Exploring an Inventive Approach to Supporting Out-of-Home Activities of Child-Rearing Households by a Smartphone-Based Information Sharing App

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This study develops a smartphone-based information sharing app for supporting child-rearing households' out-of-home activities. The app has a function of posting photos and messages and sharing them such as SNS apps. We recruited child-rearing households at nurseries in Utsunomiya to participate in the survey to use the app. Questionnaires were conducted before and after the participants learned rules and shared information on barriers and recommendations when traveling with children for a month. The results show that sharing information and educational quiz could change attitude and behavior of some participants. This inventive approach could be useful for promoting out-of-home activities of child-rearing households by raising public awareness of child rearing and travelers with children.

Key Words : Smartphone app, Information sharing, Barrier-free, Child rearing

1. INTRODUCTION

Japan is facing an aging society with a low birth rate. Although the Japanese government has been aware of this problem since the 1990s, it was not until recently that the issue was seriously addressed. Many people want more children, but various economic, social, physical and psychological barriers hinder them. In 2006, the Law on Promoting Mobility and Accessibility for Aged and Disabled and Others was enacted by combining into the Heartful Building Law and Transportation Accessibility Improvement Law (the New Accessibility Improvement Law). Thanks to these laws, the design of streets, railway stations, trains and buses, public facilities and shopping malls became universal to reduce the barriers to travel.

Ohmori[1] explained the types of cities and transportation environments required to increase the quality of life for child-rearing households in Japan. And classified the barriers face by child-rearing households in their daily lives. With comparison from other international studies, that the behaviors of and public attitudes toward stroller users in Japan are differing widely from those in other countries. Also essential to raise public awareness of child-rearing households and travelers with children. Zhang[2] mentioned the role of the social environment on children's education, life choices should be treated as an additional source of the self-selection, and dynamic interdependences between residential choice, travel behavior, and other life choices should be properly modeled. Also advocating that the choice of residential area is influenced by the neighborhood environment. From Akedo et al.[3], child-rearing households returning (from suburban areas) to live in urban areas, and double-income households are increasing in Japan, thus increasing the demand for nursing facilities and other urban facilities that can support working parents. Besides, the authors mentioned changes in the lifestyle associated with the child's growth, where parents are more concerned with the quality of living environments. Within this condition, urban areas around the country should be adapted to attend the needs of current diversified household patterns and travel behavior patterns. Ohmori et al.[4] found that after providing information through the website, safe cycling and public awareness toward child transport

bicycles were improved. Differences in attitudes between gender, the presence of young children, the use of child transport bicycles, and the location of residence have also disappeared. The classroom lectures with test ride are very effective in maintaining and improving safe riding behavior.

In recent years, with the popularization of smartphones and the promulgation of relevant documents of the Cabinet Office on the promotion of ICT society[5], more and more smartphone applications have emerged. In 2017, the market share of the mobile device in Japan are 68.6% for iOS and 30.4% for Android[6]. Therefore, we developed a mobile phone application based on iOS system. Questionnaires were conducted before and after the participants learn rules and share information on barriers and recommendations when traveling with children for a month. We hope to achieve the purpose of participants' safety education through new technologies (such as popularized smartphone app recently) combined with the communicability of social networks is to help mitigate the barriers for child-rearing households.

By using this app, the quiz function, and information sharing function. To raise public awareness of child-rearing and travelers with children, the objective of this survey could be useful for promoting outdoor activities of child-rearing households.

2. SMARTPHONE-BASED INFORMATION SHARING

In Japan it is necessary to develop a comprehensive system that appropriately acquires and arranges scattered barrier-free information and then presents that information intuitively. Miura's[7] study aimed at developing a social platform that can obtain and present information depending on users' situations, including users' disabilities and locations, as well as share barrier-free information provided by users. This report outlines the concept design, the implementation progress of the platform, and the survey result of the need of visually impaired people.

"Chiba Repo (Chiba Citizen Collaboration Report)"[8] is an app that users can report various issues which occur in Chiba City (for example, roads are damaged, park playground equipment is broken, etc.). These issues are called "regional issues" in Chiba Repo, using ICT (information and communication technology), citizens report to share those issues between citizens and government (administration), citizens and citizens, and solve them reasonably and efficiently.

Fortin[9] proposed a conceptual model. Given that the theory of reasoned action seems to be the most solid theoretical foundation in explaining coupon usage behavior (**Fig.1**), it would appear appropriate to use an extension of this theory as a theoretical framework that could incorporate the notion of control. The theory of planned behavior adds a third antecedent construct to explain behavioral intention, perceived behavioral control (PBC). PBC is added to the model basically to account for conditions of variable volitional control that reflect beliefs about access to resources and opportunities needed to perform a given behavior.

3. METHODOLOGY AND DATA

(1) Overview of the developed system

In December 2018, Han and Ohmori at Utsunomiya University developed and released an iOS smartphone application called "Kosodate" [11], which is dedicated to supporting child-rearing households' out-of-home activities. The application provides several functions. We expect these features to ease the barriers to travel. For example, users can share real-time barriers items in the city. The main function of this app is the same as SNS apps such as Facebook and Instagram. But this app is only for child-rearing households. The shared information can be read by all the application users.
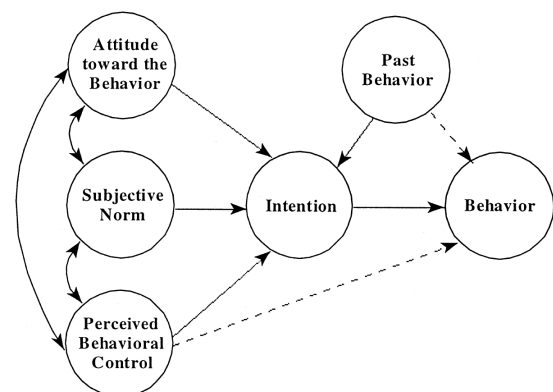

Fig.1 Proposed model of coupon use (adapted from Ajzen & Madden, 1986[10])

The application also provides a search function, which helps child-rearing households find related facilities for them to change diapers at any time.

(2) Survey

To evaluate the change in attitudes and behaviors before and after using the app, we conducted the first questionnaire with an explanation of this survey for all participants while 22nd July to 9th August 2019.

In order to understand the specific behaviors and attitudes of child-rearing households out-of-home activities. The content of the questionnaire is mainly divided into two parts. The participants' own attitudes and intentions towards certain behaviors. We chose the five behaviors that out-of-home activities of child-rearing households face primarily. Another part of the questionnaire asks vehicle ownership (car, motorcycles, and bicycle), daily travel mode, smartphone usage (**Table 1**), and use frequency of stroller, bicycle, and car. The question type of out-of-home activities attitude is 7 stage items like **Table 2.**

So further compare the characteristics of smartphones with child-rearing households, that the Ministry of Internal Affairs "Information Communication White Book"[12] and the MMD Labo (Mobile Marketing Data)'s 2018 smartphone market survey[13] are used as a comparison. Propose to determine the differentiation of child-rearing households by comparing the survey.

We conducted the second questionnaire with explanation of this survey for all participants while 9th September to 15th September, 2019. The flow of process is shown in **Fig.2.**

Table 1 Questionnaire about smartphone usage

	Questionnaire about smartphone usage of child-rearing households
1	How long do you use your smartphone every day?
2	When do you often use your phone?
3	What are the top three apps you've used in the past year? (Multiple-choice)
4	What are the messaging and SNS apps you are using now? (Multiple-choice)
5	How many apps have you used in the past month?
6	Do you know the following mobile apps for child-rearing? (Multiple-choice)
7	What features or functions do you want in child-rearing app? (Multiple-choice)

Table 2 The theory of planned behavior sample item

|	Put stroller wheel brakes on whenever you stop, even on a flat surface (Such as Platform or inside the train)							
1	For this behavior, think it would be a good thing [Attitude]	No think at all ← → Think strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐
2	This behavior that I think I should do [Subjective form]	No think at all ← → Think strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐
3	It's hard for me to do this kind of behavior [Perceived behavioral control]	No think at all ← → Think strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐
4	I intend to do this kind of behavior [Intention]	No think at all ← → Think strongly ☐ ☐ ☐ ☐ ☐ ☐ ☐
5	I do this behavior [Behavior]	Never do it ← → Always do it ☐ ☐ ☐ ☐ ☐ ☐ ☐
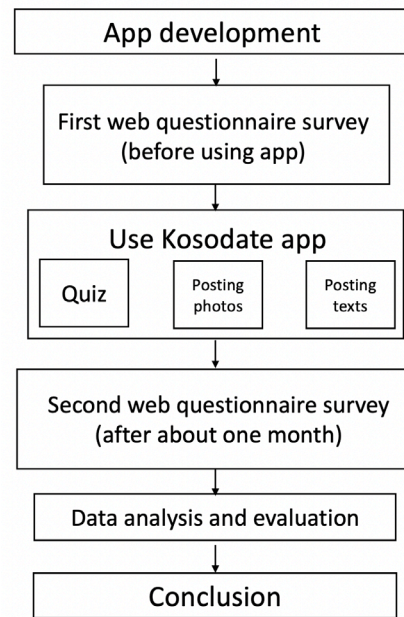
Fig.2 Flowchart of the study

(3) Contents of developed smartphone-app

In the process of developing this mobile phone app, to let users get better customer experience, reducing the cost of learning how to use the new app skillfully. We optimized the user interface and developed the main function similar to Instagram.

The developed iOS-smartphone-app has 5 screens(**Fig.3(b)**): Home, photos post (Machinaka-Check), text post (Machinaka-Check), Search, Profile.

a) Login and registration UI

When the user first uses the app, the login and registration interface displayed (**Fig.3(a)**). The user can complete the registration in three ways: email, Facebook, and Google account. When registering with a

mailbox, in order to verify that the registered email address is actually present, a verification email is sent to the registered email address after the user submits the registration. After the first registration was completed, the user will log into the last account by default the next time the application runs.

b) Learning function of how to go out with children

To mitigate the conflict between the stroller user and the surrounding people, we designed the learning function, which is in a quiz format, to help our users develop an awareness of interpersonal communication when they should be careful about when you go out with a stroller (**Fig.3(e)**). Quiz function has aimed at 10 common behaviors or scenes about out-of-home activities (**Table 3**). The quiz results of the user's response are stored in the back-end server as real-time data.

c) Machinaka-Check function

Machinaka-Check is a function where information about various spots can be shared between various users (**Fig.3(f)** and **(g)**). Post information about a place user visited can help others prepare well for an outing. Through this function, we can get real-time photos and text information shared by users from the application's real-time database "Firebase"[14]. Similar to Instagram, users can also check other users' posts through the built-in search function (**Fig.3(h)**).

d) Search function of child-rearing facility information

Users can search the information on the open data "Baby flat" in Tokyo and Utsunomiya (**Fig.3(c)**). "Baby flat" is a nickname of a space for nursing or changing diapers, so that people with small children can go out with peace of mind. The Tokyo metropolitan area are promoting maintenance in public areas such as parks and children's halls, where child-rearing households frequently go. The public data is currently available at 1502 sites in Tokyo and 240 sites in Utsunomiya.

e) Other User Interfaces

The questionnaire is on Profile function. We have prepared the homepage of City Planning Lab in Utsunomiya University and the homepage of

Table 3 Contents in quiz function

	10 common behaviors or scenes about out-of-home activities (Quiz function)
1	Stroller sign
2	Seat belt of stroller
3	Fixed direction of the stroller in the train or bus
4	Put stroller wheel brakes
5	Children's seats under 6 years old are in the car
6	Children's seats under 6 years old are in the taxi
7	Child transport bicycle sign
8	Child transport bicycle
9	Ride on the sidewalk by child transport bicycle
10	Ask the people around you for help

Subcommittee on City Planning Friendly to Child-Rearing and Children from JSCE for users to connect with us, if they have any questions and suggestions. (**Fig.3(d)**)

(4) Result of survey

Comparing the results of the two questionnaires, five specific behaviors that require attention with significant improvement when going out with children(**Table 4**). In particular, "Put stroller wheel brakes on whenever you stop,even on a flat surface. (Such as platform or inside the train) " has significantly improved from attitude, perceived behavioral control, subjective norm and behavior.

According to the results of participants, the correct rate of quiz function is close to 96%, which proves that the educational function similar to quiz plays an auxiliary role in improving the attitude awareness of participants.

The posting photos function was one of the features that the participants thought would help them the most because it made it easier to understand the barriers they encountered when they were out and about.

A total of 13 photos and 25 texts were feeded for this survey. Next, we will analyze and categorize the photos and texts to find out which category has played a role in mitigating the barriers when going out children.

After the survey, 66.7% of the participants will continue to use the app, and their suggestions will also play a decisive role in the app's next update period.

Table 4 Change about five specific attitudes and behaviors **(n=24)**

	For this behavior, think it would be a good thing [Attitude]			This behavior that I think I should do [Subjective Norm]			It's hard for me to do this kind of behavior [Perceived behavioral control]			I intend to do this kind of behavior [Intention]			I do this behavior [Behavior]		
	Before	After	After-Before	Before	After	After-Before	Before	After	After-Before	Before	After	After-Before	Before	After	After-Before
1. Children's seats should be used when children under 6 years old are in the car.	6.29	6.67	0.38	6.25	6.67	0.42	2.96	2.54	-0.42	6.58	6.63	0.05	6.46	6.50	0.04
2. You need to ride slowly when riding on the sidewalk by bicycle with child.	4.54	5.29	0.75	4.71	5.13	0.42	3.88	3.50	-0.38	4.92	4.92	0.00	3.83	3.88	0.04
3. Put stroller wheel brakes on whenever you stop, even on a flat surface. (Such as platform or inside the train)	6.92	6.96	0.04	6.92	6.83	-0.09	2.29	2.71	0.42	6.54	6.54	0.00	5.46	5.58	0.12
4. If you have trouble when going out with children, ask the people around you for help.	5.46	5.79	0.44	5.04	5.25	0.21	4.96	5.71	0.75	4.21	3.92	-0.29	3.58	3.04	-0.54
5. Give consideration to those who go out with their children.	6.42	6.67	0.25	6.25	6.67	0.42	3.46	3.46	0.00	6.54	6.50	-0.04	5.58	5.71	0.13

(a)   (b)   (c)   (d)
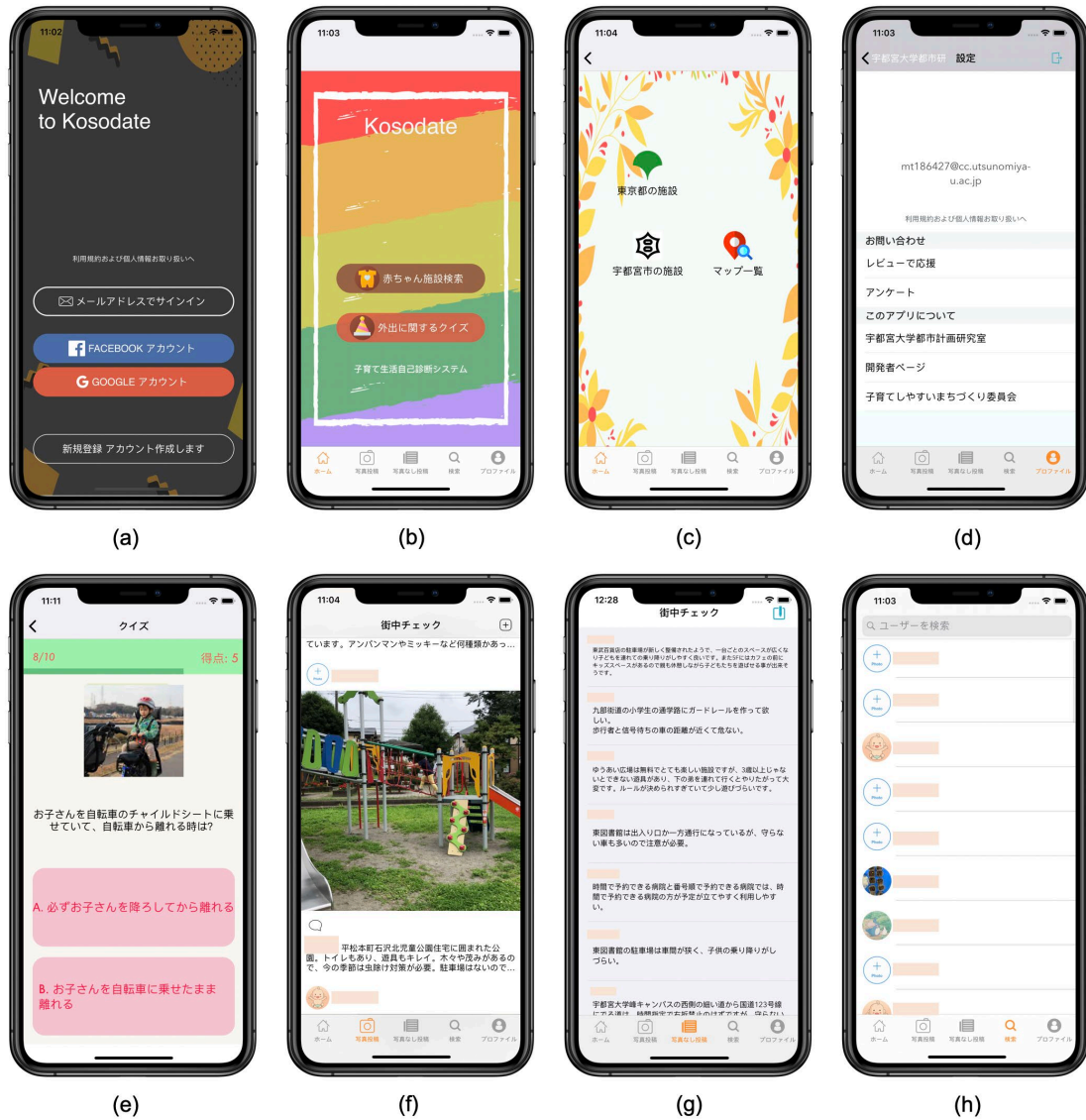
(e)   (f)   (g)   (h)

Fig.3 Screen of app

(5) Application usage and user characteristics

Through the statistical analysis capabilities[15] of Firebase's back-end server, the software can capture the user's behavior. Such as user usage in the application, engagement time, the proportion of each functional segment.

The data obtained from the back-end will also help with the analysis of user characteristics.

4. CONCLUSIONS

The development of this smartphone application aims to mitigate travel barriers for child-rearing households through information sharing between users. According to the post of users, will develop the map query function of users' posts before the next survey. Convenient for users to view the posts around when they out-of-home. Since only 24 people completed the first phase of the survey, we decided to conduct the second phase of the survey. Our following study is to recruit 50 child-rearing households to use this smartphone application. Questionnaires would be conducted before users use this app, before and after the user uses the app for a month. The collected data will be further analyzed to help enhance application performance. It is also expected that this software will be widely promoted in the future.

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