Supporting Information

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SI Materials and Methods

Participants. Of the four participants tested, one participant, age 24 y, attended a school at which Nicaraguan Sign Language was used for a total of 23 wk over the course of 3 y, starting at age 17 y. Despite this exposure, he still communicated exclusively through homesign. The relatives and friends whom we used as informants and recipients during data collection all knew the homesigners' particular gesture systems well enough to communicate with them. Although the homesigners generally did not have medical records, they have no known cognitive deficits.

The hearing controls were all female, three of whom live in Managua, and a fourth who lives in the city of Estelí, north of Managua. None of the hearing controls had any extensive contact with signers or homesigners. None of the participants had been to school for any period.

The first deaf control subject was a 69-y-old man who was immersed in an ASL environment at 4 y of age (at a residential school for deaf children). He has a bachelor's degree. The second deaf control subject was a 66-y-old woman who attended oral deaf schools in which ASL was not used. However, at approximately age 9 y she was exposed to ASL through schoolmates who had signing relatives. She completed secondary school. Both participants received intensive oral training; their written English is at approximately a high school level.

To test the homesigners' other cognitive functions, we administered a spatial reasoning task to them and all of the family members who were present for the testing. The task was a mental rotation task, in which the participant must choose one of four shapes to complete a square that has a piece cut out of it (1). Homesigners performed as well as their family members and friends. Homesigners had an average of 19.75 questions of 32 correct, and their relatives had an average of 21.5 of 32 correct. These scores were not significantly different from one another (independent-samples t test, $t(10) = -0.437$, $P = 0.671$).

Knowledge of Monetary Value. Because this task was administered on the computer, we first had the participants identify computer depictions (pictures) of the coins and bills of Nicaraguan currency [coins of 10¢, 25¢, 50¢, 1 Cordoba (C$1), and C$5, and bills of C$10, C$20, C$50, C$100, and C$500]. We presented an image of each of these coins or bills one at a time and asked the homesigner to tell us what it was. All homesigners could indicate the value of each coin or bill, all of which display their values in Arabic numerals, using finger gestures to indicate the number of Cordobas or cents it was worth. For small values through 20, homesigners indicated the value with a number of fingers equal to the number of units (e.g., they held up 10 fingers for a C$10 bill). They generally made no distinction between cents and Cordobas, meaning they held up 10 fingers for a 10¢ coin as well as a C$10 bill. All of the homesigners indicated the 50¢ coin by calling it "one half," that is, by doing a bisection gesture to the index finger of their other hand. For a C$50 bill, three of the four homesigners held up a five and a zero, imitating the Arabic numerals on the bill. One homesigner, subject S04, indicated it by holding up a five and then doing four iterations of a "10" hand shape, presumably intending to hold up five sets of 10. All four homesigners indicated C$100 and C$500 by imitating the Arabic digits on the bill: 1-0-0 and 5-0-0, respectively. The coins vary in size according to value (i.e., the largest coin is worth the most) and the bills are each distinct colors.

In the first "which is more" forced choice task, single coins or bills were presented on each side to ensure that the homesigners knew the relative value of these coins and bills. The hearing controls were all perfect on this task. The homesigners also performed extremely well on this task. Two homesigners completed all nine comparisons correctly on the first try, and two completed eight of the nine comparisons correctly. In the first trial, both mistook a 50¢ coin to be a C$5 coin and therefore indicated it was worth more than a C$1 coin. They both changed their answer when asked to identify the 50¢ coin.

In the second version of the "which is more" task, participants saw 40 trials, each of which contained two sets of coins or bills. In this task, the coins on each side of the comparison were all of one kind, but homesigners had to compare across types of coins or bills. There were four types of trials, ranging in difficulty, as follows:

Type I, which included four trials, showed small numbers of bills or coins of the same denomination. These were controls to make sure homesigners were on task (e.g., two C$5 coins vs. three C$5 coins).

Type II, which included 12 trials, showed small numbers of bills or coins of different denominations (e.g., three C$20 bills vs. one C$50 bill, two C$5 coins vs. three C$10 bills).

Type III, which included 12 trials, showed large numbers of bills or coins of different denominations with a small monetary difference between sides (e.g., six C$5 coins vs. two C$20 bills, seven C$10 bills vs. four C$20 bills).

Type IV, which included 12 trials, showed large numbers of bills or coins of different denominations with a large monetary difference between sides, always at a 1:2 or 2:3 ratio (e.g., 10 C$10 bills vs. two C$100 bills, 12 C$5 bills vs. three C$10 bills).

Trials of different types were interspersed in a quasi-random fixed order. Side of the winner, the larger number of coins being the winner, and the larger denomination being the winner were all counterbalanced across trials within each type. Moreover, within each type, homesigners saw four trials that compared coins to coins, four trials that compared bills to coins, and four trials that compared bills to bills.

Fig. 1 indicates the homesigners' and the unschooled hearing controls' performance on this task. Both groups did quite well. The hearing controls were far above chance on all trial types (one-sample t tests: all $P < 0.01$). The homesigners were above or marginally above chance on all trial types except type III [one-sample t tests: type I, $t(3) = 7.00$, $P < 0.01$; type II, $t(3) = 3.323$, $P < 0.05$; type III, $t(3) = 2.211$, $P = 0.114$; type IV, $t(3) = 2.920$, $P = 0.06$].
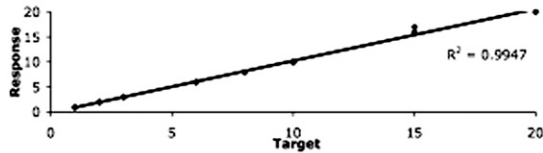
These results indicate that the homesigners understand some Arabic notation from money, and know how money varies in value, but, as a group, they struggle most with trials that require close comparisons of large numbers of bills or coins, trials on which the hearing controls did very well. However, performance on this task varied widely among participants. One homesigner got every single trial correct, whereas another homesigner was at chance level for trial types II, III, and IV. These two homesigners did not differ from each other, nor from the other two homesigners, on the other tasks reported in this study. Apparently whatever strategies allowed some success with money did not reflect robust representations of exact cardinal values.

1. Levine SC, Vasilyeva M, Lourenco SF, Newcombe NS, Huttenlocher J (2005) Socioeconomic status modifies the sex difference in spatial skill. *Psychol Sci* 16:841–845.

Fig. S1. Homesigners' and unschooled hearing control subjects' performance on the monetary reasoning task.
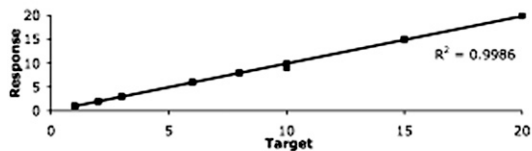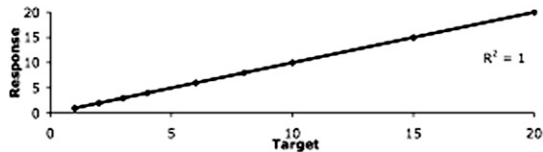
INTRA-MODAL TASKS

a) Visual Presentation (Uncovered), Visual Response

b) Visual Presentation (Covered), Visual Response

c) Tactile Presentation, Tactile Response

CROSS-MODAL TASKS

d) Visual Presentation (Uncovered), Tactile Response

e) Visual Presentation (Covered), Tactile Response

f) Tactile Presentation, Visual Response

Fig. S2. Number in noncommunicative tasks performed by the unschooled hearing controls. The graphs display the unschooled hearing controls' responses on the six match-to-sample tasks. (*A–C*) Intramodal tasks (presentation and response in the same modality). (*D–F*) cross-modal tasks (presentation and response in different modalities). The average R^2 value is shown for each task.

INTRA-MODAL TASKS

a) Visual Presentation (Uncovered), Visual Response

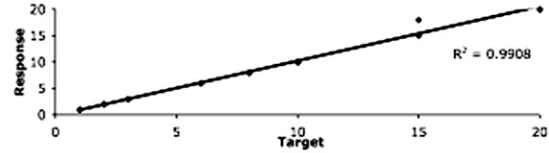### b) Visual Presentation (Covered), Visual Response

c) Tactile Presentation, Tactile Response
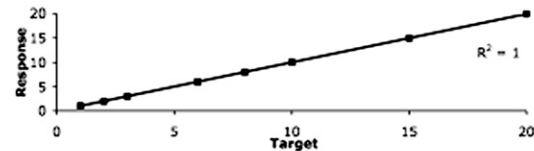

CROSS-MODAL TASKS

d) Visual Presentation (Uncovered), Tactile Response

e) Visual Presentation (Covered), Tactile Response
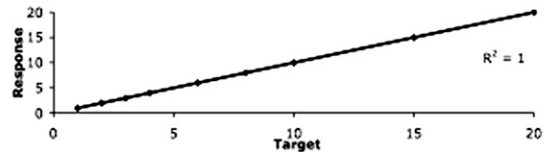

f) Tactile Presentation, Visual Response

Fig. S3. Number in noncommunicative tasks performed by the deaf controls. The graphs show the signing deaf controls' responses on the six match-to-sample tasks. (*A–C*) Intramodal tasks (presentation and response in the same modality). (*D–F*) cross-modal tasks (presentation and response in different modalities). The average R^2 value is shown for each task.

Table S1. Description of all 10 vignettes used in the number narrative task

Vignette	First set	Second set
1	2 elephants enter.	1 elephant enters.
2	1 bear sits on chair, falls off its chair.	2 bears sit on chairs, each falls off its chair 1 at a time.
3	8 monkeys enter one by one, 7 holding bananas, all 7 eat bananas simultaneously, 7 leave one by one, 1 monkey without bananas stays at end.	7 monkeys enter one by one, 4 holding bananas, 4 eat bananas simultaneously, 4 leave one by one, 3 monkeys without bananas stay at end.
4	4 flower boxes, 1 flower grows out of 3 of them, 2 small ones grow out of 1 box (5 total).	6 flower boxes, 2 flowers grow out of 5 of them, 1 large one grows out of 1 box (11 total).
5	5 cups on table, each filled with juice one at a time (3 orange, 2 red), then 2 fall over one at a time.	6 cups on table, each filled with juice one at a time (3 orange, 3 red), then 3 fall over one at a time.
6	8 frogs on lily pads, 4 jump away all at once, 2 come back one at a time.	12 frogs on lily pads, 5 jump away all at once, 3 come back one at a time.
7	10 sheep in a pen, 5 leave the pen, 1 gets killed by a wolf, 4 return to the pen.	10 sheep in a pen, 3 leave the pen, 1 gets killed by a wolf, 2 return to the pen.
8	6 ice cream cones are out, teddy bear enters 6 times, going to each cone one time. Teddy bear eats 3 ice creams (leaves cones), leaves 3 uneaten. Bear stays by last cone, doesn't eat it.	6 ice cream cones are out, teddy bear enters 6 times, going to each cone one time. Teddy bear eats 5 ice creams (leaves cones), leaves 1 uneaten. Bear stays by last cone, doesn't eat it.
9	Cup with juice and 6 straws in it. 6 birds come in one at a time, each drinks from a different straw, very little liquid left in cup at end.	Cup with juice and 5 straws in it. 5 birds come in one at a time, each drinks from a different straw, very little liquid left in cup at end.
10	First man shoots an orange basketball through a hoop 9 times, then leaves. Second man enters, shoots a yellow basketball through hoop 8 times.	First man shoots an orange basketball through a hoop 5 times, then leaves. Second man enters, shoots a yellow basketball through hoop 10 times.

Both sets are represented here: two participants saw the first set of vignettes and two saw the second set.