Natural (6W)

s6-1

S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · Pred$_i$ · Pred$_j$ · Pred$_k$

健太と	秋子と	友達が	それぞれ	泳ぎ、	座り、	泣いている
Kenta-to	*Akiko-to*	*Tomodati-ga*	*sorezore*	*oyogi*	*suwari*	*naiteiru*
Kenta and	Akiko and	friend-NOM	respectively	swimming	sitting	crying

t6-1

S$_3$ / S$_2$ / S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · Pred$_k$ · Pred$_j$ · Pred$_i$

太郎は	花子が	母親が	ときどき	歩いたと	話したと	考えている
Taro-wa	*Hanako-ga*	*hahaoya-ga*	*tokidoki*	*aruita-to*	*hanasita-to*	*kangaeteiru*
Taro-NOM	Hanako-NOM	mother-NOM	sometimes	walked-that	said-that	thinks

s6-2

S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · Pred$_{j+k}$ · Pred$_{j+k}$ · Pred$_{j+k}$

秋子は	手と	耳が	それぞれ	大きく、	綺麗で、	温かい
Akiko-wa	*te-to*	*mimi-ga*	*sorezore*	*ookiku*	*kireide*	*atatakai*
Akiko-NOM	hands and	ears-NOM	respectively	big	beautiful	warm

t6-2

S$_3$ / S$_2$ / S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · (e) · Pred$_{it}$ · Pred$_k$ · Pred$_{i+j}$

太郎と	友達は	先生が	—	ときどき	明るかったと	言ったと	思っている
Taro-to	*tomodati-wa*	*sensei-ga*	—	*tokidoki*	*akarukatta-to*	*itta-to*	*omotteiru*
Taro and	friend-NOM	teacher-NOM	it	sometimes	bright-that	said-that	think

s6-3

S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · Pred$_{i+j}$ · (e$_k$) · Pred$_{i+j}$ · (e$_k$) · Pred$_{i+j}$

太郎と	花子が	秋子と	それぞれ	話し、	遊び、	踊る
Taro-to	*Hanako-ga*	*Akiko-to*	*sorezore*	*hanasi*	*asobi*	*odoru*
Taro and	Hanako-NOM	Akiko-with	sometimes	talk	(with her) · play	(with her) · dance

t6-3

S$_3$ / S$_2$ / S$_1$

NP$_i$ · NP$_j$ · NP$_k$ · (e) · Pred$_{it}$ · Pred$_j$ · Pred$_i$

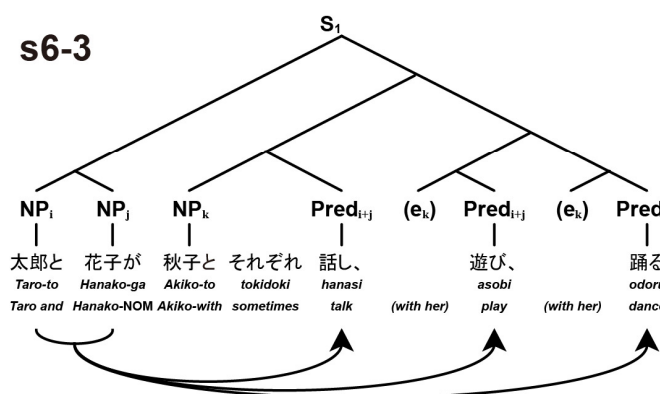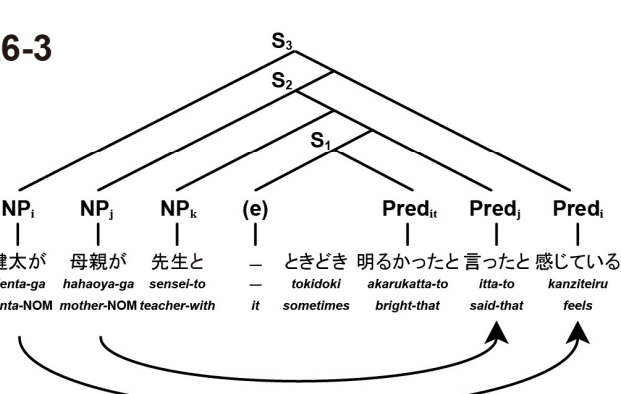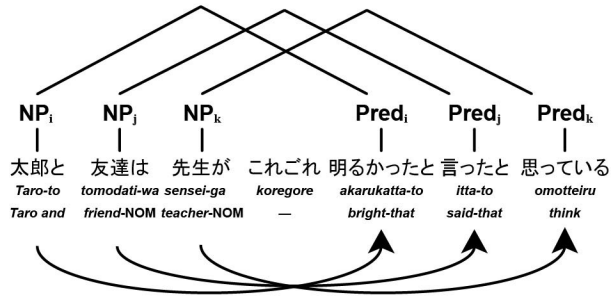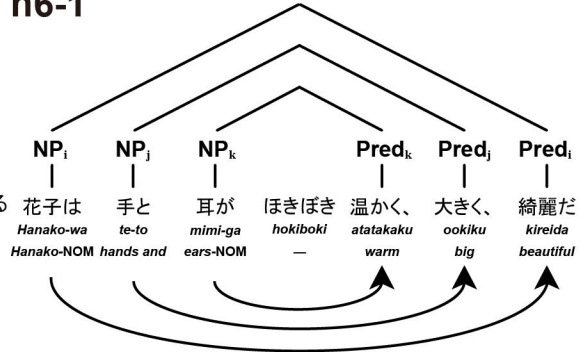| 健太が	母親が	先生と	—	ときどき	明るかったと	言ったと	感じている
Kenta-ga	*hahaoya-ga*	*sensei-to*	—	*tokidoki*	*akarukatta-to*	*itta-to*	*kanziteiru*
Kenta-NOM	mother-NOM	teacher-with	it	sometimes	bright-that	said-that	feels

SUPPLEMENTARY FIGURE 1   Six types of Natural sentences with six words. Left: Three types of sentences with *sorezore*: *e.g.*, "*Kenta, Akiko, and* [*their*] *friend are swimming, sitting, and crying, respectively*" (s6-1), "*As for Akiko,* [*her*] *hands and ears are big, beautiful, and warm, respectively*" (s6-2), and "*Taro and Hanako talk with Akiko, play* [*with her*]*, and dance* [*with her*]*, respectively*" (s6-3). Right: Three types of sentences with *tokidoki*: *e.g.*, "*Taro thinks that Hanako said that* [*their*] *mother sometimes walked*" (t6-1), "*Taro and* [*his*] *friend think that* [*their*] *teacher said that it was sometimes bright*" (t6-2), and "*Kenta feels that* [*his*] *mother said with* [*his*] *teacher that it was sometimes bright*" (t6-3).
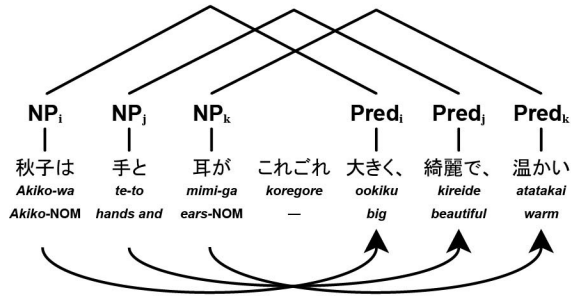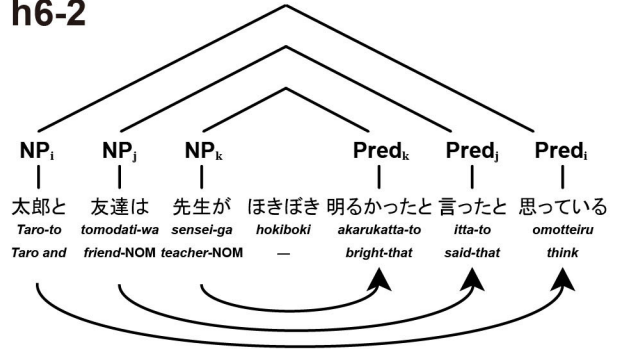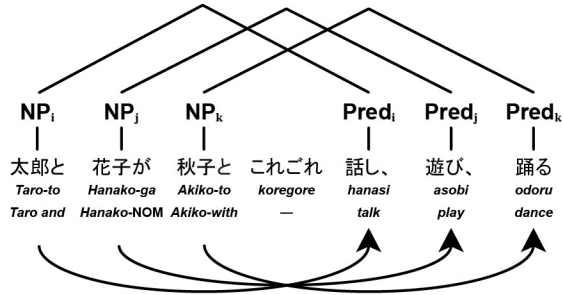
Artificial (6W)

k6-1

NP$_i$	NP$_j$	NP$_k$		Pred$_i$	Pred$_j$	Pred$_k$
太郎と	友達は	先生が	これごれ	明るかったと	言ったと	思っている
Taro-to	*tomodati-wa*	*sensei-ga*	*koregore*	*akarukatta-to*	*itta-to*	*omotteiru*
Taro and	*friend-NOM*	*teacher-NOM*	—	*bright-that*	*said-that*	*think*

h6-1

NP$_i$	NP$_j$	NP$_k$		Pred$_k$	Pred$_j$	Pred$_i$
花子は	手と	耳が	ほきぼき	温かく、	大きく、	綺麗だ
Hanako-wa	*te-to*	*mimi-ga*	*hokiboki*	*atatakaku*	*ookiku*	*kireida*
Hanako-NOM	*hands and*	*ears-NOM*	—	*warm*	*big*	*beautiful*

k6-2

NP$_i$	NP$_j$	NP$_k$		Pred$_i$	Pred$_j$	Pred$_k$
秋子は	手と	耳が	これごれ	大きく、	綺麗で、	温かい
Akiko-wa	*te-to*	*mimi-ga*	*koregore*	*ookiku*	*kireide*	*atatakai*
Akiko-NOM	*hands and*	*ears-NOM*	—	*big*	*beautiful*	*warm*

h6-2

NP$_i$	NP$_j$	NP$_k$		Pred$_k$	Pred$_j$	Pred$_i$
太郎と	友達は	先生が	ほきぼき	明るかったと	言ったと	思っている
Taro-to	*tomodati-wa*	*sensei-ga*	*hokiboki*	*akarukatta-to*	*itta-to*	*omotteiru*
Taro and	*friend-NOM*	*teacher-NOM*	—	*bright-that*	*said-that*	*think*

k6-3

NP$_i$	NP$_j$	NP$_k$		Pred$_i$	Pred$_j$	Pred$_k$
太郎と	花子が	秋子と	これごれ	話し、	遊び、	踊る
Taro-to	*Hanako-ga*	*Akiko-to*	*koregore*	*hanasi*	*asobi*	*odoru*
Taro and	*Hanako-NOM*	*Akiko-with*	—	*talk*	*play*	*dance*

h6-3

NP$_i$	NP$_j$	NP$_k$		Pred$_k$	Pred$_j$	Pred$_i$
健太が	母親が	先生と	ほきぼき	明るかったと	言ったと	感じている
Kenta-ga	*hahaoya-ga*	*sensei-to*	*hokiboki*	*akarukatta-to*	*itta-to*	*kanziteiru*
Kenta-NOM	*mother-NOM*	*teacher-with*	—	*bright-that*	*said-that*	*feels*

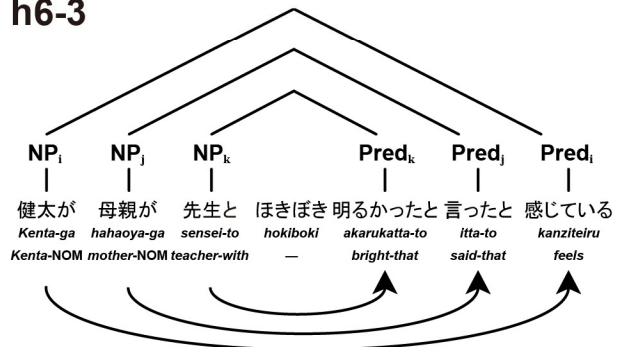**SUPPLEMENTARY FIGURE 2**   Six types of Artificial sentences with six words. Left: artificial cross-serial dependencies (pairing relations between NPs and Preds). Right: artificial nested dependencies. In these examples, pseudowords ("*koregore*" or "*hokiboki*") artificially forced the dependencies that are not Merge-generable.

APPENDIX

Task instructions

Day 1, first half

You will perform a task of judging *the correspondences between subjects and predicates* during MRI scanning.

While the stimuli are being shown, a small red cross will be presented at the center of the monitor.

Please look at the red cross, and do not move your eyes if possible.

During performing the task, please do not speak or read the sentences aloud.

・During the task, you will respond by pressing buttons.

・Please hold the controller with the button 1 on your left, and with the button 4 on your right.

・Please put your left thumb between the button 1 and 2, and put your right thumb between the button 3 and 4.

・Please press buttons with your thumbs as fast as you can.

・During scanning, you will wear goggles, and you will not be able to see the buttons.

・Please be careful not to overlook the sentences, and try to answer correctly as much as possible.

・*If a sentence disappears before you respond, please do not try to press buttons anymore, and concentrate on the next sentence.*

・Japanese sentences are shown on the monitor, in the order of subjects, an adverb, and predicates.

・*Please read the sentences carefully, and do not overlook particles such as* -wa*, * -ga *and* -to*.

・After a sentence disappears, one predicate will be presented in the upper row, and three subjects will be presented in the lower row. Some words which are not contained in the sentence may appear in the alternatives.

・From the three alternatives, choose *in the original sentence the most appropriate subject, which corresponds to that predicate*.

・The alternatives of subjects from left to right correspond to the buttons 1, 2, and 3, respectively.

♦ **Sorezore (4W)**

taro-to   hanako-ga   sorezore   hasiri,   suwatteiru

[*Taro and* *Hanako*-NOM *respectively*   *running*   *sitting*]

(Taro and Hanako are running and sitting, respectively)

[NB: Square brackets denote additional information to the reader.]

[A predicate and alternatives:]

       hasiru

taro   *hanako*   *taro-to-hanako*

1   2   3

○   ×   ×   (Use only leftmost three buttons)
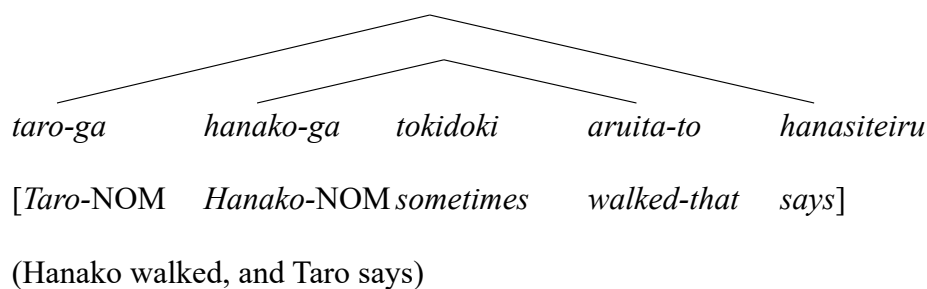
taro-ga   teasi-ga   sorezore   hosoku,   siroi

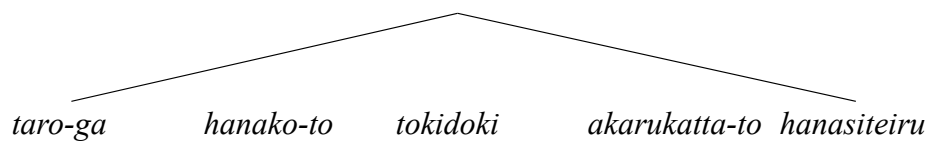[*Taro*-NOM   *limbs*-NOM *respectively* *skinny*   *white*]

(Limbs are skinny and white, respectively)

oyako-ga *taro-to* *sorezore* *odori,* *asobu*

[*parent-and-child*-NOM *Taro-with* *respectively* *dance* *play*]

(Parent-and-child dance and play, respectively)
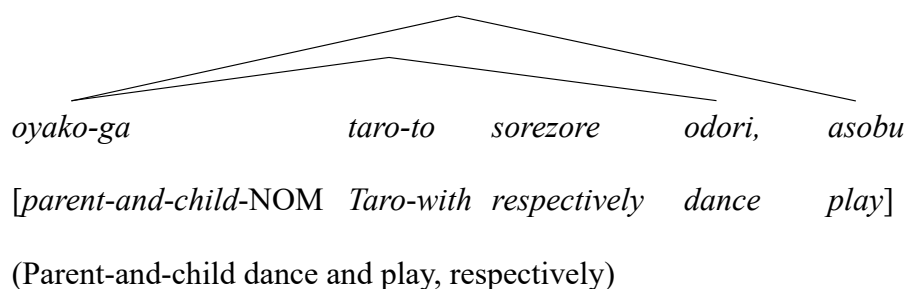
Oyako [parent-and-child] will not be presented as separate alternatives, i.e., *oya* (parent) and *ko* (child), but it will be always presented as one alternative; the same holds for *ryosin* [parents], *senseigata* [teachers], *watasitachi* [we], *simai* [sisters], *sohubo* [grandparents], and *husai* [husband-and wife]. [NB: The second NP for this sentence type was not used as an alternative.]

♦ **Tokidoki (4W)**

taro-ga *hanako-ga* *tokidoki* *aruita-to* *hanasiteiru*

[*Taro*-NOM *Hanako*-NOM *sometimes* *walked-that* *says*]

(Hanako walked, and Taro says)

taro-to *hanako-ga* *tokidoki* *akarukattato* *hanasiteiru*

[*Taro and* *Hanako*-NOM *sometimes* *bright-that* *say*]

(Taro and Hanako say)

taro-ga   hanako-to   tokidoki   akarukatta-to hanasiteiru
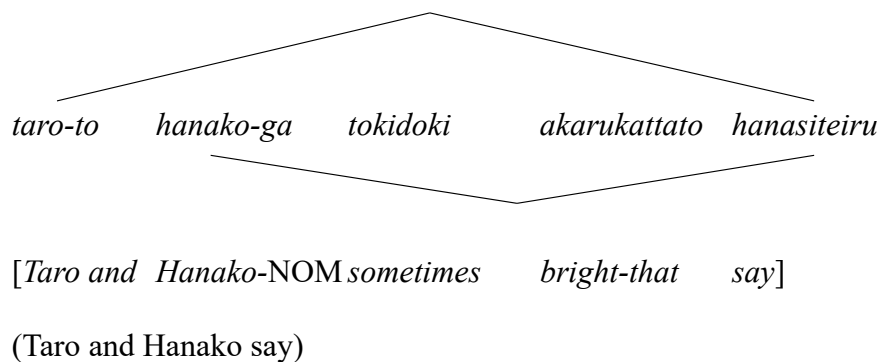
[*Taro*-NOM   *Hanako-with   sometimes   bright-that   says*]

(Taro says)

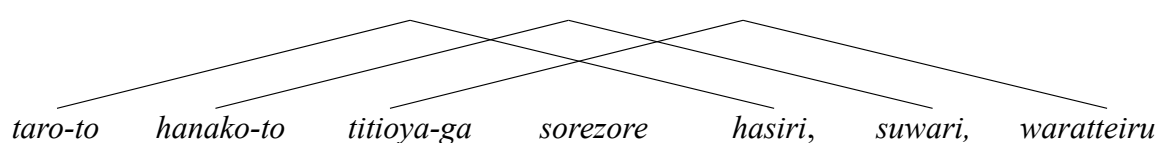[NB: The second NP for this sentence type was not used as an alternative.]

Practice: You will practice the task until you can perform two serial sets of trials, each with at least four correct answers in six trials.

In the MRI scanner, you will have 8 runs, and each run contains 19 trials.

Day 1, second half

・*Please read the sentences carefully, and do not overlook particles such as* -wa*, -*ga *and* -to.

・After a sentence disappears, one predicate will be presented in the upper row, and four subjects will be presented in the lower row. Some words which are not contained in the sentence may appear in the alternatives.

・From the four alternatives, choose *in the original sentence the most appropriate subject, which corresponds to that predicate*.
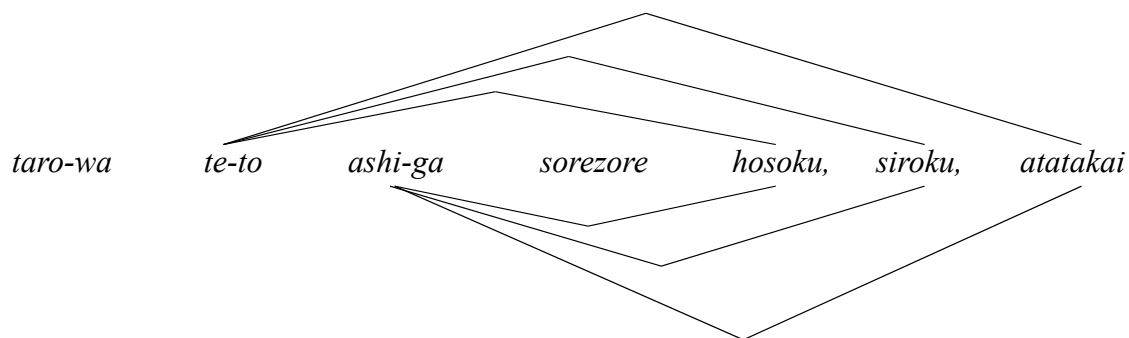
♦ Sorezore (6W)

taro-to   hanako-to   titioya-ga   sorezore   hasiri,   suwari,   waratteiru

[*Taro and Hanako and   father*-NOM   *respectively   running   sitting   laughing*]

[A predicate and alternatives:]

warau

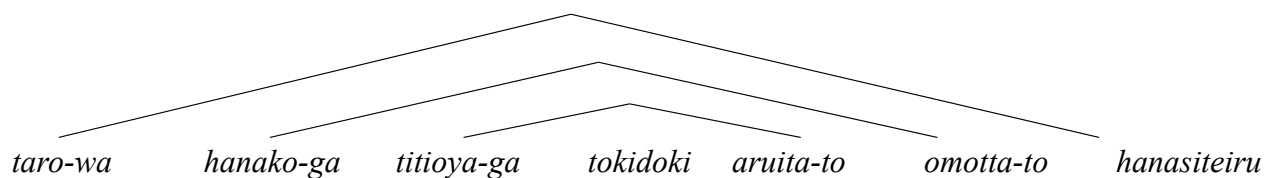| *taro*	*hanako*	*titioya*	*taro-to-hanako*
1	2	3	4
×	×	○	×

taro-wa   te-to   ashi-ga   sorezore   hosoku,   siroku,   atatakai

[*Taro*-NOM   *hands and legs*-NOM   *respectively   skinny   white   warm*]

titioya-to   hahaoya-ga   taro-to   sorezore   ai,   hanasi,   odoru
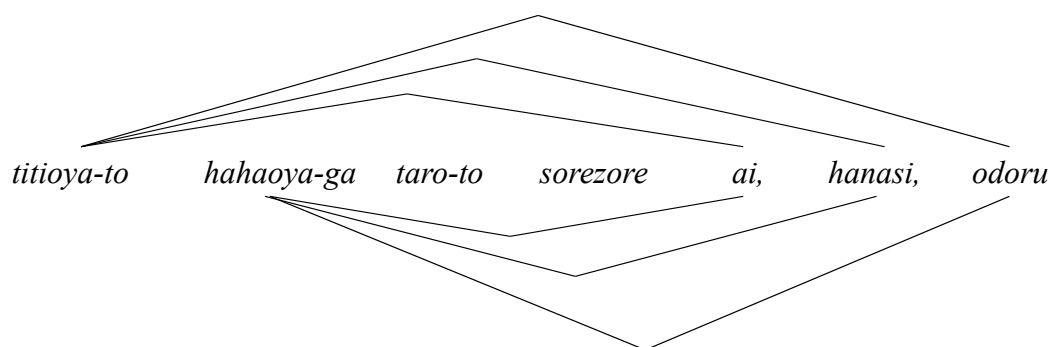
[*father and   mother*-NOM   *Taro-with   respectively   meet   talk   dance*]

♦ **Tokidoki (6W)**

taro-wa   hanako-ga   titioya-ga   tokidoki   aruita-to   omotta-to   hanasiteiru

[*Taro*-NOM   *Hanako*-NOM *father*-NOM   *sometimes   walked-that   though-that   says*]

taro-to   *titioya-wa*   *hahaoya-ga*   *tokidoki*   *akarukatta-to*   *hanasita-to*   *kangaeteiru*
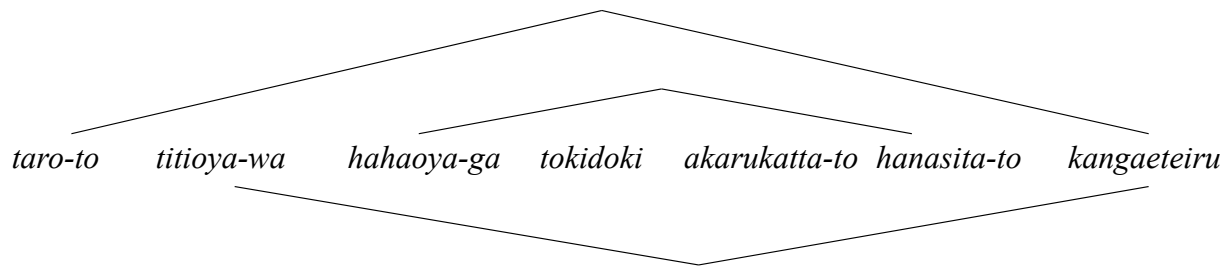
[*Taro and father*-NOM   *mother*-NOM *sometimes bright-that*   *said-that*   *think*]
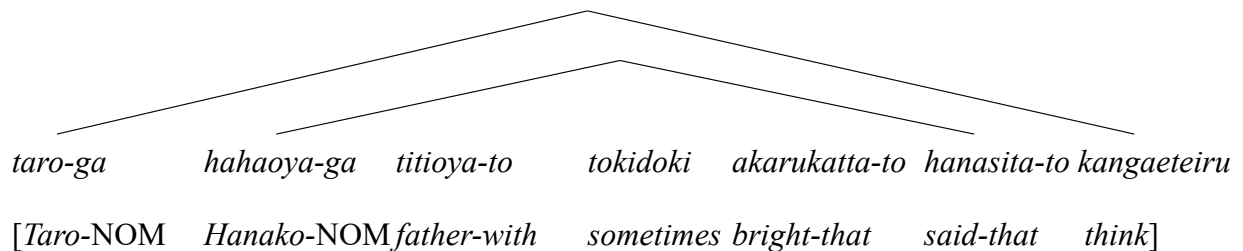
taro-ga   *hahaoya-ga*   *titioya-to*   *tokidoki*   *akarukatta-to*   *hanasita-to kangaeteiru*

[*Taro*-NOM   *Hanako*-NOM *father-with*   *sometimes bright-that*   *said-that*   *think*]

Practice: You will practice the task until you can perform two serial sets of trials, each with at least four correct answers in six trials.
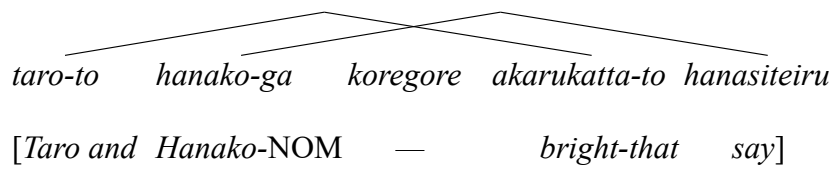
In the MRI scanner, you will have 9 runs, and each run contains 13 trials.
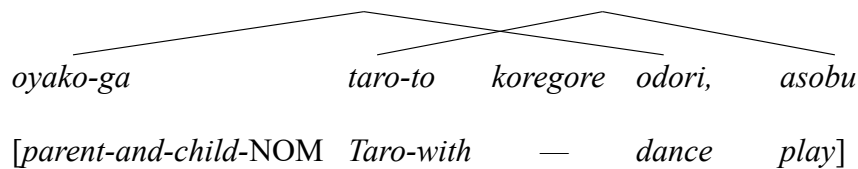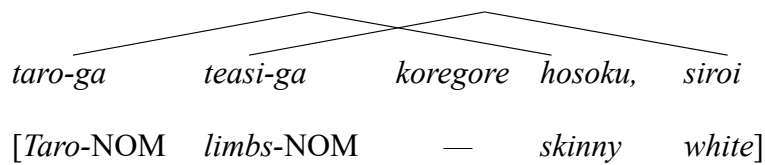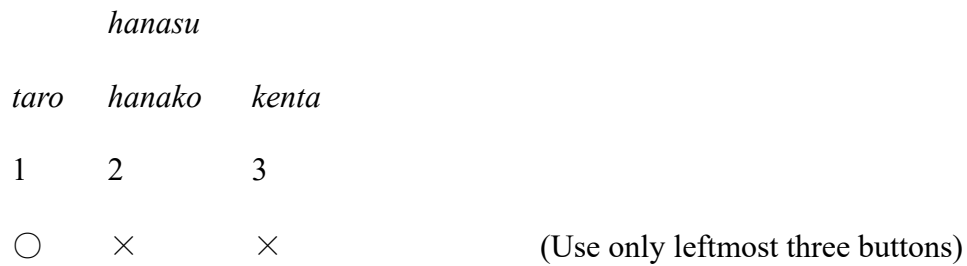
Day 2, first half

A task of judging the correspondences between words

・In this task, novel words of *koregore* and *hokiboki* will be used.

・According to these novel words, *correspondences between other four words are determined as shown by the diagrams below.* These novel words work completely differently from *sorezore* and *tokidoki* used on Day 1.

・*Under any sentence types, please remember the correspondences between words, not the meaning of a sentence.*

・From the three alternatives, choose one corresponding to that word in the upper row. Some words which are not contained in the sentence may appear in the alternatives.
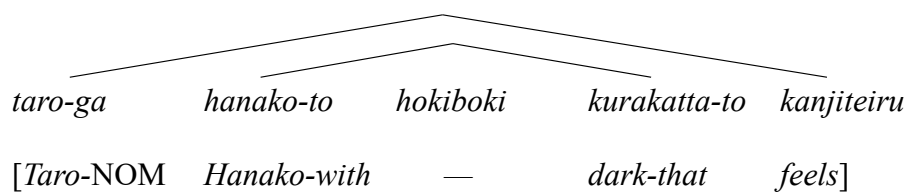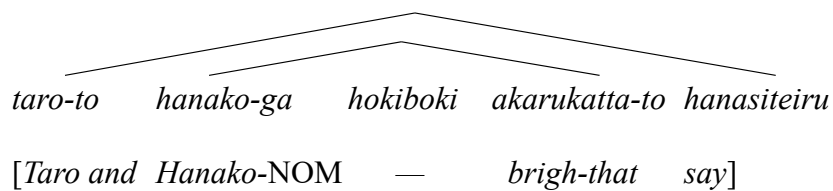
♦ Koregore (4W)
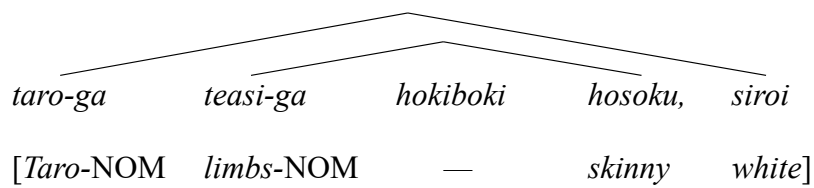
taro-to   hanako-ga   koregore   akarukatta-to hanasiteiru

[*Taro and* *Hanako*-NOM   —   *bright-that*   *say*]

[A predicate and alternatives:]

hanasu

taro	hanako	kenta
1	2	3
○	×	×

(Use only leftmost three buttons)

taro-ga   teasi-ga   koregore hosoku,   siroi

[*Taro*-NOM *limbs*-NOM   —   *skinny*   *white*]

oyako-ga   taro-to   koregore odori,   asobu

[*parent-and-child*-NOM *Taro-with*   —   *dance*   *play*]

♦ Hokiboki (4W)

taro-to   hanako-ga   hokiboki   akarukatta-to hanasiteiru

[*Taro and* *Hanako*-NOM   —   *brigh-that*   *say*]

taro-ga   hanako-to   hokiboki   kurakatta-to kanjiteiru

[*Taro*-NOM *Hanako-with*   —   *dark-that*   *feels*]

```
          _____/_____
         /        /    \          \          \
    taro-ga    teasi-ga    hokiboki    hosoku,   siroi

    [Taro-NOM   limbs-NOM      —       skinny    white]
```
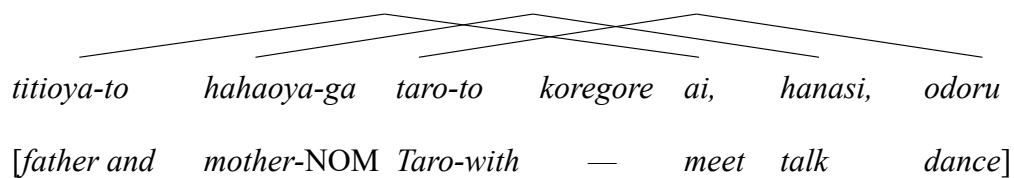
Practice: You will practice the task until you can perform two serial sets of trials, each with at least four correct answers in six trials.

In the MRI scanner, you will have 8 runs, and each run contains 19 trials.

Day 2, second half

Just like the first half, you will perform the task of judging the correspondences between six words in the second half.

♦ Koregore (6W)

```
        _____/\____/_____
       /         /         \  /   \        \     \
  titioya-to  hahaoya-ga  taro-to  koregore  ai,  hanasi,  odoru

  [father and  mother-NOM  Taro-with    —    meet   talk    dance]
```

[A predicate and alternatives:]

              au

    titioya   hahaoya   taro   kenta

    1   2   3   4

    ○   ×   ×   ×

10
```

*taro-wa*      *te-to*      *asi-ga*      *koregore*    *hosoku,*      *siroku,*      *atatakai*

[*Taro*-NOM   *hands and legs*-NOM    —    *skinny*      *white*      *warm*]

*taro-to*   *titioya-wa*   *hahaoya-ga*   *koregore*   *akarukatta-to*  *hanasita-to*   *kangaeteiru*

[*Taro and*  *father*-NOM   *mother*-NOM    —    *bright-that*   *said-that*    *think*]

♦ **Hokiboki (6W)**

*taro-to*   *titioya-wa*   *hahaoya-ga*   *hokiboki*   *akarukatta-to*  *hanasita-to*   *kangaeteiru*

[*Taro and*  *father*-NOM   *mother*-NOM    —    *bright-that*   *said-that*    *think*]

*taro-to*   *titioya-wa*   *hahaoya-ga*   *hokiboki*   *kurakatta-to*  *itta-to*   *kanjiteiru*

[*Taro and*  *father*-NOM   *mother*-NOM    —    *dark- that*   *said that*   *feel*]

*taro-wa*      *te-to*      *asi-ga*      *hokiboki*    *hosoku,*      *siroku,*      *atatakai*

[*Taro*-NOM   *hands and legs*-NOM    —    *skinny*      *white*      *warm*]

Practice: You will practice the task until you can perform two serial sets of trials, each with at least four correct answers in six trials.

In the MRI scanner, you will have 8 runs, and each run contains 19 trials.