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Cultural differences in the development of cognitive shifting: East–West comparison

Yusuke Moriguchi [a,*], Angela D. Evans [b], Kazuo Hiraki [c], Shoji Itakura [d], Kang Lee [b,e,*]

[a] Department of School Education, Joetsu University of Education, Joetsu 943-8512, Japan
[b] Department of Human Development and Applied Psychology, Ontario Institute for Studies in Education (OISE), University of Toronto, Toronto, Ontario, Canada M5S 1V6
[c] Department of General Systems Studies, University of Tokyo, Meguro-ku, Tokyo 153-8902, Japan
[d] Department of Psychology, Graduate School of Letters, Kyoto University, Sakyo-ku, Kyoto 606-8501, Japan
[e] Department of Psychology, University of California, San Diego, La Jolla, CA 92093, USA

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ABSTRACT

Prior research has documented that Japanese children's performance on the Dimensional Change Card Sorting (DCCS) task can be influenced by their observation of another person completing the task, which is referred to as social transmission of disinhibition. The current study explored whether Canadian children would also show a social transmission of disinhibition and whether their performance would be comparable to that of Japanese children. In this study, 3- and 4-year-olds in Canada and Japan were given both the standard version and social version of the DCCS. Results indicated that Canadian children displayed the social transmission of disinhibition, but their effects were significantly weaker than those with Japanese children. On the other hand, performance on the standard DCCS was comparable between children in the two countries. We discuss the results in terms of cultural differences in the relationship between self and other.

Introduction

Executive function is an important cognitive skill for us to make adaptive changes in our complex physical and social environment. It enables us to plan, execute, and monitor appropriate and relevant

* Corresponding authors. Addressess: Department of School Education, Joetsu University of Education, 1 Yamayashiki-machi, Joetsu 943-8512, Japan (Y. Moriguchi), Institute of Child Study, University of Toronto, 45 Walmer Road, Toronto, Canada ON M5R 2X2 (K. Lee).

E-mail addresses: moriguchi@juen.ac.jp (Y. Moriguchi), kang.lee@utoronto.ca (K. Lee).

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actions, and to inhibit irrelevant and inappropriate actions, for the attainment of a specific goal (Dempster, 1992; Welsh, Pennington, & Groisser, 1991). Extensive evidence suggests that this ability develops rapidly during the preschool years, which may be subserved by the maturation of the prefrontal cortex (Diamond, 2002; Moriguchi & Hiraki, 2009; Zelazo & Müller, 2002). Recent studies suggest that executive function is not unitary; instead, it consists of several components such as inhibitory control, cognitive shifting, and working memory (Garon, Bryson, & Smith, 2008; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000).

One of the major research foci of executive function has been on the Dimensional Change Card Sort (DCCS) task, which is widely used to assess the development of cognitive shifting (Zelazo, Frye, & Rapus, 1996). In the standard version of the DCCS, children are asked to sort cards that have two dimensions such as color and shape (e.g., red boats, blue rabbits). There are two phases in the task. During the first phase, children are asked to sort the cards according to one dimension (e.g., color) for several trials. During the second phase, children are asked to sort the cards according to the other dimension (e.g., shape) for several trials. Although 3-year-olds are typically able to sort the cards according to the first dimension, they fail to switch the rules during the second phase and perseverate to the first dimension. With increased age, 4- and 5-year-olds do not perseverate and are able to successfully sort the cards according to the second dimension. This developmental pattern has been replicated in several nations, including Austria, Canada, Korea, and Japan (Kirkham, Cruess, & Diamond, 2003; Kloo & Perner, 2005; Moriguchi & Itakura, 2008; Oh & Lewis, 2008; Zelazo et al., 1996).

Although the existing research has focused exclusively on various aspects of executive functioning and how they develop within a child, recent studies have begun to address an intriguing question: whether and how a child's executive functioning can be influenced by another individual's executive actions. It has been proposed that executive functions are not solitary cognitive skills that one possesses independent of others in our social environment; rather, they can be socially transmitted (Lewis & Carpendale, 2009; Moriguchi, Lee, & Itakura, 2007).

Indeed, Moriguchi, Lee, and Itakura (2007) reported such social transmission with the use of a modified DCCS task. In their task (henceforth referred to as the social DCCS), instead of sorting cards themselves during the first phase, preschoolers watched an adult model sorting cards according to one dimension (e.g., shape). After that, during the second phase, preschoolers themselves were asked to sort according to a different dimension (e.g., color). It was found that Japanese 3-year-olds perseverated to the rule the model had used, whereas most 4- and 5-year-olds were able to successfully shift to the new rule. From these results, Moriguchi and colleagues suggested that social observation can lead to perseverative errors in a manner similar to the typical perseverative errors in the standard DCCS task, which was referred to as *social transmission of disinhibition*. This finding has been consistently replicated with Japanese children (Moriguchi, Kanda, Ishiguro, & Itakura, 2010; Moriguchi, Sanefuji, & Itakura, 2007).

However, it is still unclear whether the similar social transmission of disinhibition occurs in other cultures. There is a reason to suspect that children in another culture might not show similar patterns of behavior. According to current cultural psychology theories, in Western cultures such as those in North America people are likely to have a more "independent" view of the self, whereas in Asian cultures such as Japan people tend to have a more "interdependent" view (Markus & Kitayama, 1991). People in the interdependent cultures are expected to see themselves as part of a social relationship and recognize that one's behavior is strongly affected by others' behaviors. Thus, the relationship between self and other is assumed to be closer in the interdependent culture than in the independent culture. On the other hand, people in the independent cultures are expected to be independent from others where each individual expresses one's own unique attributes.

Rothbaum, Pott, Azuma, Miyake, and Weisz (2000) also argued that Japanese people emphasize the symbiotic harmony in relationships between self and other, whereas generative tension plays an important role in the relatedness in North America. This review suggests that these cultural differences may already exist during infancy and early childhood. For example, Japanese mothers show prolonged proximity and contact with their infants and meet their needs before they are expressed, and this may blur the self-other distinction. In contrast, in North America, infants are seen as separate individuals, and the close relationship between mother and child in Japan is often regarded as unhealthy by North Americans (Chen & Miyake, 1986). During early childhood, both Japanese parents and

nursery school teachers emphasize the importance of empathy and meeting others' expectations, and children are not expected to express their individual wishes and desires (Roland, 1988; Tobin, Wu, & Davidson, 1989). On the contrary, American parents emphasize the expression of the self's will, and children are supposed to assert their desires and hopes. Taken together, Japanese children are socialized to be dependent and to be part of a social community, and as a result the distinction between self and other may be relatively blurred, whereas American children are socialized to be independent and to assert their personal wills and wishes, and this may lead to the clear distinction between self and others.

Given these cross-cultural differences, it is possible that children socialized in the independent cultures may be more likely to separate themselves from another person than those in the interdependent cultures. Consequently, children in the independent cultures might not show the social transmission of disinhibition observed with Japanese children. This possibility was tested in the current study. We compared Japanese and Canadian children's performance on both the standard and social DCCS tasks. Canadian children were chosen because existing cross-cultural studies have consistently shown that Canadians, like Americans, show strong independent self-construal (for a meta-analysis, see Oyserman, Coon, & Kemmelmeier, 2002).

In the social DCCS task, children were asked to watch another person's sorting of cards according to one rule and then were asked to sort the cards according to another rule. Thus, children needed to separate the rule they were given from the rule that another person used to sort the cards. We predicted that Canadian children would outperform Japanese children on the social DCCS. To ensure that Canadian and Japanese children were comparable in their ability at cognitive shifting, the same children were also tested on the standard DCCS task. This comparison is particularly important given the existing findings showing that Chinese and Korean children were more advanced in their executive function than North American children (Oh & Lewis, 2008; Sabbagh, Xu, Carlson, Moses, & Lee, 2006).

Method

Participants

Canadian participants were drawn from a predominantly White, middle-class community in the greater Toronto area and consisted of 38 3-year-olds (M = 40.1 months, SD = 2.8, range = 36–47, 25 boys and 13 girls) and 32 4-year-olds (M = 53.5 months, SD = 3.6, range = 49–59, 12 boys and 20 girls). Informed consent was obtained from all parents of children prior to their involvement in the investigation.

The Japanese comparison group consisted of 34 3-year-olds (M = 42.0 months, SD = 4.3, range = 38–48, 12 boys and 22 girls) and 27 4-year-olds (M = 52.8 months, SD = 3.8, range = 49–60, 13 boys and 14 girls). They were drawn from a predominantly middle-class community in the Fukuoka and Joetsu areas. There were no significant differences in age between the Canadian and Japanese samples overall.

Materials

The same laminated cards (3.5 × 7.0 cm) were used as stimuli in both cultures. In the social DCCS task, there were two trays (4.5 × 10.5 × 15.0 cm), one with a red star on the front and the other with a blue cup on the front. There were 10 sorting cards depicting either a blue star or a red cup. In the standard DCCS task, there were two trays (10.0 × 12.0 × 8.0 cm), one with a green car on the front and the other with a yellow house on the front. There were 12 sorting cards depicting either a yellow car or a green house.

Procedure

Children were given both the social and standard DCCS tasks. The dimension order was counterbalanced between children for each task (either color or shape first). The task order was also counterbal-

anced between participants. Approximately half of the children (n = 35 for Canada and n = 31 for Japan) were given the social DCCS first, and the other half (n = 35 for Canada and n = 30 for Japan) were given the standard DCCS first.

Social DCCS

The child was introduced to a model and told that the model would sort the cards first (''Now she [the model] is going to sort the cards first. Please watch carefully.''). The model was instructed to sort the cards according to one dimension (e.g., shape). The model performed four trials. At the beginning of each trial, the experimenter told the model the rule of the game, randomly selected a sorting card, and asked her to sort the card. The model sorted it correctly according to the prescribed rule and was given feedback on every trial (''yes''). The experimenter withdrew the sorting card from the tray after each trial.

After the demonstration, the model made an excuse and left the room. The child was instructed to begin a new game (''Now it is your turn. We are going to play a new game. This game is different from the game she [the model] played.''). If the model sorted the cards according to the shape dimension, the child was asked to sort the cards according to the color dimension. The child was given six sorting trials. On each trial, the experimenter told the child the rule of the game and randomly selected a sorting card for him or her to sort. The child was required to place the card in one of the two trays. The child was not given any feedback about whether he or she sorted the cards correctly.

Standard DCCS

Next, a new set of trays was brought out and the child was instructed to sort the cards according to one dimension (e.g., in the shape game, ''This is a shape game. All the cars go here and all the houses go there.''). During this first phase of the standard DCCS task, the child was given four trials, and at the beginning of each trial the experimenter told the child the rule of the game, randomly selected a sorting card, and asked him or her to sort the card. The child was required to place the card on one of two trays. The child was given feedback on every trial (''yes''/''no''). The experimenter withdrew the sorting card from the tray at the end of each trial. When the first phase of the task was completed, the child was asked to stop playing the game and told to switch to a new game. If the child sorted the cards according to the shape dimension during the first phase, he or she was asked to sort the cards according to the color dimension (e.g., ''The new game is a color game. The color game is different from the shape game. In the color game, all the yellow ones go here and all the green ones there''). The child was then given six trials that were identical to those during the first phase except for the dimension (e.g., color). During the second phase, the child was not given feedback as to whether he or she sorted the cards correctly.

Results

Preliminary analyses showed no significant effect of sex in the social and standard DCCS tasks. Therefore, all data were collapsed across gender.

Social DCCS

Data of five Japanese 3-year-olds and 1 Canadian child were excluded from the analysis because these children did not observe the model's actions, whereas all other children closely observed the actions of the model. Children were scored as correctly completing a trial if they sorted a card according to the dimension instructed by the experimenter. As in previous studies, children were regarded as passing the task when they correctly completed five of six trials. The reason for doing so was that, like most of the existing studies using the DCCS task, the distribution of the number of correct and incorrect trials was bimodal, with children making either five of six correct responses or five of six incorrect responses (Kirkham et al., 2003).

In the social DCCS task, 72% of the Canadian children were classified as having passed the task, indicating that after observing another person's sorting, most Canadian children were able to correctly

sort the cards according to the second instructed rules. In contrast, Japanese children had difficulty with the social DCCS, with only 57% of the children passing the task (Fig. 1).

Next, we examined whether children's performance on the social DCCS task was affected by age, country, and task order. Following Oh and Lewis (2008), a binary logistic regression analysis was conducted on children's performance (pass vs. fail). Because they were chosen for theoretical reasons (see Menard, 2002), age, country, and task order were first entered as predictors. The interaction between the predictors was added to determine whether it contributed significantly to the model. Significance was assessed by a block chi-square test (also known as the chi-square difference test). In this test, the retention of each predictor in a model must lower the variability significantly to justify using a more complex model. The final model that resulted from this procedure was compared with the full model (i.e., all predictors and the interaction) to confirm that it was the best-fitting model.

As a result, the final model included the main effects of age (3 years vs. 4 years), country (Canada vs. Japan), and task order (social first vs. standard first). The overall regression model was significant, $\chi^2(2, N = 125) = 19.37$, $p < .001$, Nagelkerke $R^2 = .20$. Age was found to significantly contribute to the model ($B = 1.38$, Wald = 10.34, $p < .001$, odds ratio = 3.97). The odds ratio indicated that 4-year-olds were approximately four times more likely to pass the social DCCS task than 3-year-olds above and beyond the common contributions of age and country. In addition, country was found to significantly contribute to the model ($B = -0.85$, Wald = 4.15, $p < .05$, odds ratio = 2.29). For the country factor, the odds ratio indicated that Canadian children were more than two times more likely to pass the social DCCS than the Japanese children above and beyond the common contributions of all other variables in the model. In addition, the task order was a significant factor ($B = -0.82$, Wald = 3.87, $p < .05$. odds ratio = 2.39). Children who were given the social DCCS second were two time more likely to perform the task correctly than those who were given this task first.

Standard DCCS

Data of six Canadian children and two Japanese 3-year-olds were excluded from the analysis because these children made errors in the sorting of the first dimension during the first phase of the task. The rest of the children performed perfectly on the first sorting dimension. Children were scored as correct if they sorted a card according to the dimension instructed by the experimenter. As in the social DCCS task, children were regarded as passing the standard DCCS task when they correctly completed five of six trials.

Canadian children's performance on the standard DCCS was comparable to that of Japanese children on the same task (Fig. 1), with 70% of the Canadian children and 71% of the Japanese children passing this task. We examined whether children's performance on the standard DCCS was affected by age, culture, and task order. A logistic regression analysis was conducted with children's

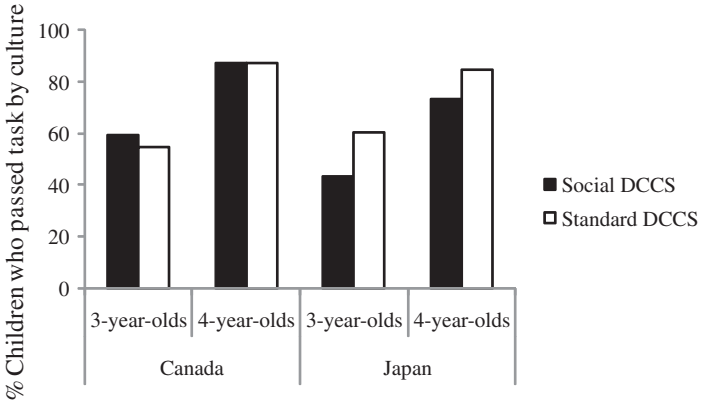

Fig. 1. Percentages of children who passed the tasks by culture and age.

performance as the predicted variable (pass vs. fail) and age (3 years vs. 4 years), country, and task order as the predictors. As with the social DCCS task, the regression model was significant, $\chi^2(2, N = 123) = 14.29$, $p < .01$, Nagelkerke $R^2 = .16$. Age was found to significantly contribute to the model ($B = 1.48$, Wald = 10.37, $p < .01$, odds ratio = 4.53). The odds ratio for age indicated that 4-year-olds were approximately four times more likely to pass the standard DCCS than 3-year-olds above and beyond the common contributions of age and country. However, country and task order did not significantly contribute to the model ($B = 0.12$, Wald = 0.09, $p = .77$, and $B = 0.55$, Wald = 1.68, $p = .20$, respectively), indicating that culture and task order did not affect children's performance on the standard DCCS above and beyond the common contributions of all other variables in the model. The results indicated that Canadian children's performance was comparable to that of Japanese children on the standard DCCS.

Relation between the social DCCS and standard DCCS

Finally, we examined the relationship between performances on the two tasks in each culture. We conducted McNemar tests to examine which tasks were more difficult for children in each culture. We found no significant differences between the tasks in Canada ($p > .78$); however, a significant difference was found between the social and standard DCCS tasks in Japan ($p < .03$), with the social DCCS being more difficult than the standard one.

Discussion

The current investigation examined whether children's executive functioning can be influenced by another individual's executive actions. Specifically, we assessed whether children who were raised in either a culture that emphasizes independence or one that emphasizes interdependence would exhibit a social transmission of disinhibition when completing the DCCS task.

Consistent with previous findings (Moriguchi, Lee et al., 2007), approximately half of Japanese children failed the social DCCS task. In contrast, the majority of Canadian children passed the social DCCS by successfully sorting the cards according to the rule they were given, not the rule by which the model sorted the cards. When examining children's performance on the standard DCCS task, no significant differences were found based on country. Scores on the standard DCCS demonstrate that without the social influence of the model, children in both countries performed similarly on the executive functioning task. However, in comparing children's performance on the social DCCS with that on the standard DCCS, we found that Japanese children had more difficulty with the social DCCS than with the standard DCCS, whereas Canadian children basically showed similar performances on both tasks. These results suggest that Japanese children are more strongly influenced by the model's behavior on the social DCCS, whereas Canadian children are equally influenced by the model's sorting behavior on the social DCCS as they are by their own initial sorting behavior on the standard DCCS.

We had originally expected that children in the more independent culture of Canada would perform much better on the social DCCS than on the standard DCCS because they would be able to more easily disregard the model's sorting behavior and focus solely on the rule they were given. If the model's sorting behavior had no impact on Canadian children's performance on the social DCCS task, they should have reached ceiling in their sorting according to the rule that was given to them. This is because they would have treated the rule as if it was the first rule of the game. This situation would have been similar to the initial phase of the standard DCCS task in which they were given the first rule to sort. During this initial phase, nearly all of the children in both age groups sorted successfully (note that the few who failed to do so were excluded from further data analyses). However, contrary to our initial predictions, Canadian children performed similarly on the social and standard DCCS tasks. In other words, after observing another model sorting according to one rule, some Canadian children were also influenced by the model's executive action and displayed social transmission of disinhibition. More generally speaking, although Canadian children's performance on the social DCCS was not as strongly influenced by observing the model as that of the Japanese children, their performance was still influenced.

Given that both Japanese and Canadian children did not significantly differ in their performance on the standard DCCS task, the cross-cultural differences found on the social DCCS task cannot be attributed to potential differences in Japanese and Canadian children's executive functioning per se. This lack of cross-cultural difference on the standard DCCS appears to be inconsistent with previous studies finding that children in Asian cultures performed better on executive function tasks than those in Western cultures (Oh & Lewis, 2008; Sabbagh et al., 2006). However, when specifically examining cross-cultural differences with the DCCS, results have been mixed, with one study demonstrating the advantage in Asian children (China) over Western children (United States: Sabbagh et al., 2006) and another study failing to find this advantage (Korea vs. United Kingdom: Oh & Lewis, 2008).

In addition to cross-cultural differences on the social DCCS, the current investigation found age differences on both the social and standard DCCS tasks. Consistent with previous findings (e.g., Moriguchi, Lee et al., 2007; Zelazo et al., 1996), 4-year-olds were significantly more likely to pass both the social and standard DCCS tasks than 3-year-olds, demonstrating a developmental increase in children's cognitive shifting abilities. Furthermore, children in both countries developed cognitive shifting skills in the social and standard DCCS tasks between 3 and 4 years of age. Indeed, we found no significant interactions between age and country in both the social and standard DCCS tasks. The differences of performance between cultures may originate from infancy, consistent with the proposal that cultural differences in relationship between self and other may already exist during early childhood (Rothbaum et al., 2000).

In general, our findings with Japanese and Canadian children support the proposal that executive functions are not cognitive skills residing in one individual and isolated from another; rather, they can be socially situated and can be influenced by another individual's executive actions (Lewis & Carpendale, 2009; Moriguchi, Lee et al., 2007). This social transmission of disinhibition may be a universal phenomenon. However, our findings regarding the cross-cultural differences suggest that the extent of this social transmission of disinhibition may depend on the culture in which children are socialized. When a culture socializes children to become interdependent members of their society, their executive actions may become more attuned to similar actions of others in their social environment. In contrast, when children are socialized to be independent from one another, their executive actions may be less dependent on those of other persons.

Furthermore, there may be specific factors that explain the Japanese children's performance. One possible factor is *amae*, which refers to complete dependence on parents (mostly mothers) and characterizes the intense interdependent nature of the mother–child relationship that is unique to Japan (Doi, 1973). Amae is an indigenous Japanese concept of relatedness that might be similar to attachment (Behrens, 2004). On the one hand, as described in the Introduction, Japanese mothers show prolonged proximity with their children and meet children's needs before they are even expressed. On the other hand, Japanese children usually show amae-based behaviors toward their mothers such as snuggling. It has been shown that Japanese mothers are more likely to accept preschoolers' dependent behaviors (amae) than American mothers (Johnson, 1993; White & LeVine, 1986). The bidirectional relationship between Japanese mothers and children from infancy may contribute to the higher likelihood of social transmission of disinhibition in the Japanese children.

In summary, the current study revealed social transmission of disinhibition in both Japanese and Canadian children. More important, we found social transmission of disinhibition to be significantly stronger among Japanese children than among Canadian children, and we attributed this to the fact that, compared with Canadian children, Japanese children are more tolerated for their strong dependency on their caregivers and are socialized from early infancy to be interdependent with other members of their social environment. Because different cultures in the world socialize their children differently in terms of independence and interdependence, one should expect children in various cultures (e.g., the United States and the United Kingdom in the West, China and Korea in East Asia) would show different levels of social transmission of disinhibition, an intriguing hypothesis to be tested in future studies. Future studies also need to be expanded to include older children with perhaps latency measures rather than accuracy measures to examine whether such social transmission of disinhibition continues to exist among older children and whether there are age-related changes associated with this phenomenon. Furthermore, we need to develop additional tasks to evaluate the "social" aspects of executive function to assess whether these findings go beyond the DCCS task. We hope that the cur-

rent work and works in the near future, taken together, will help to elucidate the social dimension of executive functioning, which has long been neglected despite the explosive increase in research on executive functioning during the past several decades.

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