Characteristics of Action in Strolling Behavior

A Basic Study on Act-finding in Urban Space

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Action occurrence in regard to strolling behavior has been analyzed from a new point of view, i.e. Act-finding. Act-finding is a phenomenon which one searches next acts in ad hoc conditions.
Some types of actions are as follows: Eyes action includes 'gaze', 'look around' and 'look back'. Walking action includes 'wind', 'turn', 'return', 'accelerate', 'slowdown' and 'stop'.
The total of recorded actions is 782. Eyes action is 421(53.8%) and walking action is 361(46.2%). The sum of the frequency until 15 seconds occupies 581 (74.3%) and until 30 seconds occupies 702 (89.8%). The frequency of actions decreases rapidly until 10 seconds. The relation between the interval time of actions and the number of times is fractal (the fractal dimension is 1.07). The occurrence of eyes action shows linear-like decrease and that of walking action shows logarithm-like decrease as much as the interval time gets long.

INTRODUCTION

As for walking in daily life, it can be classified into two large cases. One is that it has a goal to go to an appointed place. The other is that it does not have specific purposes to spend time. Paying attention to the former, functional and rational routes in urban space come to main problem. So, innumerable reports have been made so far to clarify environment-behavior relations about wayfinding. Kunio Funahashi (1991) describes some characteristic aspects of wayfinding behavior and spatial cognition with regard to an initial instruction. Maho Hiiro et al. (1994) explore wayfinding as a problem solving by protocol analysis. Toshitomo Suzuki et al. (2001) focus visual search through experiments about transfer and find an exit by using eye camera. However, very few attempts have been made at the latter though both cases must be examined to design better walking environment.

On the other hand, some studies in cognitive science to discuss small corrections of movements called 'microslips' are interesting. Kentaro Suzuki and Masato Sasaki (2001) observe preparing a cup of beverage and some foods, and investigate how microslips and pauses are related to the shifts of actions in the task. It is reported that microslips and short pauses occur much more frequently in the shift of movements at the boundary of successive sub-tasks than the shift of movements within a single sub-task. When one tries to understand walking in everyday activities, the following opinion gives an important light: "every single action does not always smoothly shift to the next one."

The purpose of this basic study is to describe some temporal characteristic aspects of action occurrence from the point of view of Act-finding in regard to strolling behavior in underground

street area. We define the term Act-finding as follows: People understand ad hoc conditions in urban space and reach acts actively. In this process, we can see some scenes to search next acts in human behavior. This phenomenon is named Act-finding. It is the important situation which makes the continuance of human acts have flexibility. (Figure 1)
In addition, 'act' is a general idea unit for analysis. In this study, 'performance' is a movement of part of human body (ex. bent a leg), 'action' is a physical movement as orientation to environment (ex. sit down) and 'act' is a behavior which has meaning as a chain of physical movement (ex. take a rest).

OBSERVATION

The observation was done for the purpose of grasping what kinds of actions occurred in everyday walking. The aim was that various actions could be observed. We chose three sites for observation in the underground market of Sapporo station (PASEO and APIA), MIZU-NO HIROBA (Site-A), TAIYOU-NO HIROBA (Site-B) and KOMOREBI-NO HIROBA (Site-C). These sites have the places that people can take a rest and wait for someone. The video camera was fixed and recording was done in each site for two hour from 1 p.m. to 2 p.m. in two days of September 29 (Sat) and 30 (Sun), 2001.
Some types of actions have been gotten from the videotaping records of which was sampling at random for each 5 minutes: Eyes action includes 'gaze', 'look around' and 'look back'; walking-orbit action includes 'wind', 'turn' and 'return' and walking-speed action includes 'accelerate', 'slowdown' and 'stop'. Figure 2 summarizes these actions.
These actions were observed in about half of the people reflected on the videotaping screen, and the rest just and only passed by. The number of actions which was reflected on the screen in 5 minutes has been measured to be: Site-A is 40 (it is 52.6% of all who passed by), Site-B is 42 (26.0%), Site-C is 44 (54.3%). And the average is 44.3%.
As the outline of characteristics of action occurrence, it can be understand that more than one action might be observed continuously and an action happens about one time in 5 seconds on the average.

EXPERIMENTAL

Next, the experiment was done to understand how for action which get by the observation to occur concretely in strolling behavior.
The purpose of this experiment is to catch the fundamental tendency of action occurrence. Therefore, the area where the attribute of store was mixed in, which influences on actions, was avoided. PASEO in the underground market of Sapporo station where it was settled as shopping store area was selected. And, it was carried out from 2 p.m. to 4 p.m. on weekdays when there is a few walker's traffic during October 16 (Tue) - 19 (Fri), 2001. Only the condition that one leaves Site-A, walks freely in PASEO and returns to Site-A in about 30 minutes was shown to the participants. And, videotape recording was done from behind the participants in consideration of the influence from the observation person. The participants in this experiment were 16 undergraduate students (13 men and 3 women).

The total of recorded actions is 782. Eyes action is 421(53.8%) and walking action is 361(46.2%). That is, eyes action and walking action occur at the about same rate. The rate of action occurrence by the kind is shown in Table 1.

RESULTS AND DISCUSSION

(1) The plotting about each type of actions

The plotting about each type of actions appears in Figure 3. On the whole, it can be understood that actions occur frequently in the crossing point where the passage, which can be patrolled greatly in PASEO, intersects with the other passage to relay (Figure 3-1). At the passage to relay, the difference is found between eyes action and walking action in tendency of action occurrence. For example, eyes action occurs 7 times at X shown in Figure 3-2. Conversely, walking action occurs only 4 times at X shown in Figure 3-3 and these are gathered around the crossing point. And take Y and Z, the passage which the interval of the forks is short has the same tendency as the passage to relay.

(2) The kinds of next actions right after that

Table 2 shows the kinds of next actions right after that. There is most 'gaze' after 'gaze'. In the same way, 'gaze' after 'look around', 'gaze' and 'return' after 'look back', 'gaze' after 'wind', 'accelerate' after 'turn', 'accelerate' after 'return', 'slowdown' after 'accelerate', 'stop' after 'slowdown', 'gaze' and 'look around' after 'stop'. All of the actions can be understood naturally.

(3) The frequency of actions on every interval time

The frequency of actions on every interval time shows Figure 4. The total of actions is 782. The sum of the frequency until 15 seconds occupies 581 (74.3%) and until 30 seconds occupies 702 (89.8%). It is characteristics that the frequency of actions decreases rapidly until 10 seconds. In brief, it is clear that a person always starts an action in the short interval.

(4) The relation between the interval time of actions and the number of times

As mentioned with (2), most of actions are being done until 30 seconds (89.8%). So, it is analyzed even for 30 seconds in the following knot.

Shown in Figure 5 is the log-log graph of the interval time of actions and the number of times. It decreases with repeating increase and decrease. When the regression line was looked for, the coefficient was -1.07 and the coefficient of determination was 0.75. It can be said that it has high reliability about it (the correlation coefficient is 0.87). The result clearly shows that the relation between the interval time of actions (x) and the number of times (y) is fractal (the fractal dimension is 1.07). Thus, it can be said that actions are in a little complicated because the fractal dimension (1.07) is close to 1.0.

(5) The characteristic of eyes action

The graph of the interval time of actions and the number of times about eyes action is shown in Figure 6. It decreases monotonously with repeating increase and decrease. The coefficient of

regression line is -0.68. And the degree of confidence is middle because coefficient of determination is 0.52 (correlation coefficient is 0.72). Therefore, the characteristic of eyes action is linear-like decrease with repeating increase and decrease.

(6) The characteristic of walking action

Figure 7 shows the graph of the interval time of actions and the number of times about walking-orbit action. Figure 8 shows the graph of the interval time of actions and the number of times about walking-speed action. The similar tendency is shown with both as well. The number of times decreases rapidly when it exceeds 2 seconds. The number of times until 2 seconds about walking-orbit action occupies 55.8% and about walking-speed action occupies 55.7%. The approximate graph is semi-log. The degree of confidence is middle because coefficient of determination of walking-orbit action is 0.62 and that of walking-speed action is 0.70. In consequence, the characteristic of walking action has tendency that the next action happens intensively within 2 seconds after the action.

CONCLUSION

There is striking difference between eyes action and walking action because the occurrence of eyes action shows linear-like decrease and that of walking action shows logarithm-like decrease as much as the interval time gets long. In other words, eyes action has characteristic that the time from the action to the next action seldom opens greatly and walking action has possibility to continue in the short interval intensively.

Judging from the above and considering the plotting shown in Fig. 3, as regards strolling behavior, it can be concluded that walking action depends on the space structure such as passage distance or crossing point, on the other hand, eyes action does not occur by the mutual relationship with such space structure. Moreover, it is clear that eyes action which shows linear-like decrease added to walking action which shows logarithm-like decrease makes fractal characteristic as the whole. It can be considered that actions are fluctuation condition and dynamic stability is kept. The fluctuation in strolling behavior is found, which, however, has not yet been thoroughly explained whether it is related to comfortableness of walking. Nonetheless, the newly viewpoint will allow us to study for the universal design concretely if it is applied further experiment and analysis on children, aged and disabled people.

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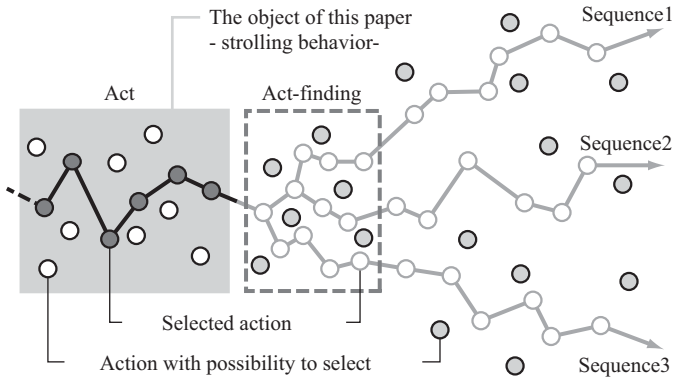


Figure 1. Concept of Act-finding

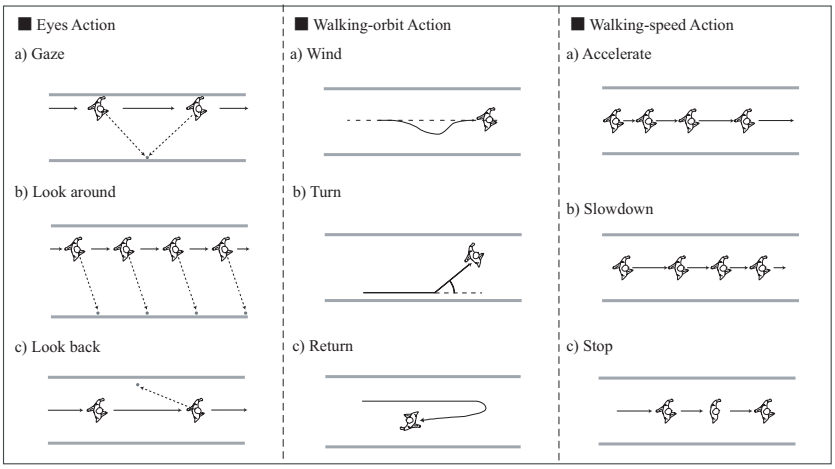
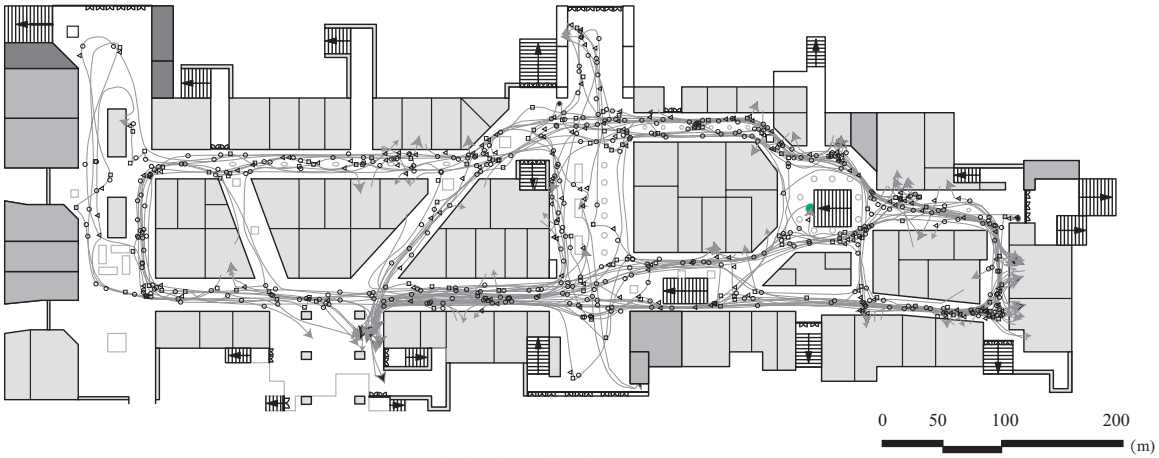


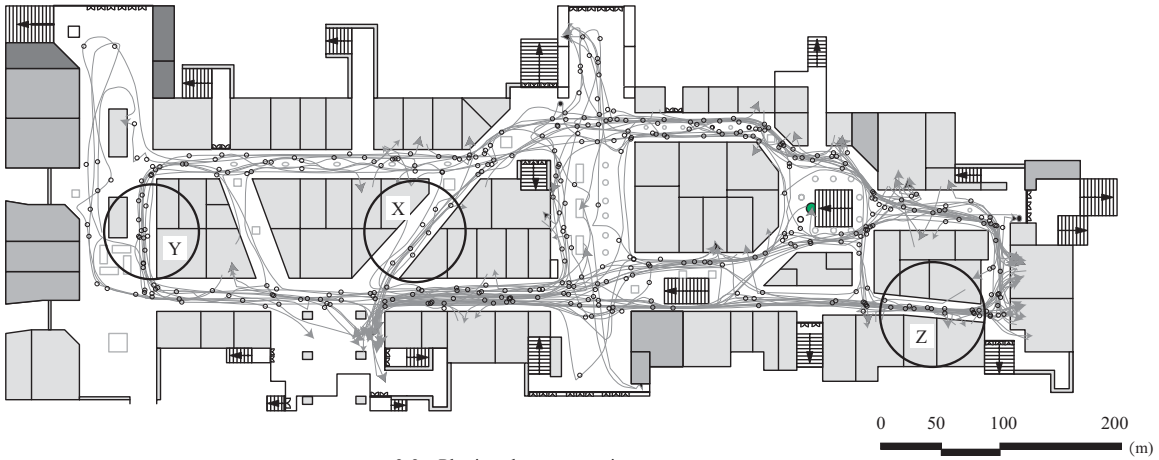
Figure 2. Types of actions

Table 1. Rate of action occurrence

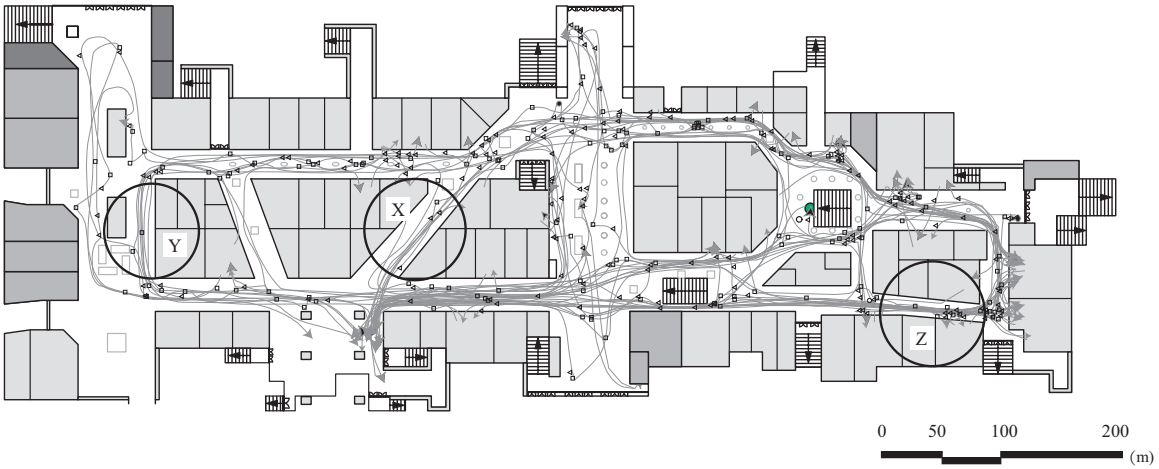
Level 1	Number of times (%)	Level 2	Number of times (%)	Kind of Action	Number of times (%)
Eyes action	421(53.8)			Gaze	246(31.5)
				Look around	163(20.8)
				Look back	12(1.5)
Walking action	361(46.2)	Walking-orbit action	143(18.3)	Wind	72(9.2)
				Turn	57(7.3)
				Return	14(1.8)
		Walking-speed action	218(27.9)	Accelerate	44(5.6)
				Slowdown	121(15.5)
				Stop	53(6.8)
Total	782(100.0)				



3-1. Plotting about all actions



3-2. Plotting about eyes action



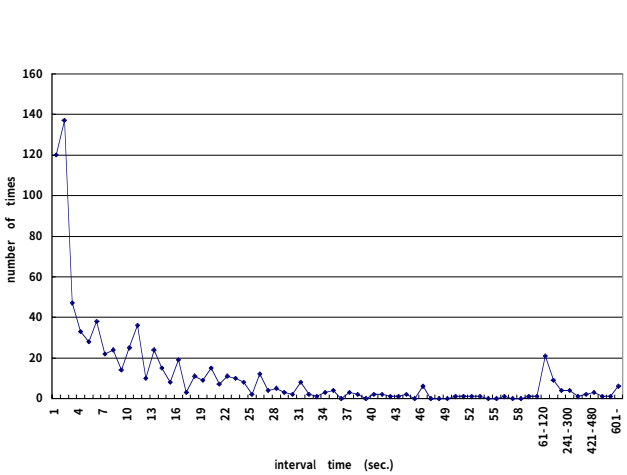
3-3. Plotting about walking action

Shopping Restaurant Others Eyes action Walking-orbit action Walking-speed action

Figure 3. Plotting about actions

Table 2. Next actions right after that

		Next action									
		Gaze	Look around	Look back	Wind	Turn	Return	Accelerate	Slowdown	Stop	Total
Before action	Gaze	53	45	4	28	21	5	8	71	11	246
	Look around	74	29	2	21	10	2	0	24	1	163
	Look back	3	1	0	1	0	3	1	2	1	12
	Wind	37	22	0	3	1	0	3	6	0	72
	Turn	10	7	2	5	3	0	18	7	5	57
	Return	4	2	0	1	0	0	5	0	2	14
	Accelerate	14	14	2	1	1	0	1	7	4	44
	Slowdown	31	22	1	9	16	3	3	4	32	121
	Stop	18	18	1	4	5	2	4	1	0	53
	Total	244	160	12	73	57	15	43	122	56	782



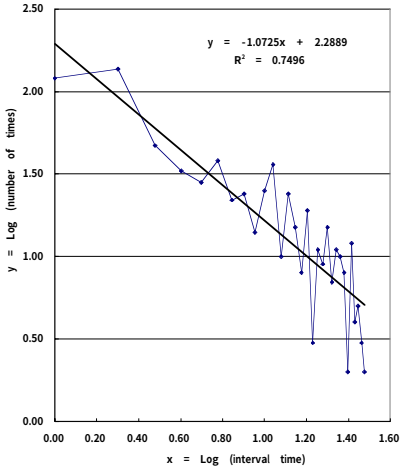
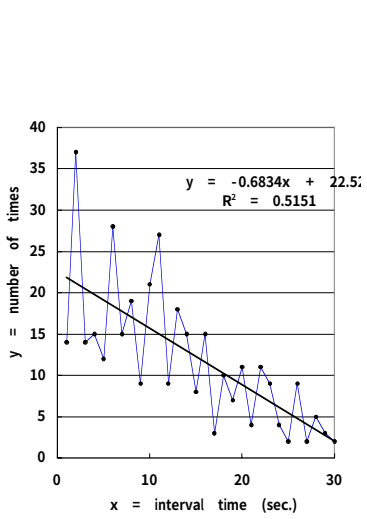
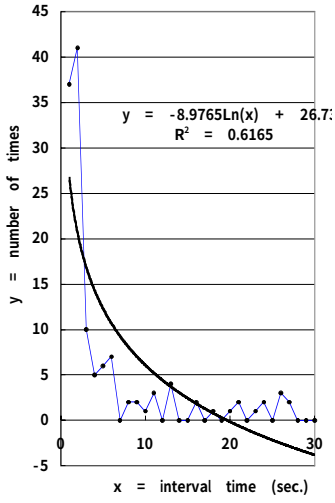


Figure 4. Frequency of actions on every interval time (left)

Figure 5. Relation between the interval time of actions and the number of times (right)





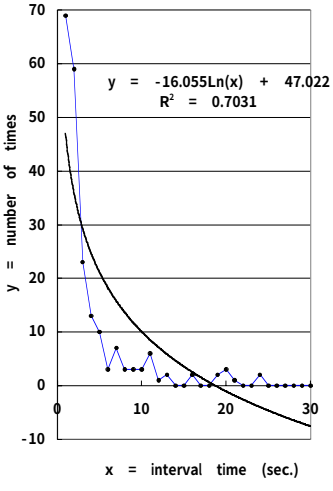


Figure 6. Interval time and number of times about eyes action (left)

Figure 7. Interval time and number of times about walking-orbit action (center)

Figure 8. Interval time and number of times about walking-speed action (right)