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How to Order a Beer

Cultural Differences in the Use of Conventional Gestures for Numbers

Simone Pika
University of Manchester
Elena Nicoladis
University of Alberta
Paula Marentette
University of Alberta-Augustana

It is said that conventional gestures for numbers differ by culture. Conventional gestures are thought to imply consistency of form both across and within individuals. The present study tests the consistency of finger gestures of 60 participants of three different cultures and in three different mother tongues in nine different hypothetical scenarios. The first subject of analysis is whether participants differentiate between counting and signaling. The second subject is the consistency of gestures within and between groups. The third is how participants depict the number 1. Result show that most people use the same gestures for counting and signaling. In addition, Germans and English Canadians show relatively low degrees of individual differences whereas French Canadians show relatively high degrees of individual variability. Furthermore, only the Germans use the thumb to indicate the number 1, whereas the two North American cultures use the index finger. The present data suggest that finger gestures of some cultures clearly qualify as conventional gestures whereas others do not. It is suggested that the development of conventional gestures is influenced by cultural exposure, which can even result into the loosening of conventions.

Keywords: *finger gestures; conventional gestures; culture; language; development*

Sabby was a Japanese girl in India, which was then at war with Japan. Her friend therefore introduced her as Chinese to an Englishman who had been living for a long time in India: "Miss Wei. 'Really?' He stretched his face forward and examined Sabby from close up, as if he were nearsighted. 'Nonsense,' said he. 'Count with your fingers! Count to five.' Sabby looked shocked; she wasn't quite sure whether this extraordinary man was joking or mad. Hesitantly she raised her hand: 'One, two, three, four, five,' she said uncertainly. Mr. Headley burst out delightedly: 'There you are! Did you see that? Did you see one. Did you ever see a

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> Chinese do such thing? Never! The Chinese count like the English. Begin with the fist closed. She's Japanese!' he cried triumphantly."
>
> R. Mason, *The Wind Cannot Read*

A variety of animal species ranging from birds to nonhuman primates show two types of quantitative skills that prefigure a humanlike concept of number: cardination and ordination (Boysen & Capaldi, 1993; Ifrah, 1985; Tomasello & Call, 1997; Wynn, 1992). Similar results have been observed for human infants (Wynn, 1992). Perceptual processing of numbers by adult humans seldom exceeds four, so for greater quantities modern humans use abstract counting (Ifrah, 1985 for the ability of animals to learn to count, see Davis & Memmott, 1982; Boysen & Capaldi, 1993; Gelman & Cordes, 2001; Heinsohn, 1997; Pepperberg, 1987; Simons, 1981; Terrell & Thomas, 1990).

Before our human ancestors developed the abstract concept of numbers, they determined quantities using *concrete numerations*, for example, pebbles, shells, notches in bones or wood, pieces of wood, carved vertical lines, clay objects, knots in string, and sticks (Ifrah, 1985; Menninger, 1958). Additionally, studies in the 19th century revealed that some peoples such as Torres Strait islanders, the Papuans, the Elemas of New Guinea, and tribes in various parts of Africa, Oceania, and America "counted visually," associating parts of the body with different numbers. They named certain parts of the body in a fixed order and touched them at the same time. People in villages along the Musa River, in the northwestern part of what was formerly British New Guinea, started with the fingers of the right hand beginning with the little finger, right wrist, elbow, shoulder, ear, and eye, then the left eye, the nose, the mouth, the left ear, the left shoulder, and so on down to the left little finger (Ifrah, 1985; Menninger, 1958). Each gesture was accompanied by a Papuan word, but because the same word was often used for different body parts, the gesture assigned the relevant meaning (e.g., the word *ano* means either the right or the left side or the neck; Ifrah, 1985). These observations make it seem likely that manual gestures associated with number preceded oral expressions of number and that our present number words had their remote origin in names of parts of the body (for detailed descriptions, see Ifrah, 1985; Menninger, 1958).

The hand was often used as material support for numbers due to its morphology, which can be regarded not only as a total but also as a natural succession of collections of fingers (one finger, two fingers . . . etc., Ifrah, 1985). Finger gestures might therefore have linked the cognitive gap from cardinal and ordinal numerals to an abstract number concept. This claim is supported by documentations of a variety of counting and calculating methods on the fingers that were used by many civilizations in ancient times (Ifrah, 1985). Different finger-counting procedures included, for instance, (a) counting on the bones and joints of fingers; (b) counting on the finger joints and ball of thumb; (c) counting with the thumb on the finger bones, each having a value of 1; (d) counting on the fingers, each having a value of 12; (e) finger numeration in which units and tens were represented with the fingers of one hand (the left in the Occident, the right in the Orient), and hundreds and thousands with those of the other (Ifrah, 1985). These techniques of "finger writing" or "finger counting" are differentiated from "finger gestures" (Menninger, 1958), which include the practice of counting up to 10 on the fingers of the two hands, and can be found in every human culture (Place, 2000). Following Ekman and Friesen (1969), these gestures belong to the

category of *emblems* or so-called *quotable gestures* (Kendon, 1992). McNeill (1998) however, used the term *conventional gestures* to emphasize that their form and meaning are established by the conventions of specific communities. This implies standards of form that must be met if the gestures are to be recognized and thus involves low levels of individual differences within the community.

Conventional ways of counting up to 10 are, for instance, the following techniques: (a) all fingers are bent down, the right thumb is raised for 1 (in dependence to hand preference), the right index finger is raised for 2, and so on to the left little finger for 10; (b) all fingers are extended and then the right little finger is bent down for 1, the right fourth finger is bent down for 2, and so on to the left thumb; and (c) all the fingers are bent down and then raised one by one, but beginning with the left or right index finger.

To the extent that finger gestures are conventional, they should be highly consistent within a cultural group and could differ between cultural groups. The primary goal of the present study was to test this hypothesis.

To address this hypothesis, we investigated the gesture techniques of 60 people from three different culture groups in nine different scenarios using their mother tongues. We first analyzed whether participants used different gesture techniques for counting and signaling a numeral. Our prediction was that during counting, the palm is directed to the counting person, whereas during signaling it is directed to the recipient. Second, we investigated the degree of concordances in the gesture techniques between and within language and culture groups. This analysis enabled us to determine to what degree these so-called conventional gestures (McNeill, 1998) share a convention.

Furthermore, by looking at three different cultures and two different countries of origin, we could determine whether the physical proximity of two cultures (English Canadian and French Canadian) might determine how similar finger gestures are.

Third, we wanted to test the hypothesis of Axtell (1991), who claimed that the thumb-up gesture to illustrate 1 is characteristic to German people, whereas the majority of other cultures depict the number 1 using the index finger.

Methods

Participants

Canada is a unique country, consisting of many different cultures, languages, and peoples, with the French and English representing the most influential language and culture groups, being in contact for more than 400 years. The University of Alberta is located in the English Canadian part of Canada, with a small but active French community. Participants were recruited by word of mouth and the credit pool of the Psychology Department of the University of Alberta. We interviewed 20 English Canadians (in Canada; 12 females, 8 males), 20 French Canadians (in Canada; 12 females, 8 males), and 20 Germans (in Germany; 14 females, 6 males) in their mother tongue. The English Canadians had grown up in the English-speaking part of Canada; the French-speaking Canadians had grown up in the French-speaking part of Canada and had moved in their early adulthood to the English-speaking part of the country. The German participants had grown up in Germany; they all had learned English in school but generally had not been in contact with English speakers

Table 1
Questions for the Participants

Questions Used to Investigate How People Signal Numbers	Questions Used to Investigate How People Count Numbers
1. How would your order 3 beers in a bar?	2. You invite 2 people to your birthday. How do you count to 2?
5. How do you order 1 croissant/muffin in a bakery?	3. In 8 days, you have an important meeting with your supervisor/boss. You count to 8 using your hands.
8. You look out of the window and see 9 birds sitting in a tree. How do you signal that there are 9 birds?	4. When you come home, you want to make a phone call, write a letter, have a beer, watch TV, and so on, altogether 7 things. You count to 7 using your hands.
9. A young child tells you that her birthday will be in 5 months. But you know that it will be in 6 months and signal the number 6 to the child.	6. You tell somebody that she or he should help you doing 5 things and count to 5.
	7. You sit in a subway in a strange city and somebody told you that you have to get out after 4 stations to find your hotel. You count the stations with your hands.

as a group. We know of no reason to suspect sex differences in finger gestures. The participants were classified according to their first language (learned in childhood), although many of them spoke one or more other languages.

All the participants were asked nine questions in order to elicit finger gestures for the numbers from 1 to 9 (see Table 1 for a list of the questions participants were asked), using one or both hands. The order of the questions was fixed as shown in Table 1. We did not elicit the number 10 because we speculated that there would be little cultural difference in this gesture. Using a written coding system, we noted the orientation of the hand toward the Experimenter; the use of left, right, or both hands; and the fingers that were used for every question.

Data Analysis and Statistics

Because more than half of the participants had difficulties in answering Question 3 using their hands, we excluded this question from the analysis.

To measure how consistent participants were when counting or signaling a numeral, we tallied the numbers of participants by the technique they used for Question 1 (signaling) and for Question 2 (counting). Fifty-seven of the 60 participants produced data that could be classified in this way. We used 1,000 nonparametric bootstrap samples (B. Efron & Tibshirani, 1994) of these data to calculate a 95% confidence interval on the proportion of the population that used the same technique for the two questions.

To make inferences about how people use finger gestures to gesture 2 through 5 using one hand, we used Questions 1, 2, 6, and 7. To investigate how people gesture 6 through 9 using two hands, we used Questions 4, 8, and 9. To test how participants gesture the number 1, we used Question 5. For each person, we analyzed how frequently (in percentages) the thumb, index, or little finger was used to start the number.

To analyze whether differences in gesture categories between the cultural groups existed, we applied a 3 × 6 (Group × Finger) analysis of variance (ANOVA), with finger as a

repeated measure. Finger was defined as the starting finger for counting (i.e., the thumb, the index finger, or the little finger).

To investigate whether participants differed in the way of gesturing the number 1, we counted the number of people who used the thumb to refer to 1. Specifically, we analyzed three matrices (3×2 matrix, all groups; 2×2 matrix, all groups except the German group; 2×2 matrix, German group vs. the two other groups [collapsed]). Each of these three matrices was analyzed using the log-likelihood ratio test (G test) for expected small cell values.

To assess individual differences and the degree of concordance in the performance of gestures between and within the cultural groups, we used Cohen's kappa statistics, with an individual either agreeing or disagreeing in the performance of each gesture (8 gestures/individual) as compared with each other individual (cf. Pika, Liebal, & Tomasello, 2003). We calculated three sets of kappas for each individual: average concordance with group members and average concordance with members of the two other groups. To calculate the kappas for each individual, we used a matrix method in which each individual received an average score (0-1) in his or her agreement with each other individual based on a comparison of all performed gestures and questions; these were then averaged across individuals to get group variables. A Cohen's kappa of 0.8, for instance, indicates an excellent level of agreement (Altmann, 1991).

To test whether the degree of concordances differed significantly between groups we carried out an analysis of variance (ANOVA, univariate), which was followed by a posthoc-test (Bonferoni).

Results

Signaling Versus Counting

The proportion of the participants who used a consistent signaling and counting technique was 69.0%. The subsequent bootstrap analysis revealed a 95% confidence interval for the proportion of consistent counters of 67.3% to 84.0%.

Gesturing Using One Hand and Two Hands

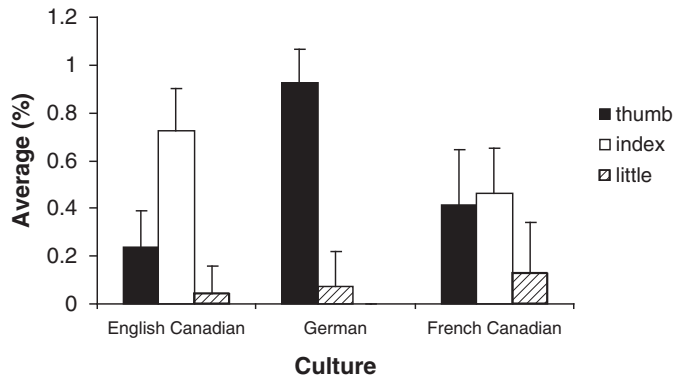
A 3×3 ANOVA (Culture $\times$ Finger) with finger as the repeated measurement revealed a significant main effect for finger, $F(2, 114) = 90.7$, $p < .001$, no significant main effect for culture, $F(2, 57) = 49.74$, $p < .48$, and a significant interaction between finger and culture, $F(2, 57) = 27.55$, $p < .001$.

To further investigate these differences, we compared the frequency of using the thumb, the index, or the little finger to start a numeral using one or two hands.

Gesturing Using One Hand

Starting a number using the thumb. An ANOVA detected a significant main effect for group, $F(2, 1.856) = 78.4$, $p < .001$. The post hoc test revealed that the Germans differed

Figure 1
Use of Finger Gestures With One Hand



Note: Average use of finger gestures (in percentages) of the three cultures using one hand, starting with the thumb, index, or little finger. Error bars indicate the standard deviation.

significantly from all other cultures ($p < .001$), starting a numeral preferentially using the thumb (see Figure 1). In addition, the English Canadians differed significantly from the French Canadians ($p < .001$).

Starting a numeral using the index finger. An ANOVA revealed a significant main effect for group, $F(2, 1.659) = 74.46$, $p < .001$. The post hoc test revealed that English Canadians differed significantly from the Germans ($p < .001$), by starting a numeral preferentially using the index finger, as well as the French Canadians ($p < .01$). In addition, we found a significant difference between the Germans and the French Canadians ($p < .01$).

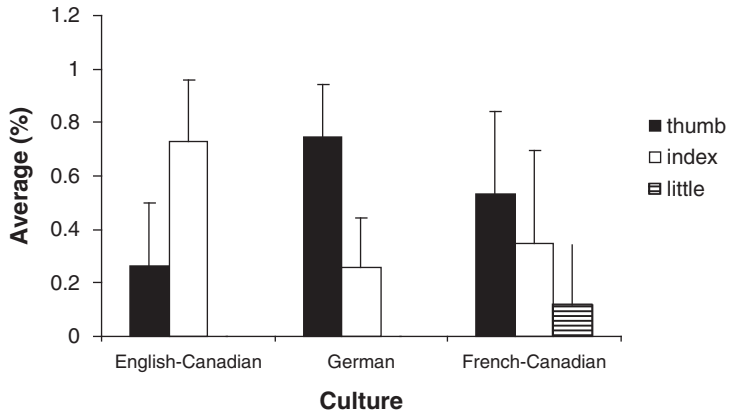
Starting numeral using the little finger. An ANOVA detected a significant main effect for group, $F(2, 1.097) = 4.28$, $p = .019$. The post hoc test revealed that Germans differed significantly from French Canadians ($p = .018$), by starting a numeral less often using the little finger than the French Canadians.

Gesturing Using Two Hands

Starting a number using the thumb. An ANOVA revealed a significant main effect for group, $F(2, 3.97) = 16.708$, $p < .001$. The post hoc test revealed that the Germans differed significantly from the English Canadians ($p < .001$) and the French Canadians ($p = .038$), starting a numeral preferentially using the thumb. In addition, we found differences between the English Canadians and the French Canadians ($p = .007$) (see Figure 2).

Starting a number using the index finger. An ANOVA detected a significant main effect for group, $F(2, 3.635) = 19.595$, $p < .001$. The post hoc test revealed that English Canadians differed significantly from the French Canadians and the Germans ($p < .001$) (see Figure 2).

Figure 2
Average Use of Finger Gestuers Across Cultures Using Two Hands



Average use of finger gestures (in percentages) of the three cultures using two hands, starting with the thumb, index, or little finger. Error bars indicate the standard deviation.

Starting a number using the little finger. An ANOVA detected a significant main effect for group, $F(2, 0.931) = 5.44$, $p = .007$. The post hoc test revealed that French-Canadians differed significantly from the English-Canadians and the Germans ($p = 0.018$) (see Figure 2).

Gesturing the Number 1

To analyze whether participants differed in the way of using their fingers to gesture the number 1, we analyzed three different matrices. The first matrix (3×2 matrix: all groups) revealed an overall significant difference, $\chi^2(2)$; $G = 60.5005$, $p < .001$. In the second matrix (2×2 matrix), we excluded the German group and found no significant difference between the English Canadian and French Canadian group, $\chi^2(1)$, $G = 1.41194$, $p = .234$. We then collapsed these groups into one group and tested German group versus non-Germans. The German group differed significantly using preferentially the thumb to gesture one, $\chi^2(1)$, $G = 54.6232$, $p < .001$.

Group Differences

To assess the degree of concordance in the performance of finger gestures between and within the three groups we used Cohen's kappa statistics (see methods/data analysis and statistics).

Concordances within groups. The average within-group kappas of the Germans (0.88) and the English Canadians (0.72) showed relatively high degrees of concordance (Altmann, 1991), whereas the average within-group kappas of the French Canadians (0.54) showed relatively low degrees of concordance. An ANOVA (univariate) detected a significant main effect for group, $F(2, 20.216) = p < .001$. The post hoc test detected significant differences

($p < .001$) between the individual kappas of Germans and the other two cultures, as well as English Canadians and French Canadians.

Concordances between groups. The average between-group kappas of the different cultures showed relatively low levels of concordances (Altmann, 1991). The between-group kappas of the English Canadians and the French Canadians (0.51) had the highest score of concordances, the French Canadians and the Germans were intermediate (0.28), and the English Canadians and the Germans (0.08) showed the lowest between-group kappas of concordances.

Discussion

Our primary goal was to test the hypothesis that finger gestures belong to the category of conventional gestures whose form and meaning are established by the conventions of specific communities (McNeill, 1998). To address this hypothesis, we investigated (a) whether participants differentiated between counting and signaling; (b) the consistency and uniformity of gesture techniques, by focusing especially on concordances within and between groups; and (c) how participants depicted the number 1.

The results showed that the majority of individuals used consistent gesture techniques and did not differentiate between signaling and counting. The prediction that the direction of the palm would differ due to the intention of the recipient (signaling to provide information to a recipient or counting for oneself) could therefore not be verified. There might be two explanations: First, the fingers themselves carry and transfer the crucial information of the message (the exact number), whereas the direction of the palm neither increases nor decreases the content of the transferred message. Second, the direction of the palm is linked to the spatial distance between signaler and recipient, with signalers choosing to direct the palm of the hand to recipients (in addition to the number gestures) mainly during long-distance communication. Further research is needed, however, to distinguish between these two explanations, because our scenario limited signalers and recipients to a small gesture space, with individual distances ranging from 1 to 2 m only.

Regarding uniformities of gestures across groups, the finger gestures of the German and English-Canadian group showed a consistent pattern and could be characterized by a high degree of uniformity: Germans gestured numbers using one or two hands, usually starting with the thumb, whereas English Canadians gestured numbers using one or two hands, usually starting with the index finger. French Canadians, however, showed low degrees of concordances and high individual variety, which indicates that an individual's cultural origin cannot always be guessed by watching his or her counting (cf. Menninger, 1958). One explanation might be that finger gestures used to illustrate numerals have a low probability to cause misunderstandings because their meaning is also understood by receivers if the conventional form is not exactly met.

Focusing on similarities of gesture use between cultures, we found that the between-group kappas of the two Canadian traditional groups (English Canadians and French Canadians) showed relatively high levels of concordances but differed significantly to the between-group kappas of Germans. These results therefore seem to support findings of

D. Efron (1941), who studied the use of gestures used by two bilingual groups in New York City, a group of eastern Jewish bilinguals (Hebrew-English) and a group of Southern Italian bilinguals (Italian-English), who were speaking their second language, English. Efron showed that gestural "characteristics" found in the traditional Jews or traditional Italians disappear with the social assimilation of the individual in the American community. Physical proximity of cultures paired with the acquisition of the predominant language as well as frequent exchange between these groups might therefore be a crucial factor to determine the ongoing development of conventional gestures. Similar results have been reported for language structures attributable to physical proximity (e.g., Munske, 1985). The effects of language contacts are often thought to take place in the minds of bilinguals, who have to mediate between the two languages and cultures (e.g., Sala, 1998). Grosjean (1982), for instance, argued that bilinguals always activate both of their languages and must suppress the activation of one language to speak the other. A similar process might account for the use of gestures in bilinguals: They might have to mediate not only between two competing languages but also between two conventional gesture systems (see also Pika, Nicoladis, & Marentette, 2006). This might result eventually in the acceptance of the gestural system of the majority language or culture or even the loosening of conventions.

Focusing on cultural differences in the way of gesturing the number 1, we found that Germans used preferentially the thumb to illustrate the number 1, whereas the two North American groups preferentially used the index finger. Because the thumb was used in a variety of ancient counting procedures as the starting finger (Ifrah, 1985), the German culture seems to have preserved the original pattern, together with a variety of new meanings. In the majority of many other cultures, however, the thumb-up gesture lost its old meaning and is used only to signal, for instance, "okay" (United States, Europe), "everything is fine" (United States, Europe), "hitchhiking" (United States, Europe), or "down and out" (Australia; Axtell, 1991). In Nigeria and Ethiopia, the thumb-up gesture is viewed as a rude gesture (Axtell, 1991). However, anecdotes suggest that European-French and European-Italian people also still depict the number 1 using the thumb. This root might explain why on average 15 of 20 French Canadians used the thumb to depict the numeral 1 in a counting sequence, but when asked explicitly to gesture the number 1 only, they used the index finger. Because the German group represents the group with the lowest exposure to other languages and cultures, these results strengthen our argumentation even further that the exposure and exchange of a cultural group to other cultures and their languages play a crucial role for the development and preservation of gestures. The index finger may have obtained the meaning of signaling the number 1 through its use to name things while pointing to them.

However, spoken languages go through diachronic change without the influence of contact with other languages, thereby preserving some original features while changing others. Gestures might also undergo a similar process, leading, for example, to differences in gesture use between French Canadians now and the original French settlers from Europe.

To further investigate whether the use of nonconventional gestures to signal finger gestures causes misunderstandings and when gestures become conventional, further studies on a variety of different other cultures and language groups are of major importance.

Conclusion

The present study provides evidence that some cultural groups use finger gestures that follow uniform conventions (German and English Canadians), whereas others do not. Finger gestures therefore qualify as conventional gestures, but their form may be influenced by the language or cultural group itself and/or the surrounding culture contact. These interior and exterior influences might even result into the loosening of uniformities.

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Simone Pika is a lecturer for evolutionary psychology at the University of Manchester, United Kingdom. Her research interest centers on the evolutionary roots of language by comparing communicative skills of human and nonhuman animals with a special focus on the underlying processes of social cognition.

Elena Nicoladis is an associate professor in developmental psychology at the University of Alberta. Her research focuses on children's language acquisition, including bilingual development, the acquisition of morphology, and the use of gestures.

Paula Marentette is an associate professor of psychology at the Augustana Campus of the University of Alberta. Her research interests include language acquisition and the link between gesture and signed languages.