Supplemental material 1:
Set-up of the disambiguation task used in Study 1

The set-up of the reference disambiguation task used in Study 1. Participants sat facing the fireplace, with four objects on one side (toward the door) and a matching set of the same four objects on the other side (away from the door).
Supplemental material 2:
Stimuli for Study 1

1) wisi-deŋ mori suwa
   up.that-gen.adv orange point.2s.nearfut
   ‘Point to the uphill orange.’

2) imi-deŋ mori suwa
   down.that-gen.adv orange point.2s.nearfut
   ‘Point to the downhill orange.’

3) wisi-deŋ tomato suwa
   up.that-gen.adv tree.tomato point.2s.nearfut
   ‘Point to the uphill tomato.’

4) imi-deŋ tomato suwa
   down.that-gen.adv tree.tomato point.2s.nearfut
   ‘Point to the downhill tomato.’

5) yik abida-ŋ a-wu
   bag hold-SS s.obj-come.up.2s.nearfut
   ‘Bring up the bag.’

6) yik abida-ŋ a-bi
   bag hold-SS s.obj-come.down.2s.nearfut
   ‘Bring down the bag.’

7) kap abida-ŋ a-wu
   cup hold-SS s.obj-come.up.2s.nearfut
   ‘Bring up the cup.’

8) kap abida-ŋ a-bi
   cup hold-SS s.obj-come.down.2s.nearfut
   ‘Bring down the cup.’
Supplemental material 3:
Arrays used in the ‘Pig & Corn’ task

“PIG AND CORN” STIMULI

ADULT ARRAYS

A1  A2

A3  A4

A5  A6

A7  A8

CHILD ARRAYS

C1  C2

C3  C4

C5  C6

C7  C8
Supplemental material 4:
Complete transcripts of all examples

Study 2:

Example 1. Outdoors, participants facing WSW (position B)

director:

bit maluŋ-gok amin tim-ni a-bi isi-don
pig small-dim one nose-3.poss move-2s.DS up.that-loc

iraisa-da yuma-gan on-gan-da y-ipm-ek e
PN-subj area-loc that-loc-adv 3s.obj-put-SS.D and

a-wo-ŋban e piŋan yo gwin yaŋ-gin y-ip-bi
s.obj-go.up-3s.DS and dog too all thus-just 3s.obj-put-2s.fut

translation: ‘Point the nose of the small pig towards Raisa's area up there. Going up, put the dog just like that too.’

Example 2. Outdoors, facing WSW (position B)

director:

bit meŋ-i-da mibiŋtok gw-im-den wusi-k
pig mother-3.poss-subj first secondary-down.that-gen.adv look.for-SS.D

ak-dak
stand-3s.pres

aka pup nan-i yo gwin a-biŋ-ban
disc chicken father-3.poss too all 3s.obj-come.down-3s.DS

im-den wusi-k ak-dak
down.that-gen.adv look.for-SS.D stand-3s.pres

translation: ‘The big pig first is looking downwards. The rooster too, coming down—it is looking downwards.’
Example 3. Indoors, facing WSW (position B)

director:

pup nan-i busuŋ-o y-ip-bi
corner father-3.poss head-poss 3s.obj-put-2s.DS

on ga-ga yik-dal tet-gin tibil a-kan
that 2s-emph sit-2s.pres side-loc turn do-3s.DS.D

isit yut barat-da y-ip-bi
corn plant flat-adv 3s.obj-put-2s.fut

pup nan-i busuŋ-o y-ip-bi i-deŋ
corner father-3.poss head-poss 3s.obj-put-2s.DS this-gen.adv

w-akan
come.up-3s.DS.D

gaga yik-dal-gin w-akan
2s-emph sit-2s.pres-loc come.up-3s.DS.D

isit yut barat-da y-ip-bi imin tiron-ŋ-gin
corn plant flat-adv 3s.obj-put-2s.DS down.that door.area-loc

ki-sak
go-3s.fut

translation: ‘Put the rooster’s head facing that side where you are sitting. Put the corn horizontal. Put the rooster’s head coming up here, toward where you are sitting. Put the corn plant horizontal toward that door area down there.’

Example 4. Indoors, facing ENE (position A)

director:

kili isit-naŋ aŋ-tibil yomaga-gin y-ipmaŋ-dal
disc corn-s.obj s.obj-turn.SS door-loc 3s.obj-put-2s.pres

y-ip-bi imi-deŋ ki-sak
3s.obj-put-2s.DS down.that-gen.adv go-3s.fut

kili pup nan-i y-ipmaŋ-bi isin
disc chicken father-3.poss 3s.obj-put-2s.DS up.that
yut-dom-gan  tibil-jak
house-wall-loc  turn-3s.fut

*translation*: 'Okay, turn the corn and put it toward the door. Put it towards down there. Okay, put the rooster turned toward that wall up there.'

**Study 3**

**Example 5. Indoors, facing ENE (position A)**

director:

bit kwin-da  y-ip-bi  tim-i  imin  abilak
pig above-adv 3s.obj-put-2s.DS  nose-3.poss  down.that  fire.place

ka-ŋgan  piki-akan
inside-loc go.down-3s.DS.D

isit y-ip-bi  imin  tet-gan  pikw-an
corn 3s.obj-put-2s.DS  down.that  side-loc go.down-3s.nearfut

*translation*: 'Put the pig above with its nose going down toward the fire down there. Put the corn down toward that side down there.'

**Example 6. Indoors, facing ENE (position A)**

director:

piŋan-kat  bit  men-ŋ-gat  an-tobil  isi-deŋ  tet-gin-da
dog-com  pig mother-3.poss-com  s.obj-turn.SS  up.that-gen.adv  side-loc-adv

y-ipmanŋ
3s.obj-put.2s.nearfut

*translation*: ‘Put the pig and dog turned toward the side up there.’
**Study 3 — Additional example**

Example 7. Indoors, facing ENE (position A)

*director:*

isit barat-da ga-ga yik-dal-on y-ipm-ek
corn flat-adv 2s-emph sit-2s.pres-loc 3s.obj-put-SS.D

a-wo-ŋban piŋan-an isin tet-gan an-tobil ek
s.obj-go.up-3s.DS dog-s.obj up.that side-loc s.obj-turn do.SS.D

y-ip
3s.obj-put.2s.nearfut

*matcher:*

pom tet
far.from.door side

*director:*

isin tet-da isin amin yik-gaŋ tet-gan
up.that side-adv up.that people sit-3s.pres side-loc

*translation:*
Director: ‘Put the corn horizontal where you are sitting. Going up, turn the dog facing the side up there.’
Matcher: ‘The side away from the door?’
Director: ‘The side up there, where those people up there are sitting.’
Supplemental material 5:
Satellite imagery of the terrain

Satellite imagery showing the terrain surrounding Gua village, where the present studies were conducted. Gua is situated in a valley—one of several such valleys within the broader Yupno valley—that is bisected by the Daldal river. When in Gua, the slope toward and away from the Daldal is steep whereas the axis along the river is comparatively gentle.