Research article

The Dynamics of Social Interactions of Children Playing around Rural Rivers in Japan

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Received 19 February 2022 Accepted 22 April 2022 (*Corresponding Author)

Abstract In Monsoon Asia countries, rivers have intimate bonds with rural communities, which create diverse social interactions regarding community building such as recreation, education, and tourism. Especially, children tend to play around rivers, which is considered as one of the foundations of community building since playing fosters children's place-attachment to the local rivers. However, the number of children playing around rivers has been decreasing owing to expanding urbanization. This study aims to reveal 1) the influences of river use by family members and neighborhoods on children's river play, 2) the dynamics of children's social interactions in playing around rivers, and 3) the emergence mechanisms of children's social interactions in the play places. Questionnaire survey (127 local children from 9 to 11 years old), participatory observation, and hiring survey (49 local children from 9 to 11 years old) were conducted in the town of Gujohachiman, the Gifu Prefecture, Japan. Social network analysis (SNA) was applied to the observation data to examine the dynamics of social interactions in playing. As a result, river play frequency and preference of children were positively related to the frequency of daily use of rivers by their family members and neighborhoods. SNA showed that the interaction density of children playing around the river gradually increased while repeatedly fluctuating up and down. This dynamical change of interactions was caused by several leaders. The two factors for the emergence of children's social interactions were identified: introducing by the playgroup members and playing with caregivers. These results imply that rural rivers have the function for children to expand their local interpersonal relationships through playing, which are supported by local communities. Furthermore, children's play places around rivers have the potential to become the social interface for rural and urban communities.

Keywords rural rivers, children, play places, social interactions, social network analysis, environmental education

INTRODUCTION

In Monsoon Asia countries, rivers have intimate bonds with rural communities, which create diverse social interactions regarding community building such as recreation, education, and tourism. Especially, children tend to play around rivers (Senda, 1982; Kinoshita, 1992). However, children's water play around rivers has been decreasing owing to expanding urbanization.

As described in the Convention on the Rights of the Child, an outdoor play of children is essential for their sound development and it is required that the local communities support children's outdoor play towards sustainable community building in terms of their well-being. Various effects have been pointed out for nature play, including river play, such as emotional stability of children (Yoshinaga et al., 2006), improvement of athletic ability and intellectual ability

(Nakamura, 1999), an increase of independence (Kako, 2009), etc. Also, it is reported that playing around rivers is effective in improving children's spatial cognitive ability (Onishi, 2000), deepening their cognitive ability to living organisms (Ohgoshi et al., 2002; Ohgoshi et al., 2003), and improving children's social ability through interpersonal interactions (Sato and Takahashi, 2002; Sato et al., 2004; Enomoto and Nakamichi, 2021). In addition, river play fosters children's place-attachment to the local rivers, which leads them to nature conservation in the future (Satake and Kamihogi, 2006). Therefore, river play is important not only for community development but also for the conservation of river environments. So far, various studies have been conducted on the physical structure and biological environments that support children's river play (Fujiwara and Maekawa, 2003; Osawa, 2005; Terauchi et al., 2006; Horiuchi et al., 2009; Kakudo and Nishiyama, 2009; Imanishi and Matsumoto, 2016; Hasegawa et al., 2017).

However, there is no study that examines children's playing in the river from a social aspect and clarifies the dynamics of human interaction. It is important to quantitatively grasp the social interactions of children and to examine the relationships between children's river play and the local community, in order to conserve the children's river play in the future.

OBJECTIVE

The objectives of this study are to reveal 1) the influences of river use by family members and neighborhoods on children's river play, 2) the dynamics of children's social interactions in playing around rivers, and 3) the emergence mechanisms of children's social interactions in the play places.

METHODOLOGY

Study Area

The study was conducted in the Hachiman district of Gujo city (hereinafter called "Gujohachiman"), which is a rural area located in the middle of the Gifu prefecture, Japan (Fig. 1). The east, west, and north side of Gujohachiman are adjacent to the mountainous area, and the residential area is formed along the Yoshida River, which is an upper branch of the Nagara River. The area is also well known as "Water Town" since the water sources such as springs and wells have been maintained collectively by local communities in history.

Fig. 1 Location of study area

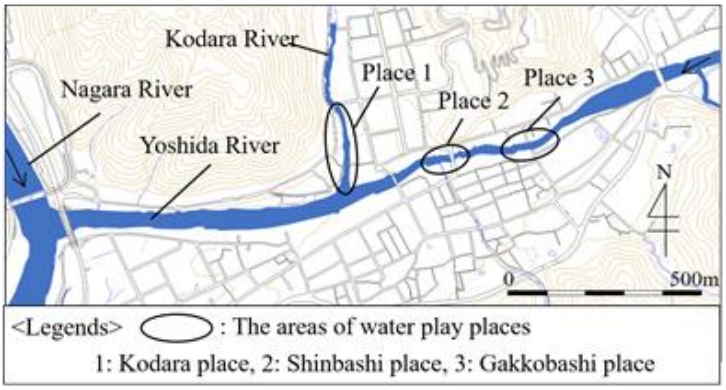


Fig. 2 The play places in the rivers in Gujohachiman

In the area, the river play of children was conserved as local culture. The local children play with water mainly in three places around rivers: Kodara place, Shinbashi place, and Gakkobashi place (Fig. 2). The three places are recognized as "play places" by the residents. Especially Shinbashi place is a popular sightseeing spot of Gujohachiman for urban tourists, because the place is known as "jumping spot," where children jump by the top of the Shinbashi bridge (12m above

water surface) into the Yoshida River. This place has been designated as one of the 100 Soundscapes of Japan by the Ministry of the Environment since 1996.

Data Collection

In order to collect the data for objective 1, Questionnaire survey was conducted to 127 students, who are in 4th to 6th grade (aged 9 to 11 years old) at the local primary school, on 15 September, 2010 (Table 1). The questionnaire survey was conducted at the integrated study classes. During children answered the questions, the teachers supervised them to secure the reliability of the answers. The response rate was 100%. The respondents answered the 18 questions regarding daily river play around rivers. In this paper, the results of 7 questions out of 18 questions were used: the preference and frequency of river play (2 items), the living environments (3 items), social interactions at playing with water (4 items). After the questionnaire, we conducted supplementary hiring to twelve children regarding to their river play.

Table 1 Respondents of questionnaire survey (n=127)

Sex	Grade		
	4th	5th	6th
Boys	22	16	27
Girls	20	16	26
Subtotal	42	32	53

In order to collect the data for objectives 2 and 3, observation and hiring survey were conducted on 29 local children from 9 to 11 years old from the 3rd to 5th September. The subjects of the survey were selected by those who answered the questionnaire. During the children playing around the three water play places, investigators recorded the number of children, the playing behavior of each child, and the playing location with one-minute intervals until all children left the play places. After the all children left the play places, the investigators conducted open-ended group interviews to them. The interview consists of the following questions:

- Where do you play with water around rivers usually?
- Why do you play there?
- Have you ever played with an infant or adult, who you did not know before?

Analysis

In order to analyze the relationships between the preference and the frequency of children's river play and their living environments (objective 1), simple tabulation and cross-tabulation were conducted on the data obtained by questionnaire survey. Secondly, the p-value was calculated using the results of cross-tabulation. These computations were done using the SPSS program, version 10.0.

As for objective 2, Social Network Analysis (hereinafter called "SNA") was applied to the observation data (Freeman, 2004; Nooy et al., 2012). The dynamics of children's social networks were analyzed by using density, which is an index of SNA. The density is calculated by using Eq. (1) as follows:

$$D_i = \frac{2m_i}{n_i \times (n_i - 1)} \quad (1)$$

Where

D_i: Density of children's social networks at the time i

n_i: The number of children existing in the play places at the time i

m_i: The number of children's ties at the time i

Density (Di) is an index of how close the social interchange between children playing in the play places at the time i is. If the density is high, the children make relatively large groups to play together. If the density is low, children play individually or in small groups.

As for objective 3, how children become acquainted with another child, infant or adult was analyzed based on the observation data. Focusing on the matter of how the children's communication started, the emergence mechanisms of children's social relationships in the play places were classified by the acquaintances' attributes: child, infant, and adult.

RESULTS AND DISCUSSION

Status of River Use of Children

Table 2 shows the preference and the frequency of river play of the subjects by sex. The ratio of those who prefer river play was 91.3% in total. As a result of chi-square analysis, the ratio of boys, who prefer river play (96.9%) was significantly higher than the ratio of girls (85.5%, $p < 0.05$). As for the frequency of river play, the ratio of those who play with water more than once a week was 50.4% in total. As a result of chi-square analysis, the ratio of boys, who play with water more than once a week (67.7%), was significantly higher than the ratio of girls (32.3%, $p < 0.001$). Water play around rivers was generally preferred by many children. In particular, it was found that boys tended to prefer playing around rivers.

Table 2 Children's preference and frequency of water play around rivers by sex

	The number of children by their preference of river play ("prefer" vs "not prefer") and its ratio*		The number of children by their frequency of river play ("once a weelk or more" vs "less than once a week") and its ratio***	
	Prefer	Not prefer	Once a week or more	Less than once a week
Boys (n=65)	63 (96.9%)	2 (3.1%)	44 (67.7%)	21 (32.3%)
Girls (n=62)	53 (85.5%)	8 (14.5%)	22 (36.1%)	42 (67.7%)
Subtotal (n=127)	116 (91.3%)	11 (8.7%)	64 (50.4%)	63 (49.6%)

*Significant difference is indicated by *p < 0.05, **p < 0.01, and ***p < 0.001, determined by chi-square test.*

Table 3 Relationship between the experiences to get to know new persons during river play and the number of members of river play

The experience of children to getting to know new persons during river play	The number of children by the number of members to play with around the river*	
	With 1 or 2 members	With more than 3 members
Yes, I had experiences to getting to know new persons during river play	31	36
No, I had no experience getting to know new persons during river play	39	19

*Significant difference is indicated by *p < 0.05, **p < 0.01, and ***p < 0.001, determined by chi-square test.*

As for the number of members to play with around rivers, all children answered "*playing with someone (friends or caregivers)*", which means no one played alone around rivers. As for the experiences of children to getting to know new person during river play, 53.6% of the children (n=127) had experiences to getting to know new person during river play. Table 3 shows the relationship between the experiences to get to know new persons during river play and the number of members of river play. As a result of chi-square analysis, the children, who play with more than three members, tended to have the experiences to get to know new persons during river play, compared to the children, who play with two or three members ($p < 0.05$).

Table 4 shows the relationships between the daily river use of family members and neighbors and children's preference and frequency of river play. The children, whose family members and neighbors used the river in daily life, tended to prefer river play (95.5%), compared to those whose family members and neighbors did not use the river in daily life (86.9%, $p < 0.05$). Further, looking

at the frequency of playing in the river, 63.6% of children, whose family members and neighbors used the river in daily life, answered that they played around the river for a week or more. On the other hand, the ratio of children, whose family members and neighbors did not use the river in daily life, was 36.9%, significantly lower than that of children whose family members and neighbors used the river in daily life ($p < 0.001$). Regarding this result, there were several opinions from eleven children such as:

"*Since I was baby, my grandfather (or grandmother, uncle, aunt) went to rivers and played together with me and he (or she) told me how to play around rivers*".

In addition, there were opinions from eight caregivers such as:

"*Because we all local residents played around rivers during childhood, so we know that playing with water is very fun and it is very important for child development*".

Thus, it is concluded that the daily use of rivers by family members and neighbors had a positive effect on children's preference and frequency of river play, and the children's river play was supported by the adults at home and in the neighborhoods.

Table 4 Relationships between daily river use of the family members and the neighbors and the children's preference and frequency of river play

	The number of children by their preference of river play ("prefer" vs "not prefer") and its ratio*		The number of children by their frequency of river play ("once a weelk or more" vs "less than once a week") and its ratio***	
	Prefer	Not prefer	Once a week or more	Less than once a week
Someone of the family members and neighbors uses the rivers in daily life (n=66)	63 (95.5%)	3 (4.5%)	42 (63.6%)	24 (36.4%)
None of the family members and neighbors use the rivers in daily life (n=61)	53 (86.9%)	8 (13.1%)	22 (36.1%)	39 (63.9%)

*Significant difference is indicated by *p < 0.05, **p < 0.01, and ***p < 0.001, determined by chi-square test.*

Dynamics of Children's Social Interactions in Playing Around Rivers

Fig. 3 shows the dynamics of the social interactions of 21 children played at the Gakkobashi place from 16:25 to 17:34. The density of the social interactions went up and down over time, which means that children were playing while repeating gathering and dispersion. The interaction networks of the children at each time from 16:40 to 17:10 are illustrated in Fig. 4. The black circle with the alphabet indicates the individuals of the children (ID: from "a" to "u") and the lines show that they had interactions, which means playing together.

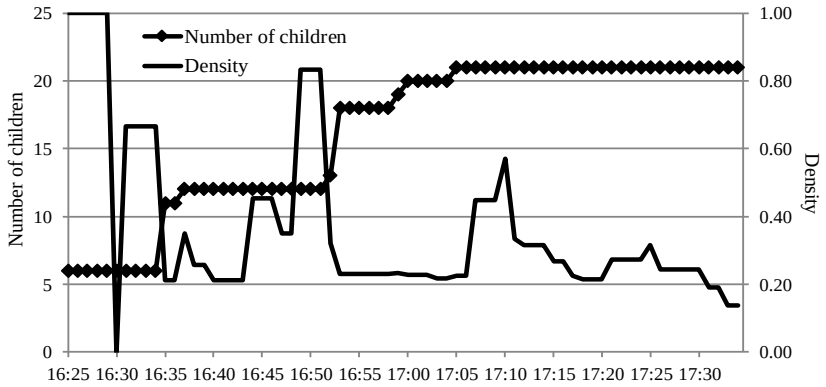
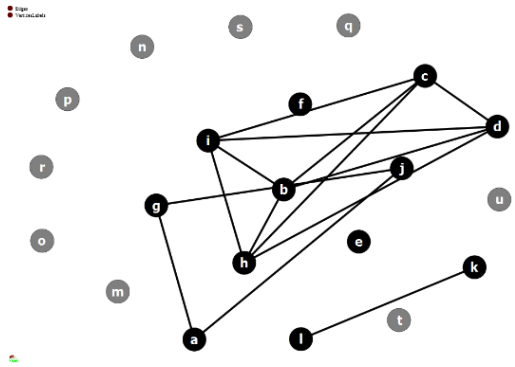
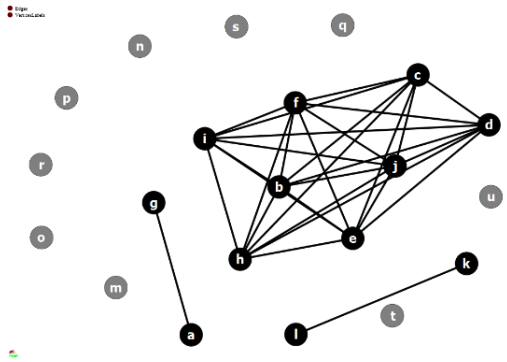


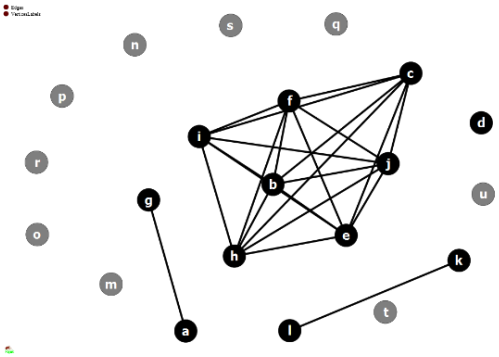
Fig. 3 Dynamics of children's social interactions in playing at the Gakkobashi place



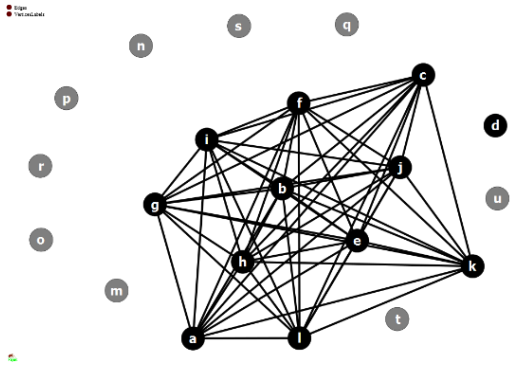
a) Interaction network of children at 16:40



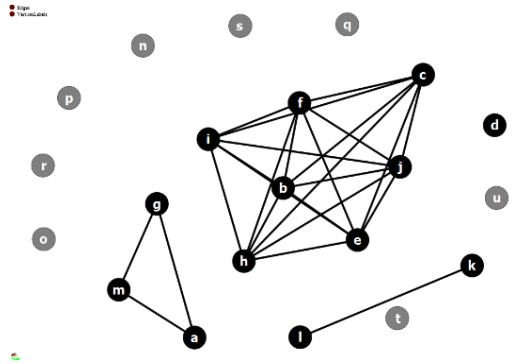
b) Interaction network of children at 16:45



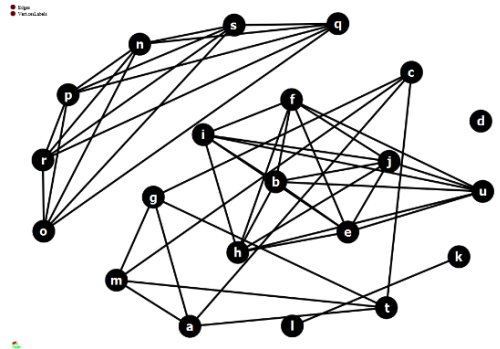
c) Interaction network of children at 16:47



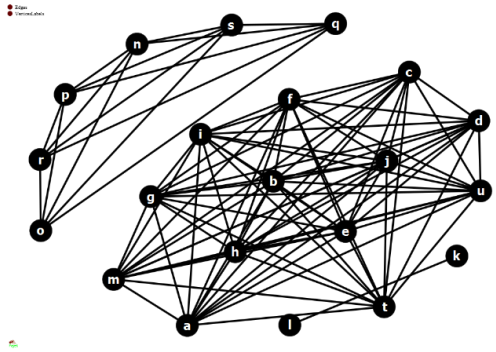
d) Interaction network of children at 16:50



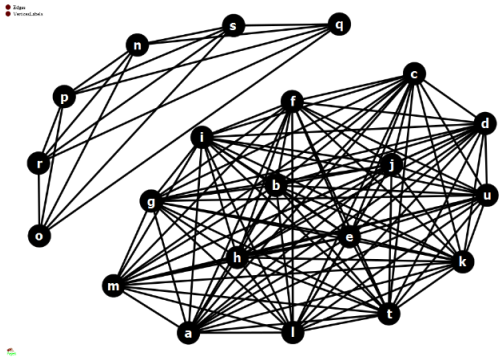
e) Interaction network of children at 16:52



f) Interaction network of children at 17:06



g) Interaction network of children at 17:07



h) Interaction network of children at 17:10

Fig. 4 Interaction network of children in the river playing at each time from 16:40 to 17:10

At 16:40, twelve children were playing and four playgroups were formed (Fig. 4a), and the density at this time was 0.21 (Fig. 3). Then, at 16:45, the playgroups changed, forming a bigger group of eight children and two pairs (Fig. 4b), and the density was 0.45. Further, at 16:47 child

"d" started playing alone, so the group was dispersed (Fig.4c), and the density was decreased at 0.34. At 16:50, the two pairs (child ID: a, g, l, k) started playing with a group of seven children, forming a large playgroup of 11 children (Fig. 4d), and the density increased at 0.83. Then, again, the children were dispersed and the group was divided into four groups at 16:52 (Fig. 4e), and the density was 0.32 at this time. At 17:06, six new children appeared and started group play (Fig. 4f) and the density was decreased at 0.30. At 17:07, as the two playgroups merged (Fig. 4g), the density increased at 0.75. Finally, the children formed two big groups to play and the density was 1.00 at 17:10 (Fig. 4h).

In this way, the children played while repeating gathering and dispersion, forming a larger playgroup. Fig. 5 shows the integrated diagram of the interaction networks between 21 children that occurred from 16:25 to 17:34. The thickness of the tie indicates the length of time to play with, and the longer the time, the thicker the tie. The ties between child b, d, h, i were very thick. These children were the leaders among the playgroups. For example, they decided what kind of play and where to play next. Therefore, it can be said that the daily relationships of the children were expressed by quantifying the interactions among them that changed over time during river play.

In this section, it was found that the children gradually expanded their playgroups as they repeatedly gathered and dispersed during river play.

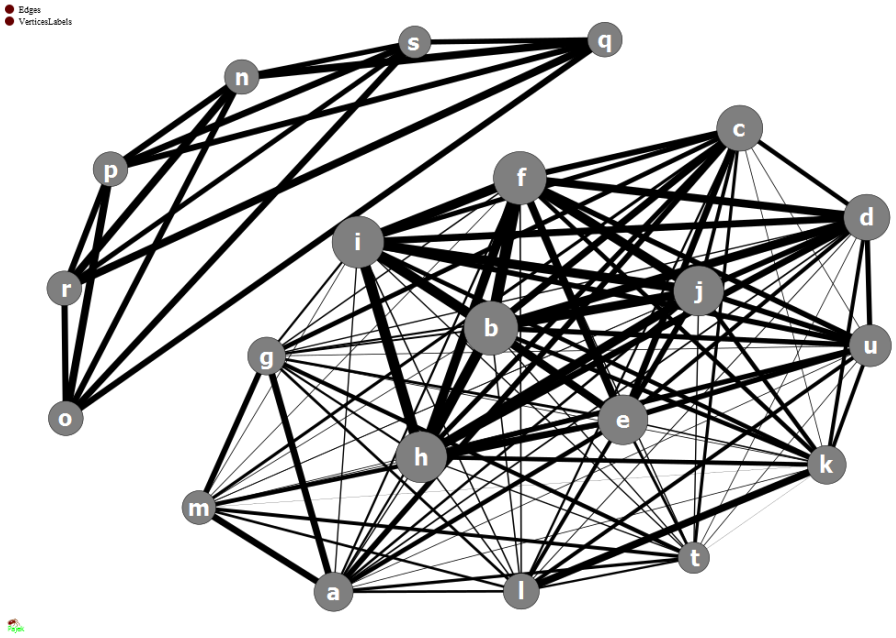


Fig. 5 Integrated interaction networks of 21 children observed from 16:25 to 17:34

Factors for The Emergence of Children's Social Interactions

Through the observation survey and hiring survey, two factors for the emergence of children's social interactions were identified: (1) introducing by playgroup members and (2) playing with caregivers.

(1) Introducing by playgroup members: From the results in the previous section, it was found that children gradually expanded their playgroups as they repeatedly gathered and dispersed during river play. Regarding this social interaction processes, the following opinions were given by the three children who were playing:

"We all (local children) play usually in the three play places (Gakkobashi, Shinbashi, and Kodara place). So local children playing with water around the rivers have many chances to know each other very well."

In addition, the following oral data were obtained from the four children:

"When we find some friends in other playgroups during river play, we play together with all group members via the friends."

Therefore, it can be said that there was a social exchange process by introducing to playgroup members. This process is modeled in Fig. 6. In the Gujohachiman, children's play places in rivers are fixed, so children's playgroups appeared in close proximity when playing in the river. At this time, when groups 1 and 2 appeared, if the member "a" and "b" were acquainted, they first left the group and had a conversation (Fig. 6). This formed a small play subgroup. Then, the children "a" and "b" were invited to play together in each playgroup, and all of them played together to form a large playgroup. Then, everyone became friends through river play together.

In this way, the cases that social interactions occurred through an introduction by playgroup members were observed 17 times during the observation survey. The reason why the children's play group gradually expanded in the previous section was due to the introduction by playgroup members.

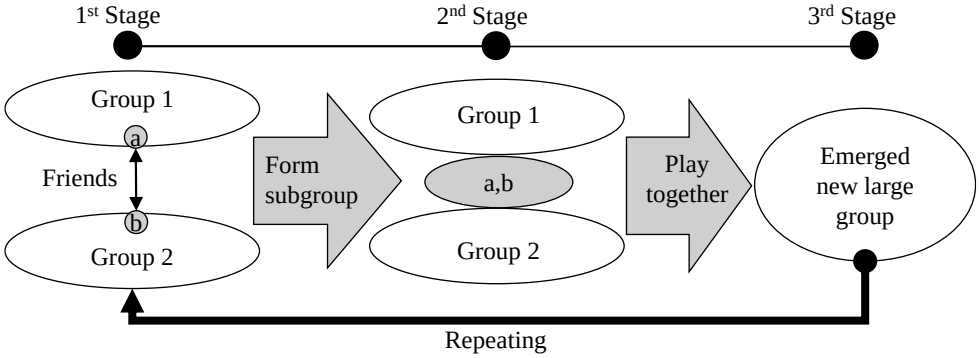


Fig. 6 Social interaction process model by introducing by playgroup members

(2) Playing with caregivers: The second is to play with caregivers. In this area, children were often seen playing in the river, so visitors from outside the area, tourists, often played around the rivers with their family members. From a viewpoint of the tourists, during the observation survey in the Shinbashi place, social interactions from the toursts to the children were observed seven times per hour. In addition, the following oral data were obtained from the ten tourists:

"It looks very fun that the local children play with water dynamically and actively."
"I (or We) want to play together with them."

On the other hand, it was also observed that children actively played with adults. When the children played with an adult, they could play, such as riding on adults' backs or throwing them on the water surface, which the children could not do with children. Once the children started to play with an adult, who is a caregiver of another child, they all played together finally. This process was shown in Fig. 7. The adult "c" is a caregiver of the child "a", and once the child "b" started to play with the adult "c" (the first stage in Fig. 7), the child "a" and "b" played with the adult "c" (the second stage in Fig. 7). Then The adult "c" introduced the child "b" to child "a" and they played all together finally (the third stage in Fig. 7). This process was confirmed eleven times during the observation survey.

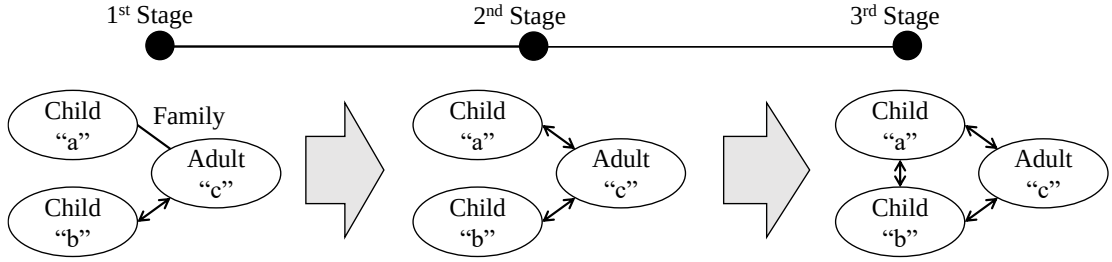


Fig. 7 Social interaction process model of playing with caregivers

CONCLUSION

There were several findings from this study.

Firstly, river play frequency and preference of children were positively related to the frequency of daily use of rivers by their family members and neighbors. Secondly, the SNA showed that the interaction density of children playing around the rivers gradually increased while repeatedly fluctuating up and down. Thirdly, the two factors for the emergence of children's social interactions were identified: introducing by the playgroup members and playing with caregivers.

In addition, although the hiring survey of this study was conducted in 2010, the authors also conducted supplementary interviews with local children playing around the river in this area in 2016, and have confirmed that the children yet played around river dynamically and their social interaction was formed through river play by introducing by playgroup members and caregivers (Nitta et al, 2017).

These results imply that rural rivers have the function for children to expand their local interpersonal relationships through playing, which are supported by local communities. Furthermore, children's play places around rivers have the potential to become the social interface for rural and urban communities, since the tourists were attracted by the children playing around the rivers dynamically and social interactions have occurred.

ACKNOWLEDGEMENTS

This study was conducted with the cooperation of the teachers, the students, and the parents of the Hachiman elementary school in the Gujohachiman. We would like to thank them for collaboration. Also, this work is supported by the Toyo University Faculty of Science and Technology Policy Research 2020.

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