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KANSEI TO SUBTLE FINGER MOVEMENTS TO KNOW REFERENTIAL INTENTIONS OF OTHER PEOPLE
COMPARISON OF DOMINANT AND NON-DOMINANT HAND MOVEMENTS

Harumi KOBAYASHI[*a], Tetsuya YASUDA[b]

[a], *Tokyo Denki University, School of Science and Engineering, Saitama, Japan*
[b], *Tokyo Denki University, Graduate School of Advanced Science and Technology, Saitama, Japan*

ABSTRACT

This study investigated the effect of adults' pointing with a circular motion on children's interpretation of the gesture and learning novel part names of unfamiliar objects. The participants were 2-year-olds, 4-year-olds and adults. In the experiment, an experimenter pointed while moving her finger with a circular motion around an object part and named a part of an unfamiliar object. The experimenter moved her finger touching the object part or moved her finger with seven centimeters distance from it. She also used either her dominant hand or non-dominant hand in pointing the objects. The participants were asked to make inferences about novel part names. The results show that the participants of all ages learned more part names when object parts were pointed with touching than when they were pointed without touching. 4-year-olds and adults focused on an object part more if the experimenter pointed it with her non-dominant hand. Adults and 4-year-olds seem to be sensitive to subtle non-smooth movement of a pointing finger and they may feel such movement is a result of a special effort of pointing something. The study suggests that humans have KANSEI to subtle finger movements to know specific intentions of others.

Keywords: *referential intentions, gesture, pointing with a circular motion, dominant hand*

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* **Correspondent author**: Tokyo Denki University, Ishizaka Hatoyama, Hiki-gun, 350-0394 Saitama, Japan. E-mail: h-koba@i.dendai.ac.jp

1. INTRODUCTION

Pointing is one type of nonverbal communication medium. We often point at objects or object parts in the environment to clearly communicate our referential intentions. We seem to use various types of pointing such as simple pointing with or without touching objects, pointing with tapping object, pointing with a circular motion of the pointing finger, etc. In our laboratory, we confirmed mothers of 4-yaer-olds actually used these various types of pointing when they were asked to teach part names of objects (Kobayashi & Yasuda, 2009) [1]. These various types of finger movements may be specifically interpreted by both children and adults. We seem to have sensitivity or *KANSEI* to these subtle finger movements and use such *KANSEI* to feel and know other people's feelings and intentions. However, how these various types of finger movements are interpreted is rarely investigated. In this study, we focus on the situation of a referential intention where a person utters a word intending it as a name of a certain part of the environment.

This paper investigates cues in addition to linguistic cues that young children may use to learn novel part names. One important cue may be adult gestures. Many recent studies suggest that young children are sensitive to non-linguistic information such as adults' actions and are able to use non-linguistic information to infer word meanings (e.g., Baldwin, D. A. 1993 [2]; Kobayashi, 1998 [3], 2002 [4]; Tomasello & Akhtar, 1995 [5]). Although many gestures exist, this study focuses on pointing to objects and object parts. Doherty, Anderson, and Howieson (2009) showed that pointing is a salient cue among non-linguistic cue and more accessible for young children [6]. Various styles of pointing can be observed, each with different referential intentions. As it can be easily imagine, pointing from a distance may be ambiguous from a child's point of view. Because children simply recognize the general direction of an adult's attention to an object, it seems probable that the child will relate the uttered word to the whole object. The reason is that because there is only one object in the direction and any part of the object is not specified at all by any means. However, pointing with a circular action of the forefinger may effectively specify the intended object part of the object. The reason is that a circular action may be recognized as a special addition to usual pointing and referential intention is likely to be included.

Kobayashi (1998) examined whether Japanese 2-year-olds could learn novel part names of unfamiliar objects when an adult handled object parts in addition to pointing to and naming them. In one experiment, she presented a standard stimulus (a novel inverted U-shaped bolt with a nut), pointed to and named the part ('nut'), and handled the part by turning it around the bolt. In the test phase, she presented a nut ['part choice'] or an inverted U-shaped bolt without a nut ['whole choice'] (the U-shaped bolt without a nut had a similar overall shape to the standard object) and asked children, which they thought was the 'nut'. Another standard stimulus was a novel plate hanger with two springs. The 2-year-olds chose an isolated 'part' [a nut] that they had observed an adult manipulate, as the referent for the newly acquired part name. However, they chose the whole object [a U-shaped bolt without a nut] when they had not observed the adult manipulating the part. These results suggested that two-year-old children use pragmatic information garnered from adult actions upon object parts to learn part names. When an adult points towards and acts upon a specific part, young children may better understand the part to which the adult's ostensive definition, i.e., "This is xx" applies. Because simple pointing does not clearly promote part identification, children

may default to think that the whole object was named. However, if pointing with manipulation promotes part identification, children may properly use KANSEI to pointing gestures and associate the indicated part with its newly learned name. In another study, Kobayashi (2007) showed that simply touching an object part significantly promoted part interpretation among 4-year-olds and adults, but not among two-year-olds [7]. Two-year-olds have not developed KANSEI to recognize adults' touching behavior and relating it to interpreting adults' referential intentions.

The present study further examines the effect of pointing and touching cues in learning part names. While there are many possible styles of pointing towards objects and parts, this study focuses on the effect of pointing and touching a critical part of an object with a circular motion by dominant hand and non-dominant hand. Two- and four-year-olds were selected as participants because the results of Kobayashi (1998), Saylor and Savage (2004) [8], and pilot studies in our laboratory suggest that a developmental change in learning part names occurs between these ages: Two-year-olds are able to learn part names but their ability appears to be fragile, whereas 4-year-olds seem to be better able to learn part names. The experimenter pointed to and touched the parts with a circular motion by either dominant hand or non-dominant hand. Thus, object parts were always pointed to with a circular motion while novel part names were uttered. This style of pointing, namely pointing with circular motion, may include pragmatic information that promotes part name identification when presented with novel words. In a pointing with circular motion with distance, an experimenter pointed at a critical object part from a distance of seven centimeters. This distance was chosen because it allows young children to successfully observe the relationship between the pointing finger and an object and a paper plate upon which the object was placed. [If the distance was too small, young children might not easily distinguish between pointing with touching and non-pointing with touching. If the distance was too large, young children might not easily associate pointing with the appropriate object.] Finally, the experimenter used her dominant hand or non-dominant hand in pointing the object part. Whether using dominant hand or non-dominant hand in pointing may have any effect in interpreting referential intentions has never been investigated. Kobayashi and Yasuda (2008) showed that pointing with circular motion tended to specify the pointed part of object (such as a nut of a bolt) more distinctively than pointing without circular motion (simple pointing) for both young children (2- and 4-year-olds) and adults [9]. In this study, we investigated the effect of hand dominance in interpretation of pointing gestures. When we point at something with a circular motion by a dominant hand, we seem to do it easily and the movement tends to be smooth. However, if we do it by a non-dominant hand, we seem to do it a slight difficulty and the movement tends to be non-smooth.

The objects from all the sets used were designated as 'whole objects' based on Kobayashi's criteria (1998): [whole] objects are bodies that are cohesive, bounded, spatiotemporally continuous, and solid or substantial. They may be considered to move as connected entities, independently of one another, on connected paths through unoccupied space (Spelke, 1985) [10]. Their parts are portions of these objects (Tversky & Hemenway, 1984) [11] and move with the whole objects to which they are. A forced-choice test procedure used in Kobayashi's study (1998) was utilized to ensure that the designation of the 'whole' did not designate the

'part' at all; the selected 'whole' choice whose overall shape was similar to the standard did not actually contain the critical part.

2. METHOD

2.1. Participants

Participants were thirty-one Japanese 2-year-olds (mean age 29.5 months, range 24-38 months), thirty 4-year-olds (mean age 58.9 months, range 48-62 months), and thirty-one adults (undergraduate students). The children's data were taken at daycare centers in Saitama Prefecture, Japan. Adults' data were taken at a laboratory at a university.

2.2. Materials

The stimuli consisted of four sets of unfamiliar objects. The stimulus sets were exactly the same as the ones used in Kobayashi's (2007) study. In one set, a training object was a U-shaped bolt, and test choices were a nut (part choice) and a U-shaped bolt (whole choice).

Each set consisted of one standard and three test items. In one set, the standard object was a U-shaped bolt with a nut. The test items in the first test phase (an isolated part task) were a nut (part choice) and a U-shaped bolt without a nut (whole choice). The test items for the second test phase (a transfer task) were an I-shaped bolt with a nut (part choice) and a U-shaped bolt without a nut (whole choice). The parts in each set had distinctive shapes. The shapes of the whole choice items were similar to the standard objects except that they did not contain the critical parts.

2.3. Procedure

In the training phase, there were 3×2×2 different conditions of touching and circular motions. There were 3 age group conditions ("2-year-olds", "4-year-olds", "adults"), and 2 hand-dominance type conditions (dominant hand: the experimenter used her dominant right hand or non-dominant hand: the experimenter used her non-dominant left hand) and 2 touch type conditions (with touch: the experimenter touched the crucial part, without touch: the experimenter did not touch the crucial part keeping the finger with a distance of 7 cm above the part (Figure 1). In the test phase, the participant was asked to point to the item that could be called by the part name. For adults, part names were replaced by nonsense syllables and they were asked to think there were foreign words.

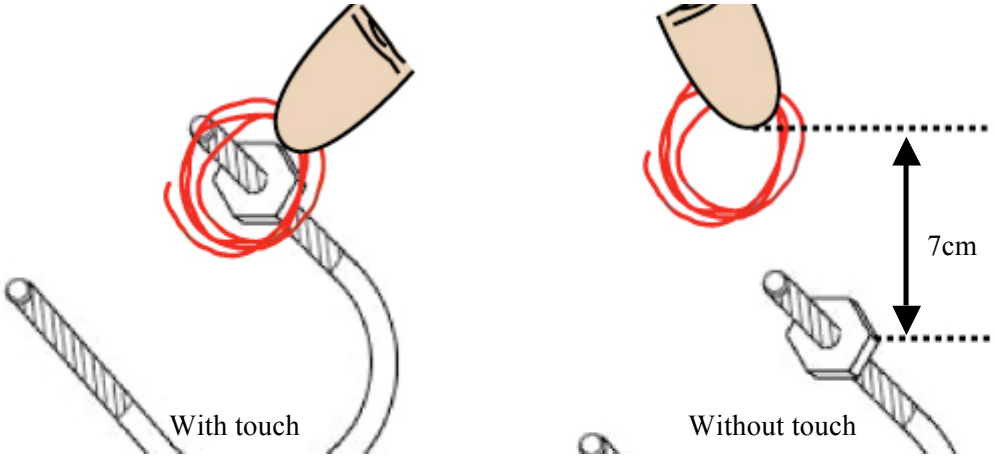

Figure 1: Touch type condition

In the pointing and action condition in the nut set, the experimenter first placed the standard object, a U-shaped bolt with a nut, on a white paper plate. She 'touch-pointed' the nut part and said in Japanese: "This is (a) natto." ("Kore wa natto desu.") Then she turned the nut around the bolt a few times (for 3 seconds) and touch-pointed the nut and said: "This is (a) natto." ("Kore wa natto desu.") Following the training phase, the isolated part test began. The experimenter presented two test items which were placed on a separate paper plates. She then asked the child, "On which plate do you find (a) natto?" ("Docchi no osara ni natto ga aru kana?") After the isolated part test, a transfer test began. The experimenter presented two transfer test items in the same manner and asked: "On which plate do you find (a) natto?" ("Docchi no osara ni natto ga aru kana? ") A similar procedure was used for other stimulus sets (Table 1).

Japanese is a classifier language which does not have count/mass syntax as in English. A novel part name 'natto' without any article can mean either an individual object or more than one object. Even though the number of parts of the standard objects and the test items were different in the nut set (There was only one part) and the spring set (There were two parts), the instructions were identical. Furthermore, the test question "On which plate do you find natto?" was chosen for both the isolated part test and the transfer test because this question does not imply any part/whole interpretation. ("Which is natto?" may exclude the possibility that natto is the part of an object.) The order of presentation of the two stimulus sets was counterbalanced across the children. The part items were presented on the left in one half of all test trials (2 trials) and on the right in the other half of all test trials (2 trials).

Table 1: Stimulus materials used in the isolated part task and the transfer task

Part	Training	Isolated	Transfer
Nut	U-shaped bolt[(a)]	nut U-shaped bolt[(b)]	I-shaped bolt[(a)] U-shaped bolt[(b)]
Springs	plate hanger[(a)]	springs plate hanger[(b)]	V-shaped wire[(a)] plate hanger[(b)]
Pump	spray bottle[(a)]	pump spray bottle[(b)]	round bottle[(a)] spray bottle[(b)]
Clip	letter scale[(a)]	clip letter scale[(b)]	L-shaped wire[(a)] letter scale[(b)]

Note. 'a' indicates that the object included the significant part.
'b' indicates that the object did not include the significant part.

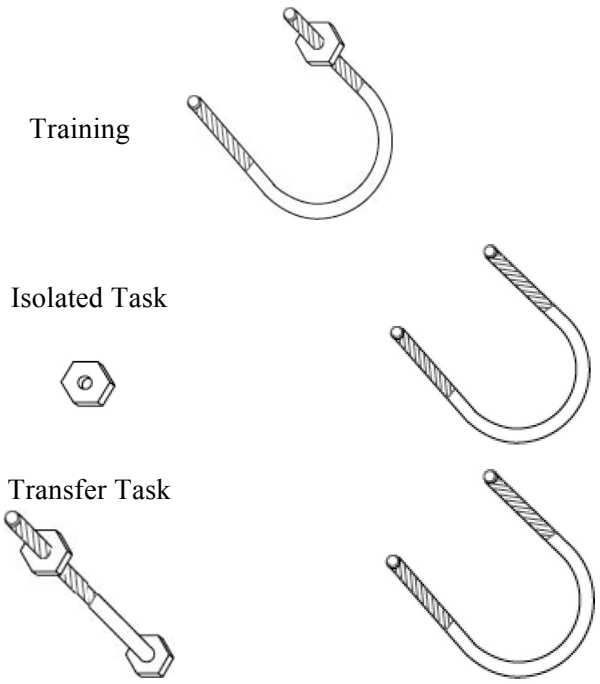

Figure 2: Experimental material of nut set

3. RESULTS AND DISCUSSION

The number of part choices by each participant in the part condition were taken and a 3 (age group) × 2 (hand-dominance type) × 2 (touch type) ANOVA was computed (Figure 3). In isolated task, there was a significant main effect of touch type, $F(1,94) = 99.173$, $p<.001$. It suggested that if the experimenter touched the object part in the training phase, the participants tended to take part choice. There was a significant age group and touch type interaction, $F(2,94) = 9.403$, $p<.001$. Simple main effect of age group within each touch type was tested. Only significant effects are reported. There were two significant effects, "without touch" effect within each age group ($F(2,94)=3.425$, $p<.05$), and "with touch" effect within

each age group (F(2,94)=6.358, p<.05). Ryan's method tests were performed to examine the simple main effect of "without touch" within each age group and "with touch" within each age group. In "without touch," condition, 2-year-olds (M=1.875) made more part responses than adult (M=1.042), t(1,44)=2.657, p<.05. In "with touch" condition, adults (M=4.000) made more part responses than 2-year-olds (M=2.944), t(1,44)=3.412, p<.05., and adults (M=4.000) made more part responses than 4-year-olds (M=3.083), t(1,44)=2.912, p<.05. Simple main effect of age group within each touch type was tested. The participants of all age groups performed better in "with touch" condition than in "without touch" condition. Thus, participants of all age groups made more part responses if the object was touched. 2-year-olds made more part responses than adults if the object part was not touched, whereas adults made more part responses than 2-year-olds and 4-year-olds if the object part was touched.

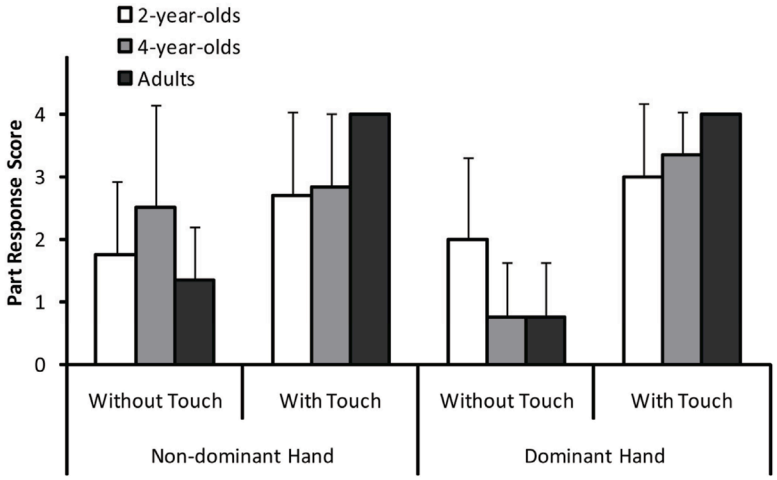

Figure 3: The number of part choices by each participant in the isolated task

There was a significant age group, hand-dominance type and touch interaction. Simple-simple main effect of hand-dominance type and touch type within each age group was tested. There were three significant effects, "non-dominant hand" and "without touch" within each age group (F(2,94)=3.378, p<.05), "non-dominant hand" and "with touch" within each age group (F(2,94)=4.186, p<.05), and "dominant hand" and "without touch" within each age group (F(2,94)=5.587, p<.05). Ryan's method tests were performed to examine the simple-simple main effect. In "non-dominant hand" and "without touch" condition, 4-year-olds (M=2.500) made more part responses than adult (M=1.333), t(1,44)=2.459, p<.05. In "non-dominant hand" and "with touch," condition, adults (M=4.000) made more part responses than 2-year-olds (M=2.889), t(1,44)=2.459, p<.05, and adults (M=4.000) made more part responses than 4-year-olds (M=2.833), t(1,44)=2.618, p<.05.

If the experimenter used non-dominant hand and if she did not touch the object part, the 4-year-olds tended to choose part choice. If the experimenter used non-dominant hand and if she touched the object part, adults chose more part responses than 2- and 4-year-olds.

A similar analysis was conducted in the transfer task. There was a significant main effect of touching, F(1,94) = 69.274, p<.0001. It suggested that if the experimenter touched the object part in the training phase, the participants tended to take part choice. There was a significant age group and touch type interaction, F(2,94) = 5.666, p<.001. Simple main effect of age

group within each touch type was tested. There were two significant "with touch" effects within each age group ($F(2,94)=4.113$, $p<.05$). Ryan's method tests were performed to examine the simple main effect of "with touch" within each age group. Adults ($M=3.833$) made more part responses than 2-year-olds ($M=2.944$), $t(1,44)=2.805$, and adults ($M=3.833$) made more part responses than 4-year-olds ($M=3.111$), $t(1,44)=2.240$, $p<.05$. Other effects were not significant. A similar results with the isolated part task was obtained. The result of transfer task indicates that adults chose more part choices than 2- and 4-year-olds if it was touched.

4. CONCLUSION

This study examined whether participants would interpret the word is the name of the object part when an experimenter pointed an object part with a circular motion and uttered a word (name of the object part). The experimenter used her dominant hand or non-dominant hand in pointing gesture. The results were that participants of all age groups made more part responses if the object part was touched than if the object part was not touched keeping the pointing finger above the object part with 7 cm distance. This effect of touching the object part increased with age. In addition, if the experimenter used non-dominant hand and if she did not touch the object part, 4-year-olds tended to think that object part was named. If the experimenter used non-dominant hand and if she touched the object part, adults chose more part responses than 2- and 4-year-olds. These results may be interpreted that 4-year-olds and adults are sensitive to subtle non-smooth movement of non-dominant hand and felt that such movement might mean specific referential intentions. Thus, humans seem to use KANSEI to subtle finger movements to interpret referential intentions of other people. Further research is needed how subtle non-smooth finger movements would promote humans' focusing on object parts and relating those parts to part names.

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