Which inventory should be used to assess Japanese handedness?: Comparison between Edinburgh and H. N. handedness inventories

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日本人のきき手は何で測定すべきか？――エディンバラきき手検査と H.N. きき手検査の比較――

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要約

わが国での利用度が高い Edinburgh きき手検査と八田・中塚きき手検査の比較検討を行った。207 名の大学生に両方の検査項目が裏表に印刷された用紙を手渡し、それぞれに記入を求めた。その際に他方の検査項目への記入結果を参照することを禁じた。その結果、両検査のきき手指数の相関係数は r =.957 であった。したがって、両検査結果でのきき手評価結果は極めて類似していることが明らかとなった。しかしながら、Edinburgh きき手検査では両手ききのカテゴリーを想定していないために、左ききき、右ききき、両手ききなどのカテゴリー分類をすると両検査での結果は必ずしも類似しておらず、きき手検査の選択は研究目的に応じて考慮する必要があることが明らかとなった。

Key words

handedness, Edinburgh handedness inventory, H. N. handedness inventory, cultural difference

1. Introduction

It is clear that human handedness is one of the critical factors in considering brain function and brain morphology. In his review of brain imaging studies relating to human handedness, Hatta (2007) raises an important question. That is, researchers have employed various kinds of criteria to determine participants' handedness, such as the Edinburgh Inventory (EDI), the H. N. Handedness Inventory (HNI), self-report, and so on. In the majority of studies cited in Hatta's review, either EDI or HNI was employed, since an inventory is a reasonable tool in assessing handedness. If a handedness inventory is not reliable and generates different classification results, a meta-analysis study, such as Hatta (2007) that includes various kinds of inventories, loses scientific value.

Since Oldfield developed a standardized handedness inventory called EDI, this test has become widely used by many researchers, primarily those who are interested in the study of laterality (Oldfield, 1971). There are several reasons for this. First, the sky- rocketing increase in cerebral specialization studies stimulated by the split-brain reports of Sperry and his colleagues (Sperry, 1968) needs a reliable handedness assessment. Second, that up until then there had been no standardized handedness inventory, though various test inventories had been used in handedness studies (Durost, 1934; Hull, 1936; Annett, 1967). And third, that a shortened version consisting of 10 items of EDI has high usability.

After the development of EDI, several researchers have begun to develop different kinds of handedness inventories for several reasons, probably related to their own handedness theories (Annett, 1970; Chapman & Chapman, 1987). However, a direct comparison between the different handedness inventories has not been conducted, each researcher only emphasizing the advantages of his/her own new inventory.

One of the trials undertaken to develop a new handedness inventory derives from the researchers' stress on a cultural difference in item selection, since the items selected involve culture-unique unilateral hand actions. The HNI was developed for the same reason (Hatta & Nakatsuka, 1974). Generally, one of the criteria of item selection in the developing process of a standardized handedness inventory is whether or not the item reflects the unilateral hand use in a popular daily action. Due to cultural differences, several items in EDI cannot be regarded as customarily used or practiced by the Japanese; for example, card games, rakes, cricket bats, knives and forks are rarely to be seen among the Japanese people. The use of the hands for such activities as throwing snowballs or painting the house that appear in the Chapman Inventory are also typical items of culture dependence. Therefore Hatta and Nakatsuka have tried to develop a new handedness inventory for the Japanese following the identical procedure of Oldfield (1971) as a standardized psychological test.

Although the HNI has been widely used in Japanese handedness related studies (Nagae, 1999; Hatta, 1976, 1996, 2003; Hatta & Kawakami, 1994, 1995), the first author has received several inquiries as to what extent the assessment results by HNI are com-

patible with those of the Edinburgh Inventory. These are mainly happened in the case of response to foreign journal editors. This is because these reviewers have no idea about HNI. It is difficult to respond to these inquiries, because until now no systematic comparison between EDI and HNI had been conducted. It is understandable, and customary, that each inventory should examine the validity and reliability, but without comparing the compatibility, since if full compatibility is shown between the two scales, there would be no reason to develop a new inventory.

Therefore, we addressed the following questions. First, how similar are the assessment results to an identical sample population? Second, do any problems arise when we classify a handedness group by one of the two types of handedness inventories? Finally, we will discuss several points to address the question as to which inventory is valid in assessing Japanese handedness.

2. Method

2.1 Participants

Two hundred and seven students from three universities participated in this project. Fifty-six of the participants were male and 151 were female, and their ages ranged from 20 to 31 years. Therefore the proportion of males and females was largely similar to that of the original EDI (394 males and 734 females). Although no special examinations such as neurological or personality tests were administered, nevertheless these students can be regarded as a typical sample of Japanese adolescents because they spend their day to day lives as students. This criterion of sample selection procedure was similar to that of the HNI, and probably also of the EDI.

Table 1: Items that consisted of EDI and HNI

EDI	HNI
Writing	Rubbing out by eraser
Drawing	Striking a match (stick holding)
Throwing	Cutting with scissors
Scissors	Using a knife (without folk)
Toothbrush	Shaving (lip stick)
Knife (without fork)	Using a screw driver
Broom (upper hand)	Pinning down
Striking match (match)	Tooth brushing
Spoon	Throwing a ball
Opening box (lid)	Hammering

2.2 Procedure

Items of EDI and HNI were printed on each side of the questionnaire sheet (Table 1). Although the original EDI consisted of a binary choice of 20 items, the use of a shortened version of a binary choice of 10 items has been widely employed. We therefore used a shortened version of the EDI in order to compare the HNI of 10 items (Oldfield, 1971). The HNI consisted of a three-fold choice of 10 items; that is, one type of sheet consisted of HNI printed on one side and EDI printed on the reverse side (A-type), while the other type of sheet consisted of EDI on one side with HNI on the reverse side (B-type). Half the participants filled in the A-type first while the other half filled in the B-type sheet first at their own pace, and they were asked to fill in each side of the questionnaire without reference to the other side of the sheet.

3. Results

3.1 Comparison of laterality tendency assessed by EDI and HNI

Basically, it is easy if both scales have identical assessment criteria. However, the original assessment criteria of both EDI and HNI are not identical. That is, EDI gives two points when the use of a unilateral hand is absolute, and one point when the use of the hand is largely, but not entirely, absolute, and the laterality quotient score is calculated by means of the following formula: LQ = 100 × (right minus left hand points) / (right plus left hand points). Therefore LQ (LQ-ED) distributes from –100 to +100. They take a criterion of the left handedness if LQ < 0. EDI has no category for the ambidextrous, but shows a degree of lateral tendency, whereas HNI gives plus one point when the right hand is used, minus one point when the left hand is used, and 0 points when either hand is used in largely equal proportion. Therefore the handedness score of HNI (LS-HN) ranges from -10 to +10. The criterion of left handedness is used when the score is < –4, while a score of between –3 and +7 is classified as ambidextrous.

To examine the similarity between both handedness scores, LQ-ED and LS-HN, a Pearson's coefficient correlation was calculated. As the correlation score was r = .957, the compatibility of the handedness score by EDI and HNI was high.

3.2 Classification of handedness group by EDI and HNI

Table 2 shows the results of the proportion of the handedness groups based on the criteria of each inventory. According to the criterion of EDI, 3.6 % of male participants and 5.3 % female participants were classified as left-handers. On the other hand,

Table 2: Number of participants and handedness categories as a function of sex

			Left-hander	Right-hander	Ambidextrous
Male	EDI	N	2 (3.6 %)	54 (96.4 %)	–
	HNI	N	0	36 (64.3 %)	20 (35.7 %)
Female	EDI	N	8 (5.3 %)	143 (94.7 %)	–
	HNI	%	6 (4.0 %)	121 (80.1 %)	24 (15.9 %)

according to the criterion of HNI, no male participant was left-handed while 3.8 % of the female participants were left-handers. The results of the handedness group classification were different.

3.3 Handedness grouping by a common criterion of both EDI and HNI

Originally, the purpose of EDI development did not take into account handedness group classification. However, it is possible to compare the assessment characteristics of EDI and HNI if we apply the identical criterion of handedness group classification. Therefore we applied the handedness classification criterion of HNI to EDI results. The result is shown in Table 3, and shows a very similar pattern of handedness in group populations by both EDI and HNI. However, Table 4 shows handedness classification by EDI and HNI as a function of participants' gender difference. As seen from this Table, the proportion of the three handedness groups was not necessarily identical, but it was significantly different to the proportion of the handedness groups of the male participants ($\chi^2 = 6.93$, $df = 2$, $p < .03$). With regard to the female participants, the classification result was largely the same.

Table 3: Handedness classification by the criterion of HNI

		Left-hander	Right-hander	Ambidextrous
EDI	N	6	176	25
	%	2.9	85.0	12.1
HNI	N	6	158	43
	%	2.9	76.3	20.8

Table 4: Handedness classification by the criterion of HNI as a function of sex

		Left-hander	Right-hander	Ambidextrous
Male	EDI	1	48	7
	HNI	0	38	18
Female	EDI	5	128	18
	HNI	6	121	24

4. Discussion

The purpose of this study was to address the question as to which handedness inventory, EDI or HNI, a Japanese researcher should select. The answer seems to be simple; it depends on the aim of the study.

As the similarity of laterality scores (quotient) of EDI and HNI was very high (r = .957), it may be possible to claim that even if an inventory is employed, it does not create a serious problem when our aim is to compare laterality tendencies of certain populations. This means that if the purpose of the study is to compare handedness distribution between two populations, e.g., that a cross-cultural comparison of two populations is the actual aim of the study, the employment of either EDI or HNI is no serious problem. This is apparent from Figure 1, in which it is suggested that there may be some differences in the frequency distribution at the right end part, score from –5 to –9, however, largely similar handedness distribution patterns could be produced by either EDI or HNI measures.

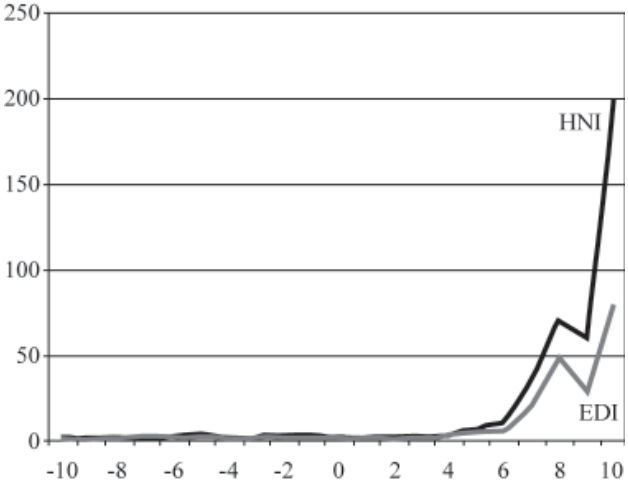

Figure 1: Handedness score distribution by EDI and HNI

On the other hand, when the purpose of using the handedness inventory is to classify handedness groups such as left-handers and right-handers, either EDI or HNI could invite different results. This type of classification is usually used to compare cognitive performances between handedness groups, for example in a study where an examination of any difference between handedness groups is the aim. Table 2 shows the handedness group classification results according to both EDI and HNI criteria. Apparently, EDI takes into consideration only two handedness groups, left-handers and right-handers, while HNI classifies participants into three groups, left-handers, right-handers and ambidextrous. This difference is based on the original aim of the development of the inventory, which was to assess handedness in a quantitative manner for use in clinical and neuropsychological work, while the basic aim of HNI was to develop an inventory for an experiment that can classify handedness groups in a standardized manner.

One question that arises is whether we can get similar results for handedness groups if we apply identical criteria to both inventories. Table 3 and Table 4 show the results of handedness group classification when identical criteria are applied to both EDI and HNI. According to the criterion of HNI whereby a laterality score of over +8 would indicate a right-hander, less than -4 a left-hander, and the residuals ambidextrous, a handedness group classification was administered. The results showed a differing distribution pattern between EDI and HNI. This difference was marginally significant, especially in male samples ($\chi^2 = 5.60$, $df = 2$, $p < .061$). As is apparent from this slight difference, it is clear that

both inventories cannot be regarded as identical.

Why an identical classification pattern was not shown by both inventories is not clear at present, but the response stability of the participants may be one of the reasons. Four common items are involved in both inventories; ball throwing, tooth brushing, scissors, and striking a match. Ideally, we would hope that the participants make identical responses to these items in both inventories, since a translation of the item from English to Japanese would not be difficult due to the simplicity of the language in the description of the items. This comparison revealed that the results of incongruent responses between EDI and HNI for striking a match were null. However, incongruent response percentages for ball throwing, using scissors, and brushing teeth were .72 % (15 in 208 responses), .67% (14 in 208 responses), and 28.8 % (60 in 208 responses), respectively. An incongruent response means that the same participant responded with the “left hand” to the item of EDI, but with the “right hand” to the item of HNI. Another possibility is that there is a cultural difference between the Japanese and the British in tooth brushing behavior, which would account for a high variance.

These results mean that we should take into consideration the instability in the responses of the participants in a study involving a questionnaire, suggesting that the students’ responses in this situation are not very reliable, and therefore not ideal. However, the fact that the correlation coefficient laterality score between EDI and HNI was r = .957 seems to suggest that employing a certain amount of plural numbers of questionnaire items could compensate the reliability of the volunteers’ responses.

In conclusion, the correlation of laterality scores that represents the degree of handedness between EDI and HNI was very high, and therefore either inventory could reasonably be employed to assess the degree of handedness tendency of each participant on a quantitative scale for use in neuropsychological and other clinical and experimental work. However, to classify a handedness group such as left-handers or ambidextrous would not necessarily be the same as that based on EDI or HNI.

These results seem to suggest that the appropriate handedness inventory to be used should depend on the actual purpose of the study for which it is intended.

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