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Exploring the Spatial Transferability of FEATHERS – An Activity Based Travel Demand Model – For Ho Chi Minh City, Vietnam

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Abstract

This paper presents descriptive analyses to investigate the transferability of FEATHERS, an activity-based travel demand model developed for Flanders (Belgium), a region in a developed country to Ho Chi Minh City (Vietnam), a metropolitan area of a developing country using personal and household travel survey data. The transferability was tested by using indicators which represent individuals' activity and travel behaviors. The results confirm the transferability of FEATHERS modelling structure to Ho Chi Minh City (HCMC), but all sub-models require recalibration due to the different cultural settings between the two study areas. The differences in transport mode options, land use patterns and individuals' location choice preferences make transport mode and location choice the least transferable models.

Keywords: transferability; activity based travel demand model; action space; schedule pattern

1. Introduction

As other developing cities, Ho Chi Minh City, the center for economic growth of Vietnam, is undergoing a strong urbanization process that brings serious congestion and emissions from transportation activities. The city government is seeking tools to effectively manage travel demand through a series of policies/strategies which aim to change the travel behavior of individuals. A travel demand forecasting model based on an individual's participation in activities is an essential tool for this problem. The development of an Activity-based travel demand Model (ABM)

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from scratch, however, requires significant resources in terms of time, money and skills while another promising alternative is to use an already existing well-developed ABM system. Koppelman and Wilmot [1] defined transferability as the "…*usefulness of information provided by a model that predicts in context different from that in which it is estimated*". Spatial transferability is the transferability of a model to a different geographical region. Sikder [2] reviewed and synthesized from Ben-Akiva [3] and Hansen [4] the requirements considered in a spatial transferability of an ABM model with 4 levels: underlying theory of behavior, model structure, empirical specification and parameter values. There is, however, no empirical study found in transferring the theory of travel behavior and decision making [2]. As the first phase in a long-term project to adapt FEATHERS (developed for Flanders, Belgium) [5] for HCMC, this study investigates the systematic (dis)-similarities of the activity–travel behaviors between Flanders and HCMC. The paper focuses on exploring the transferability extent of FEATHERS at model structure level based on the travel survey data. The rest of this paper consists of three parts: the first part reviews some existing ABMs to position FEATHERS with other ABM systems. The second part presents the descriptive analysis of the spatio–temporal patterns of activity and travel behaviors in the two study areas and discussions on model transferability. The last part concludes the paper and presents directions for future researches.

2. Activity based travel demand models

Existing ABM systems can be categorized based on the underlying assumptions of the individual decision-making process. They include: econometric models, heuristic rules based models and hybrid models which combine both decision making assumptions in the simulation process. The econometric ABM was first proposed by Alder and Ben Akiva et.al in 1979 and then Bowman in 1995[6] developed an operational full-day model. These models assume that individual's daily activity pattern consists of several tours in which activities are scheduled based on a prior assumption of primary and secondary purposes. The next level predicts the tour attributes including transport mode, the destination of the primary activity and tour time of day. The intermediate stop level predicts transport mode, location and time of day for the other activities in tours. All choices in the simulation process are made by discrete choice models which rooted from econometrics.

Arguing that individuals do not always make rational decisions, Arentze and Timmermans [7] introduced ALBATROSS (A Learning Based Transportation Oriented Simulation System) – a fully operational computation process model based on the principle of heuristic search. In ALBATROSS, individual daily activity pattern is generated based on the set of rules, where activities are scheduled bonding with a skeleton structure of fixed activities. The tours in schedules are then formed in the nature of available time windows between activities. This model also applies the sequential decision process to predict activity's attributes (travel mode, location and time) as in econometric models at tour level and intermediate stop level.

FEATHERS (Forecasting Evolutionary Activity – Travel of Household and their Environmental RepercurssionS) was originally developed by IMOB, Hasselt University, to evaluate transport policy measures for Flanders, Belgium. FEATHERS simulation framework also consists of three levels: daily patterns, tour and intermediate stops, similar to the two above mentioned models. It, however, combines heuristic rules adapted from ALBATROSS [8] for decisions at daily pattern level and discrete choice models for several models such as transport mode and location choices. With a modular architecture, FEATHERS allows practitioners to customize the system [5] with their preferences around the core scheduling module. The model has been studied for the transferability to the Seoul region of Korea [9] and some other European cities.

Auld and Mohammadian [10] introduced ADAPTS (Agent-based Dynamic Activity Planning and Travel Scheduling) – a dynamic model in terms of the time dependence of activity planning and scheduling process. It combines heuristics with an econometric model in a discrete event microsimulation. In ADAPTS, the process to generate activities and predict activities' attributes is dependent on the priority of activity planning horizons. However, Auld [11] did not explain the generation and scheduling of full-day activity patterns. Besides, this model was calibrated with a two-week-long GPS(Global Positioning System)-based and activity-travel survey which is unavailable in many regions especially developing countries like Vietnam.

At a model structure level of spatial transferability, the modeling framework with a daily pattern, tour and stop levels of either econometric or rule-based models have shown the high possibility to be transferred to many geographical regions where data resource is limited. Although being criticized for somehow unrealistic

representation of daily behavior, but from the practical point of view, discrete choice models allow researchers to represent complicated interactions of individuals' characteristics in scheduling their daily activity and travel routine. To this point, FEATHERS, with the combination of different decision-making mechanisms and the modular architecture, can be considered the promising base application for HCMC.

3. Investigating activity- and travel behaviors of residents in Flanders and HCMC

3.1. General information of study areas and data sources

Flanders and HCMC intuitionally seem different in many aspects: economic development, social and cultures, climate and geographical characteristics, transportation infrastructure and so on. Flanders, with a surface area of 13,522 (km^2), a population of 6,444,127 (in 2015), is a geographic region in Belgium divided into five provinces with land use patterns spreading over the region [12]. HCMC, with a total area of 2,061 km^2 and population of 8,127,900 (in 2015) meanwhile is a metropolitan area in the South of Vietnam with monocentric structure region. The population, as well as the road network, is mainly concentrated in the city center.

FEATHERS was trained by OVG data which is based on the large-scale person travel survey conducted in all Flanders region funded by the Ministry of Mobility and Infrastructure, Flanders, Belgium. Data with similar administrative and geographical level of HCMC and Flanders is not available for this study. In HCMC, a large-scale household travel survey is used which is available as "Data Collection Survey on Railways in Major Cities in Vietnam" (METROS Study – funded by JICA: the Japan International Cooperation Agency) from January to April 2014 for HCMC and some parts of the surrounding provinces. After cleaning and filtering for only individuals living and making trips within HCMC, there are 1,208 observed schedules of 46,197 individuals. The similar temporal data of Flanders as OVG3 (the survey conducted from 2007 to 2013 in phases) is used for analyses with 1,115 observed schedules of 5,879 individuals after cleaning.

Bearing in mind the differences between two study areas, the attributes of household and person described in the two survey questionnaires are defined differently except for generic attributes such as gender and age but FEATHERS currently does not model individuals younger than 18 years old. Most activity types, however, are found similar except "To eat (not at home)". "Visiting someone" and "Recreation, sport, culture" are categorized as a single activity in METROS (see Table 1). The next section presents the comparisons of activity-travel behavior indicators based on three modelling levels in simulation framework of FEATHERS as introduced in the previous section.

Table 1: Activity categories in OVG and METROS

Symbol in number	OVG3 purpose	METROS purpose	ATC symbol
1	Going home	To Home	h
2	Work	To Work	w
3	Business trip	Company business	c
4	Shopping	Shopping/Market	l
5	Education	To School	w
6	Visit someone + Recreation, sport, culture	Social/recreation/religious	l
7	Services (physician, bank)	Private matters (e.g. bank)	l
8	Walk, tour, run	Joy riding	j
9	Bring/get someone/something	Pick-up/Send Off	b
10	Other	Others	o
11		To eat (not at home)	l

3.2. Analyzing structure of day activity schedule pattern

At daily pattern level, we consider two indicators which are important: schedule pattern and the number of home-based (HB) tours. The schedule pattern in this study refers to the sequence of activities including in-home (composing of all activities performing at home) and out-of-home activities in a daily routine of individuals (Table 2). A day-long activity schedule in FEATHERS is constructed from a priority assumption based on the activity type

and its duration. The primary activities are the activities that show higher predictability than others (secondary activities) will be scheduled first into home-based tours. The secondary activities will then be added to those tours as the intermediate stops. In order to investigate if this activity classification assumption is similar between HCMC and Flanders, the time use pattern for each activity could be used as criteria to compare the importance of that activity to the individuals in the two datasets. An optimized classification method developed by Ector et.al [13] was applied to get the optimal sets of activities for both METROS and OVG3. This method tries to optimally classify different activities into groups – ATC (Activity Type Classification) – with most similar temporal (activity start time and duration) patterns. From ATC result, the "Work"/"To work", "Business trip"/"Company business" (work-related activities) and "Education"/"To school" activities are recognized to have distinctive temporal patterns which mean their start time and duration attributes are easier to be predicted than other activities in both OVG3 and METROS. These activities can be considered as primary activities in both datasets. "To eat-out" activity in METROS shows similar temporal patterns as "Private matters", "Shopping/Market" and "Social/recreation/religious" categories, therefore, it can be considered as a flexible activity which denoted as letter "l". "Others" and "Walk, tour, run" activities in OVG3 and "Pick-up/Send off" activity in METROS respectively show more distinctive patterns than the other dataset. So, the scheduling priority for those activities may need revisions in the transferred model.

Based on these ATCs, activity categories are re-grouped into 7 ATCs which are symbolized as the *"ATC – symbol"* column in Table 1. This step simplifies the day activity schedule in order to compare schedule patterns in two datasets. The observed schedules which are built based on these ATCs form 408 unique schedule patterns in METROS and 976 unique schedule patterns in OVG3. When comparing two datasets, 200 patterns were found common. These patterns share 67.42% observed schedules in OVG3 and 87.09% observed schedules in METROS. Table 2 lists ten most frequent scheduled patterns by age and gender. In both datasets, these patterns depend on age stronger than gender. The schedule pattern 7 is found more frequent in METROS than OVG3. The work-based tour is currently not considered in FEATHERS thus it needs to be extended for HCMC model. Assumptions on activity and travel behaviours for the less than 18 year-old individuals also need to be added in the transferred model. Fig. 1 presents the frequency of Home-Based Work (HBW) and Home-Based non-work (HBO) tours of two datasets. In METROS, most frequently observed patterns are 01HBW, (01HBW+01HBO) and 02HBW tours and these tours are mainly composed of 01 or 02 out-of-home activities. FEATHERS is capable to capture these patterns since its framework allows at maximum 02 work episodes and multiple out of home activity tours.

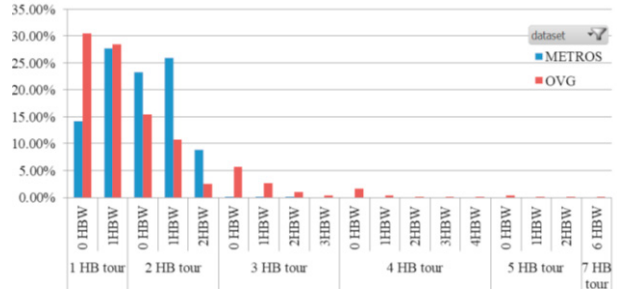

Fig. 1 Frequency of HB tour and HBW

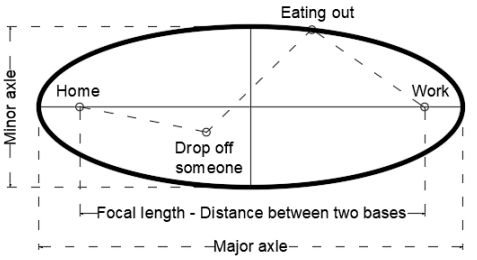

Fig. 2 Trip chain beginning at 6:30 AM and ending at 8:00 AM (Adapted from Newsome, 1998)

Mode choice sub-model in FEATHERS only considers the main mode, which is the longest duration mode of the trip. In a home-based tour, there are at least two trips and the tour transport mode of FEATHERS is assumed to be the main mode of the trip from home to work/education or the primary activity (the longest activity duration) in a HBO tour. There are about 9.3% HB tours in OVG3 and 4.2% HB tours in METROS that involved different modes (Table 3). The marginal distributions of mode choices over slow mode, private motorized mode and public transport are somehow similar in both datasets. Motorbike (as driver and as passenger) is a unique transport mode in HCMC that used as the main mode for nearly 62% HB tours in METROS. This transport mode is popular because of its reasonable cost, higher mobility than bus or car in the peak hours and accessibility in small alleys of HCMC. However, motorbike is highly exposed to the weather and other traffic. Therefore modelling mode choice should include safety and convenience for specific alternative factors [14] additional to vehicle ownership, household context (with or without children), income, travel cost, travel distance, etc. More work should be invested in developing level-of-service data for HCMC in order to capture the sensitivity of mode choice in a different time-of-day due to the different mobility of different modes in the mixed traffic in HCMC.

Table 2: Ten most frequent schedule patterns by group age and gender (in percentage)

Schedule pattern		Male							Female						
	OVG3	Un-known	18 - 34	35 - 54	55 - 64	65 - 74	75+	Total	Un-known	18 - 34	35 - 54	55 - 64	65 - 74	75+	Total
1	hwh	35.3	33.3	33.2	17.10	1.67	0.72	26.9	35.93	26.0	25.3	9.03	0.47	0.00	20.8
2	hlh	18.0	16.5	14.8	24.2	34.4	50.4	20.9	14.76	18.3	21.1	38.3	45.1	54.8	26.5
3	hlhlh	4.33	6.49	6.38	14.87	17.9	14.4	8.53	5.57	5.24	8.04	13.0	15.8	12.9	8.80
4	hwhlh	13.2	8.44	7.68	2.97	0.00	0.72	7.24	10.86	6.77	3.27	1.08	0.00	0.00	4.45
5	hllh	3.85	2.81	2.75	1.86	5.00	7.19	3.34	3.90	4.37	4.17	6.86	11.2	9.68	5.62
6	hwlh	2.40	1.52	1.01	1.86	0.56	0.00	1.39	3.34	3.49	3.57	1.81	0.00	0.65	2.72
7	hwhwh	3.85	1.73	2.61	1.12	0.00	0.00	2.09	3.62	0.66	1.79	1.44	0.47	0.00	1.54
8	hlllh	0.72	1.08	0.72	2.23	2.22	2.88	1.25	2.23	1.09	2.23	3.61	2.33	3.23	2.25
9	hbh	0.48	0.65	1.45	2.97	1.67	2.88	1.39	0.84	2.84	1.64	1.81	1.40	0.00	1.64
10	hoh	1.44	1.30	1.16	1.12	3.33	2.88	1.53	0.84	0.44	0.45	1.44	3.26	1.94	1.03
	METROS	6-17	18 - 34	35 - 54	55 - 64	65 - 74	75+	Total	6-17	18 - 34	35 - 54	55 - 64	65 - 74	75+	Total
1	hwhlh	23.4	25.3	18.9	9.44	2.44	0.87	20.1	21.3	20.4	10.6	3.96	1.49	0.78	14.3
2	hlhlh	0.41	5.79	10.7	18.1	17.1	16.2	8.43	0.92	10.6	21.2	26.3	22.9	17.6	15.4
3	hwh	30. 1	11.5	9.09	5.48	2.14	0.87	12.5	30.07	11.2	5.05	2.92	1.16	0.78	10.0
4	hwhwh	19.5	10.5	7.28	6.96	1.22	0.44	9.99	21.09	8.13	3.68	1.48	0.50	0.00	7.11
5	hlh	0.58	2.14	4.12	8.05	15.6	22.3	3.84	0.52	4.91	10.7	17.4	23.0	25.0	8.67
6	hwlh	4.07	6.53	4.49	1.65	1.22	0.00	4.68	3.57	6.89	3.68	1.78	0.33	0.00	4.41
7	hwlwh	1.63	6.93	5.49	3.00	0.46	0.00	4.91	1.88	5.15	2.05	0.79	0.00	0.00	2.87
8	hlwh	3.84	5.55	5.61	2.91	0.76	0.00	4.83	4.05	3.48	1.69	0.74	0.00	0.00	2.44
9	hllh	0.29	2.03	2.99	5.39	6.11	4.37	2.60	0.12	2.88	5.76	7.17	9.45	1.56	4.24
10	hlhoh	0.15	1.19	1.99	4.44	4.43	5.24	1.79	0.04	2.01	4.95	6.73	5.97	4.69	3.51

Table 3: Frequency of home based tour by tour mode (in percentage)

Is single main transport mode used in tour?		**No**				**Yes**				**Grand**
Number of activities in tour		**1**	**2**	**3**	**4+**	**1**	**2**	**3**	**4+**	**Total**
OVG3	Car driver	18.28	13.96	25.41	33.57	44.91	56.21	68.53	78.18	45.94
	Slow mode	32.26	53.96	30.81	40.56	32.48	23.49	15.73	11.82	30.94
	Public transport	26.88	18.87	24.86	11.89	6.35	1.44	1.33	0.91	6.76
	Car passenger	22.58	13.21	18.92	13.99	16.27	18.87	14.40	9.09	16.36
	Number of tours	186	265	185	143	6177	975	375	220	8526
METROS	Slow modes={walk, bicycle}	28.14	27.45	8.94	18.06	34.96	28.68	21.50	16.55	33.21
	Electric bike	2.71	1.57	2.16	2.78	0.70	2.01	3.22	6.90	0.99
	Motorbike driver	17.06	14.90	65.30	55.56	50.60	62.30	70.24	73.10	51.99
	Motorbike passenger	34.46	21.18	11.26	11.11	10.05	5.95	4.10	4.14	9.88
	Car driver	0.68	0.20	1.46	0.00	0.14	0.25	0.41	0.00	0.19
	Car passenger	0.56	0.39	0.15	1.39	0.10	0.11	0.06	0.00	0.11
	Public transport (taxi, bus, motorbike taxi)	16.16	34.12	10.41	11.11	3.34	0.58	0.41	0.69	3.51
	Others	0.23	0.20	0.31	0.00	0.11	0.12	0.06	0.69	0.12
	Total number of tours	885	510	1297	72	54595	7222	1707	145	66436

Table 4 shows statistics of activity and trip duration based on activity type. Regarding activity duration, work/education activities show comparatively smaller variations than other activities in both datasets. This again supports earlier discussion on the distinctive temporal patterns of these activities. Comparing to OVG3, individuals in METROS tend to spend longer duration on work/education activities and shorter duration on leisure ones. This suggests the difference in time use patterns of the people in two areas and confirms the necessary adaptation on activity scheduling priority assumption of FEATHERS. The duration variation of each activity in two datasets is quite similar hence the duration choice sub-model of FEATHERS is possible to capture this behaviour of METROS.

The ratio between trip and activity duration are not much different for each activity type between two datasets at an aggregate level. This infers the similar preferences of individuals in HCMC and Flanders in the choices of activity location regarding activity duration. However, this similarity does not confirm the transferability of location

choice sub-model because the travel time variances of most activity types are higher in OVG3 than in METROS. Individuals in OVG3 might have more spatially dispersed opportunities for those activity purposes. Taking the "Walk, tour, run" in OVG3 and "Joy riding" in METROS as an example, individuals in HCMC mainly perform this activity within their neighborhood in comparatively short duration compared to Flanders where people travel to specific places for hiking or touring. More details on location choice behaviour will be discussed in the next section.

In summary, this descriptive analysis of the day-long activity schedule pattern has identified that there are groups of observed patterns in METROS can be reproduced by FEATHERS simulation structure. The overall daily activity patterns are found largely similar in both datasets. However, there are several aspects that need to be changed in FEATHERS when transferring to HCMC, include: revising the assumptions on scheduling priority for non-work/education activities; adding new sub-model for modelling work-based tour and behaviour of less than 18 year-old-individuals; re-calibrating all sub-models due to different definitions of most social demographic attributes in two datasets.

Table 4: Frequency of activity type (in percentage) and activity & trip duration (in minute)

		Frequency	Average activity duration	StdDev of activity duration	Average of trip duration	StdDev of trip duration	Trip-activity duration ratio
OVG3	Work	14.87	379.24	198.67	23.96	22.84	0.06
	Business trip	5.90	115.69	157.93	24.19	82.82	0.21
	Shopping	21.22	43.65	78.71	14.02	23.09	0.32
	Education	6.93	315.89	165.14	19.52	20.07	0.06
	Visit someone + Recreation, sport, culture	24.37	148.21	126.28	17.08	46.99	0.12
	Services (physician, bank)	5.66	51.67	76.16	13.29	13.27	0.26
	Walk, tour, run	3.90	147.96	177.12	56.64	88.36	0.38
	Bring/get	11.91	32.17	92.79	13.62	13.76	0.42
	Other	5.24	176.19	185.28	14.98	57.01	0.09
METROS	To Work	25.90	444.26	189.96	19.33	12.79	0.04
	Company business	0.81	130.84	162.26	20.01	13.21	0.15
	Shopping/Market	20.41	52.42	60.09	13.28	9.48	0.25
	To School	13.51	330.22	160.04	17.83	12.61	0.05
	Social/recreation/religious	5.15	92.56	71.37	15.67	10.78	0.17
	Private matters (e.g. bank)	4.53	77.82	75.99	14.73	10.47	0.19
	Joy riding	4.12	53.43	50.29	12.15	9.23	0.23
	Pick-up/Send Off	4.48	52.23	121.99	13.93	9.06	0.27
	Others	6.66	95.19	113.67	16.60	14.84	0.17
	To eat (not home)	14.43	56.89	62.54	11.08	7.88	0.19

3.3. Analyzing individuals' action space

The performance of the location choice sub-model in ABM depends on the resolution of land use data and the spatial-temporal effects on activity-travel behavior which can be measured by the space–time accessibility of individuals. The travel survey data in HCMC and Flanders only provided spatial information in sub-zone level with an approximate area of 6km^2 for both regions. This spatial resolution might absorb intra-zonal activities and trips in the compact land use sub-zones. Since the two study areas differ largely in land use patterns as mentioned in the previous section, it is important to have insights on how this resolution shapes individual's space–time accessibility when investigating the transferability of the location choice sub-model. Action space (AS) concept found in literature as a theoretically sound approach to measure space–time accessibility because of the incorporation of constraints, time dimension and the option to use the fixed point locations of fixed activities (home/work) [15]. This study derived the definition by Newsome [16] where AS is an observed potential space that accommodates all potential activity locations that an individual can access within specific time duration (Fig. 2). In [17], Dijst used three forms of AS including lines (travel between two bases – no additional stops), circles (only one base) and ellipses (other cases). This study proposes an additional "point" AS form to capture the action spaces where the bases and intermediate stops are in the same sub-zone. The elliptic action space is constructed using Newsome's method [16] which based on the distance of two fixed activity locations (bases) such as home location and work location and the furthest activity in the trip chain (Fig. 2). It is difficult to compare the size of potential activity locations between study areas because of the different land use in the two datasets. Table 5 presents some

characteristics of AS such as form, number of out of home activities in an AS, AS size (area or length), and duration of all stops in trip chains, total trip chain duration. One can see that individuals in METROS are more spatially - temporally restricted than OVG3 in terms of AS sizes which are much larger in OVG3 but the ratios between stop duration and total duration are not much different. This large discrepancy is partly explained by limited area and mobility of HCMC compared to Flanders and the different location choice preferences of individuals in the two areas. In METROS, the frequency of the point AS form is comparatively high for both worker and non-worker groups. For that reason, the spatial patterns of activity-travel behaviors in HCMC might be not fully captured with the areal size of the traffic analysis zone.

Table 5: Action space characteristics by work status

		Worker				Non- worker			
	Action space form	circle	ellipse	line	point	circle	ellipse	line	point
OVG3	Avg. nr. of activities in AS	1.36	1.62	0.00	1.11	1.35	1.04	0.00	1.10
	Avg. area (km^2) or length of line (km)	2619.77	2276.02	16.40	0.00	3161.36	980.22	7.96	0.00
	Avg. duration of stops (minute)	112.46	93.10	0.00	63.29	132.52	85.46	0.00	69.32
	Avg. of total duration (minute)	151.98	142.38	21.51	74.04	177.19	128.31	14.08	81.02
	Stop duration and total duration ratio	0.74	0.65	0.00	0.85	0.75	0.67	0.00	0.86
	Frequency of AS form	28.53%	10.00%	53.45%	8.02%	70.81%	0.92%	6.67%	21.60%
METROS	Avg. nr. of activities in AS	1.13	1.08	0.00	1.06	1.18	1.00	0.00	1.12
	Avg. area (km^2) or length of line (km)	90.13	276.87	3.31	0.00	72.25	69.45	2.77	0.00
	Avg. duration of stops (minute)	97.00	61.67	0.00	60.30	94.41	110.88	0.00	57.18
	Avg. of total duration (minute)	136.61	97.42	19.85	81.33	132.96	134.38	17.72	80.32
	Stop duration and total duration ratio	0.71	0.63	0.00	0.74	0.71	0.83	0.00	0.71
	Frequency of AS form	11.59%	4.77%	64.36%	19.28%	31.50%	0.05%	0.73%	67.72%

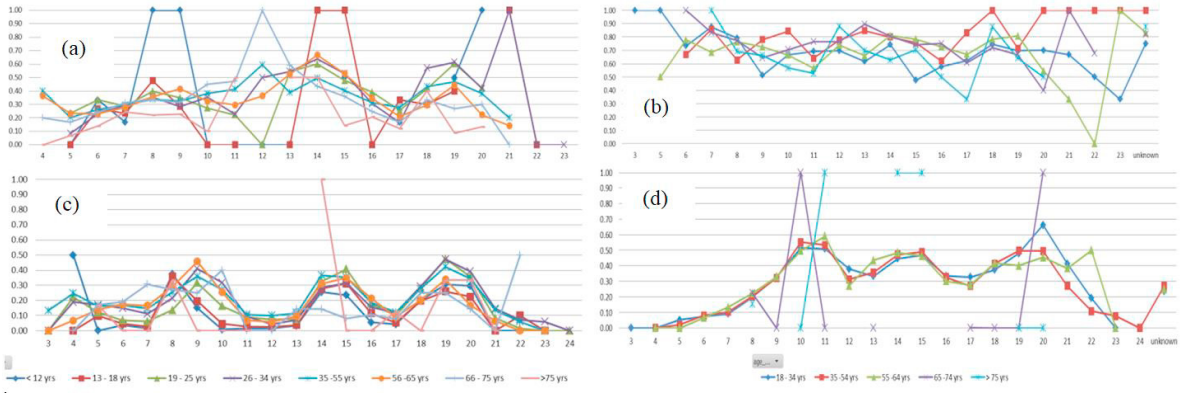

Fig. 3: Axle ratio with AS start time and age group: a) METROS non-worker; b) OVG3 non-worker; c) METROS worker; d) OVG3 worker

Another indicator discussed in this study is the axle ratio. The value for this parameter is assigned zero (0) for point and line forms, one (1) for a circle and the ratio between the minor axle and major axle for elliptic action space (Fig. 2). Values closer to 1 signify that the activity location is performed away from the bases. Fig. 3 illustrates the spatial – temporal constraints in terms of the axle ratio variation with the starting time of each AS for worker and non-worker in different age groups. In general, there is a time-dependent pattern of workers in both samples. In the time period from 11 AM to 1 PM and 4 PM to 5 PM in METROS, most workers did not start any activity or performed a work based sub tour with the primary activity closed to workplace. In OVG3, from 12 AM to 1 PM and 4 PM to 5 PM are also the low axle ratio value periods but most people travelled to the locations in different sub-zones other than the base. Individuals in METROS choose out of home activity location more bounded to home or work locations. Due to the differences in location choice preferences and land use attribute data, the location choice sub-models in FEATHERS might not be transferable to HCMC. To this point, this analysis found that the geographic resolution is sensitive to the analysis of location choice behavior and the action space concept can provide descriptive statistics to examine the extent of transferring location choice model between the regions.

4. Conclusion and future researches

This work investigated the (dis-)similarities of activity and travel behavior of Flanders and HCMC in the direction of exploring the extent to transfer FEATHERS to HCMC using the one-day travel survey data. The first task is to assess data inventories in addition to the travel data based on data requirements of the based model. The next task is to analyze temporal and spatial activity schedule patterns to identify the differences in spatial, temporal or physical constrains which are important in evaluating the transferability of the base model. Comparing to earlier experiences transferring, HCMC is lacking of good quality data. The activity schedule pattern, however, in METROS is less complex and among the most observed patterns found in OVG3 which can, therefore, be represented in the scheduling structure framework in FEATHERS without strategical changes. This analysis also confirms that the location choice model and transport mode choice are the least transferable models. The future works focus on implementing work-based sub-tour model which mainly composes single travel purposes and depends on workplace land use pattern. Personal and household attributes differently impact activity and travel behavior in both datasets hence all sub-models in FEATHERS have to be recalibrated with HCMC data. Transport mode choice sub-model will be rebuilt with new choice set and specific attributes for motorbikes. Based on existing land use data, the location choice model for HCMC will be constructed in different contexts which are conditional on activity type, individuals' mobility, accessibility and time availability at the tour and stop modeling levels.

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