obtain a scale of handedness [6].

Apparently, the most widely used measure of this kind is the Edinburgh Handedness inventory [12], including hand preference on 10 different unimanual activities: writing, drawing, throwing, using scissors, using a toothbrush, using a knife without a fork, using a spoon, using a broom, lighting a match, and opening a lid. C h a p m a n and C h a p m a n [4] proposed a questionnaire, comprising 13 items selected from the 23 items of R a c z k o w s k i et al. [14]. Although less widely used than the questionnaire of O l d f i e l d [12], this by C h a p m a n and C h a p m a n [4] is preferred in some recent studies, e.g. K a l a j g i o g l u [7].

In our study on 870 apparently healthy Bulgarian right-, mixed and left-handers, whose results have already been partly published [8, 9, 10] we also preferred the mentioned questionnaire for three main reasons. First, the moderate number of items - thirteen, selected from the 23 items of R a c z k o w s k y et al. [14]. Second, the carefully investigated reliability and validity of the questionnaire with convincing results. And third, we had at our disposal a method for measurement of foot preference, published by the same authors in the same year. In our judgment, it was highly desirable to measure hand and foot preferences by methods elaborated and advocated by the same authors, i.e., founded on the same basic principles.

The purpose of the present study is to assess separately the 13 items applied and to compare them with each other.

Material and Methods

Subjects

All the students from several randomly selected Bulgarian secondary schools were orally questioned as to which hand they used to write, draw, throw, cut with scissors, hammer a nail into wood, and use a screwdriver. Those of them who preferred the left hand in any one of these activities were tested on the inventory of C h a p m a n and C h a p m a n [14]. Among those who used the right hand to perform all the six activities concerned in the verbal interview, 264 randomly selected presumed right-handers were tested on the same questionnaire. As far as the population incidence of left-handedness was not aimed by this study, the sampling was directed at obtaining a high proportion of NRH subjects and equal proportions of male and female participants. Therefore, in some cases the recruitment was somewhat extended in order to equalize the presentations of both sexes in each handedness class. Thus, the sample reached a total of 870 subjects (264 right-handers, 246 mixed handers and 360 left-handers), each handedness category comprising equal

numbers of males and females. Subjects had the following age distribution (in completed years): 14 (years) — 34 (subjects), 15 — 68, 16 — 312, 17 — 261, 18 — 183, 19 — 12, mean age = 16.6 years, SD = 1.0 year.

Assessment of handedness

On every single one of the 13 items, included in C h a p m a n and C h a p m a n ' s [14] questionnaire, each subject had to fill in whether he/she performed it with the right hand (thereafter scored "1"), with either hand (scored "2") or with the left hand (scored "3"). These items were as follows: 1.Drawing; 2. Writing; 3. Using a bottle opener; 4. Throwing 5. Using a hammer; 6. Using a toothbrush; 7. Using a screwdriver; 8. Using an eraser on paper; 9. Using a tennis racket; 10. Using scissors; 11. Holding a match to strike it; 12. Stir a can of paint; 13.Which shoulder is used to rest a bat before swinging.

Accordingly to the original procedure, subjects with scores from 13 to 17 were designated as right-handers (RH), from 18 to 32 as mixed handers (MH), and from 33 to 39 as left-handers (LH).

Assessment of familial sinistrality

Although it could be assumed that the interest in handedness and the knowledgeability of the relatives' hand preferences are lower in the families of right-handers as compared to those of left-handers, an overwhelming majority of authors which have investigated familial sinistrality gathered data concerning handedness of the biological relatives from the investigated subjects (including from the right-handers) themselves. In this way numerous important differences, including such ones between right-handers with and without FS, were reported.

After having obtained the informed consent of the subjects and their parents, in each school the examination was performed during several hours on two days, separated by a "free" one, on which the subjects and their families gathered the requested relatives' handedness information. A shortened questionnaire, comprising the six activities about which subjects were orally questioned during the preliminary screening, was given to each subject at the end of the first session. Subjects were asked to take these questionnaires home and to fill in the hand preferences of as much as possible living biological relatives, by contacting them, with the help of the parent(s), either personally or by telephone. The answer "With either hand" was not included; the only possible answers were "With the right..." or "With the left hand". The relatives who answered "With the left hand" at least two of the questions were assumed to be NRH. There were two cases when dead relatives were considered, since their families were unanimous concerning their non-right-handedness and insisted them to be taken into account; one of them was subject's maternal great-great-grandfather (direct line relative of fourth degree). The genealogical trees were drawn up, along with each subject, using the brought questionnaire with his relatives' answers, at the beginning of the second experimental session on the third day.

A cumulative index of familial sinistrality (CIFS) for each subject was calculated through our own formula, by summing up the subject's coefficients of relationship [16] with every single one of his/her NRH biological relatives:

$$\mathrm{CIFC} = \sum_{i=1}^{k_1} (1/2)^n + \sum_{j=1}^{k_2} \left[2(1/2)^n \right],$$

where k_1 is the number of direct line NRH relatives, k_2 is the number of collateral line ones and n is the number of degrees of relationship between the subject and a given NRH

relative. It should be reminded that, to avoid the described confusion in degrees, the latter must be counted by generation-to-generation steps from the subject to his NRH progenitor (for direct-line relatives) and from the subject to his NRH relative via their closest common progenitor (for collateral line relatives). In the latter case, as far as the common progenitors are two but the degrees are counted once, the multiplier "2" in the second member of the binominal makes the formula consider both of them.

Assessment of items vs. handedness categories

To compare the accordance between the handedness category and performance of each item by the corresponding hand, the percentages of performance of each item were presented and compared as follows: for the RH — percentages of answers "with the right hand", for the MH — percentages of answers "with either hand", and for the LH — answers "with the left hand".

Assessment of items vs. familial sinistrality

To analyze relationship between hand preference on each single item and the corresponding familial sinistrality, the latter was presented by the mean values of the CIFS, and the hand preferences were presented irrespectively of the handedness category. Thus, the curves in Fig. 2 represent the preferences "right hand", "either hand" and "left hand" across the handedness categories.

Results

The results of the first set of comparisons are graphically presented in Fig. 1. It could be seen from the figure that in the mixed handers percentages of performance with either hand are much lower than those shown for the right and the left hand in the RH and LH, correspondingly.

The curves of the item-specific preferences of RH and LH are, in general, close to each other. However, among the 13 per cent differences between them, only three, those for items 8, 9 and 12 are not statistically significant. Among the rest 10 differences, three items showed higher correspondence with the handedness category in the LH, and seven showed higher correspondence in the RH. The most prominent differences are observed in items 1, 2, and 10 — drawing, writing and using scissors.

These observations concern, although somewhat indirectly, the traditional "looking for the best single item". It could be seen from the figure that there is a considerable difference between the RH and LH in this respect. Drawing and writing show the highest percentages of performance with the right hand in the RH, along with the using of hammer and cutting with scissors. Oppositely, in the LH drawing, along with cutting with scissors, they are among the items, rarely performed with the left hand; and, what is more, writing is undoubtedly "the worst" single item, showing only 54.4% of performance with the left hand.

An interesting relation that is observed here is that the curves of the RH and MH are nearly mirror images to each other, i.e., they are symmetrically disposed in relation of an imaginary horizontal axe, parallel to the abscissa. Obviously, the items, most often performed by the right hand in the RH, are the least often performed by either hand in mixed handers, and vice versa.

It could be seen from Fig. 2 that for all the 13 items people preferring the right hand show lower familial sinistrality than those preferring the left hand and the curves of these

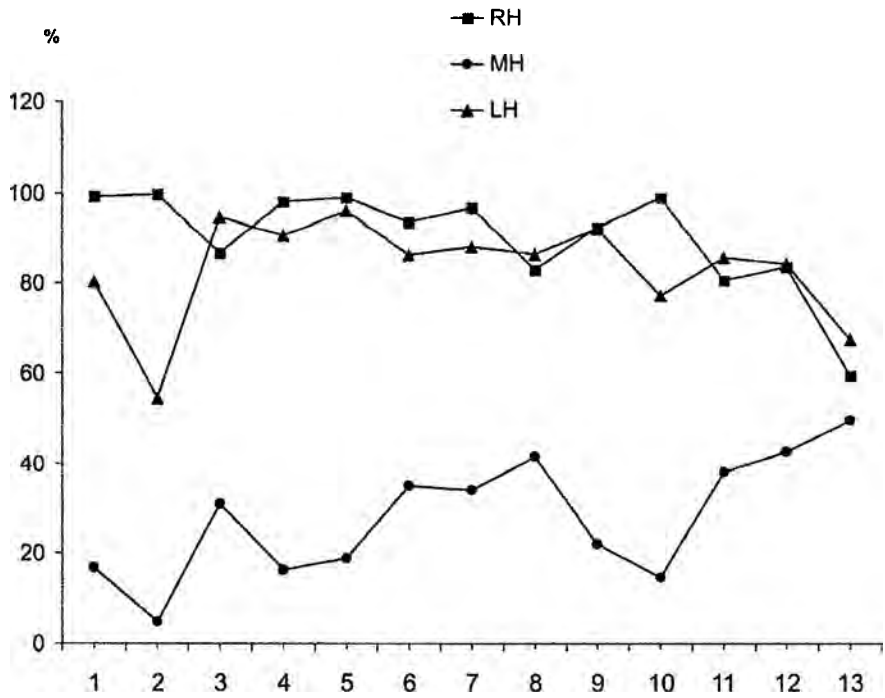

Fig. 1. Percentages of coincidence of hand-preference for each of the 13 items with handedness category: right hand in the right handers (RH), left hand in the left handers (LH), and either hand in the mixed handers (MH)

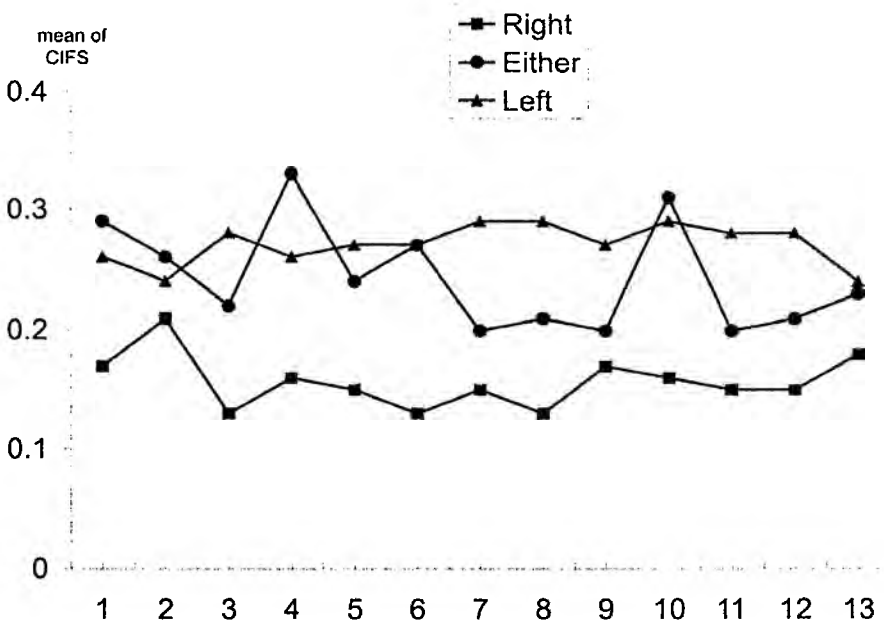

Fig. 2. The 13 items and the means of the CIFS as indicator of the familial sinistrality in the subjects preferring the right, the left and either hand

two groups show a moderate modulation by hand preference items. It is quite different with the subjects answering "with either hand", whose "item by CIFS" curve is much more modulated. In four important items (drawing, writing, throwing and using scissors) familial sinistrality exceeds that of the people preferring the left hand. It seems that for these items a stronger familial disposition is needed to prefer either hand than to prefer the left hand.

Discussion

The presented results show, first of all, that even if writing is the best single item in the RH, the same is not true for the LH, where, on the contrary, it is the worst single item. The large difference between the right-hand preference for writing in the RH and the left-hand preference for this task in the LH witnesses for a hidden persistence of the social pressure towards right-hand writing, contrary to the opinion that this pressure has been surmounted a long time ago.

It is also evident that the item-specific preferences in the mixed handers need further investigation. At this stage it could be concluded that the most asymmetrical items, showing the strongest right-handedness in the RH, are the least "ambidextral" items in the mixed handers. The mirror-symmetric disposition of the curves of RH and MH does not indicate any antagonism between their patterns of item-specific concordance with the handedness category. On the contrary, these observations show rather similarity in their patterns. Probably, the study should be expanded in this respect — to find the relative contribution of each hand to explain the low proportion of "either hand" responses for most of the items.

Obviously, the peculiarities of these relationships and especially those in the people answering "with either hand" deserve additional attention and investigation.

Conclusion

Enriching evaluation of handedness as a whole with an analysis of every single one of the hand-preference items gives us a more detailed picture of the relationships in this field. On the other hand, the results raise interesting questions which need additional investigations to be answered.

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