Whereabouts from Monday to Sunday?

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1 Introduction

Accessibility is an overarching concept dependent on geography, topography, transport infrastructure and services together with human abilities and needs. This makes benchmarking of accessible transport difficult, since it needs multiple indicators, while policy makers need easy-to-handle metrics.
In general, questions such as:

- how far and how long people travel per trip and per day, and which modes are used for travel;
- which destinations are chosen for particular out-of-home activities and what determines the choice;
- how spread the activities conducted during a day or a week are, and what are the factors influencing this; and
- is zonal accessibility offering enough opportunities for various population groups?

need to be addressed in order to assess how transport services satisfy accessibility.

Traditionally, calculation of simple aggregate indicators of travel accessibility and associated mobility to satisfy accessibility has been applied in transport planning, but complex spatial and temporal ties mark each individual's mobility patterns, thus their accessibility needs, their activity scheduling, and their values of time require a more detailed approach.

The concept of activity spaces may simultaneously answer some of the questions above because it accounts for the interaction between individuals/households and the natural and built environment. The activity space is defined as the part of the environment where individuals or households perform activities within a certain period of time. It comprises the visited locations, routes, and areas the people travelled through. Activity spaces are developed around home, workplace, and other places frequently visited.

Activity spaces may show whether there are similarities in access needs and mobility options and preferences between population groupings. Individual characteristics such as gender, age, possession of drivers licence, and employment affect the daily routine and travel patterns. Females may take less time for travel and have their activity space around home because of their family commitments; young children and senior people are expected to travel less than the working-age group; individuals possessing driver licenses have more flexibility and higher access than people who cannot use car travel; and equally, cultural background can lead to specific access needs and can limit mobility options. At the household level, lifecycle stages affect both travel needs and options. For example, presence of children means increased household responsibilities and in order to juggle their activities households may need to travel more and further from home; elderly people face mobility constraints and their activity space is strongly tied to home.

At the same time, by examining the temporal aspect of activity spaces, we may identify whether travel-activity patterns on individual weekdays and weekends differ, and if households trade off time and location attributes when they schedule their activities. These three dimensions – spatial, behavioural, and temporal - are particularly relevant for the success of transport policies, which are dependent on the description and measurements of travel behaviour in relation to the accessibility of transport and urban services. The activity spaces concept can account for the spatial and temporal richness of individuals/households mobility correlated with accessibility (Handy and Niemeier 1997, Kwan 1998, Weber 2003).

2 Activity spaces: Concepts and definitions

2.1 Activity based perspective

Links between travel behaviour, socio-economic characteristics, land-use, and the environment have been extensively debated in transport and geography in the last few decades, with a general acceptance that travel demand is derived from the need and desire for activity participation (e.g., Mackett 1994, Crane and Crepeau 1998, Handy 1996, Lu and Pas 1999, Srinivasan and Ferreira 2002). To enhance understanding on the behavioural issues of travel, a substantial amount of research has addressed travel-space-environment and accessibility from an activity-based perspective.

Accessibility has evolved over time, and sets of measures of varied form and content, have been introduced (Harris 2001), from location accessibility towards an individual-based indicator (Ashiru, Polak, and Noland 2003, Dong, Ben-Akiva, Bowman, and Walker 2004). Recently, the action/activity space concept has been developed as a tool for analysing urban travel (Newsome, Walcott, and Smith 1998) or for addressing social exclusion issues (Schöenfelder and Axhausen 2003). The activity space is based on a broad determination of space-time behaviour, being an approximate measure of the size of the individual's mental map (locations and opportunities known to him/her (Downs and Stea 1977, Dijst 1999) correlated with the costs of accessing different opportunities. The activity space describes the individual perception, experience, and actual usage of urban environment, being the so-called *repertoire* of daily activities (Golledge and Stimson 1997, Gärling 1998, Schöenfelder 2001, Schöenfelder and Axhausen 2003).

The configuration and size of the activity space reflects three processes influencing accessibilities: household scheduling of daily routines within time and monetary budgets, the characteristics of the transport system, and the time-space organisation of accessed services - Church, Frost, and Sullivan (2001), Harvey and Taylor (2000). The latter two elements represent the urban form, features of the environment and quality of transport services, while the first reflects the socio-demographic characteristics of the individuals or households and their activity routines.

2.2 Activity space measures

Several measures may be used for activity space. Although each of them stress different elements of travel behaviour and have their assumptions, the activity space illustrates the feasibility of carrying out the desired activities by evaluating the spatial spread of activities, both on environmental criteria and socio-economic criteria.

2.2.1 Confidence ellipse

The area of the ellipse, *A*, can be calculated by the covariance matrix of all ordered activity locations of an individual/household (Schöenfelder and Axhausen, 2003)

$$A = 6\pi\sqrt{|S|}\text{, where } S = \begin{pmatrix} S_{xx} & S_{xy} \\ S_{yx} & S_{yy} \end{pmatrix} \quad (1)$$

$$S_{xx} = \frac{1}{n-2}\sum_{i=1}^{n}(x_i - \bar{x})^2 \qquad S_{yy} = \frac{1}{n-2}\sum_{i=1}^{n}(y_i - \bar{y})^2 \quad (2)$$

$$\text{and } S_{xy} = S_{yx} = \frac{1}{n-2}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) \quad (3)$$

The coordinates of the activity locations are weighted by the frequency of visits, deriving the centre of gravity (cg) of activities, which is the centre of the ellipse. Alternatively, home as centre of gravity, or other 'pegs' of daily activity, (Cullen and Godson 1975), may be also considered.

2.2.2 Kernel density

Comparison the density surface of various activities for individuals and household is also used for identifying locations and activities with high frequencies. To generate the density surface from a point distribution of *n* activity locations, the kernel estimation method may be applied, with a quartic kernel function (ArcMap-GIS) as described by Kwan (2000):192. The activity space measured by kernel densities is more restrictive in its spatial assumptions, including locations visited with a certain non-zero likelihood (Schöenfelder 2001).

2.2.3 Shortest path band

Another possibility to measure the activity space is to identify the network part used by individuals and a band adjacent to the road (Schöenfelder and Axhausen 2003). This measure assumes that what shapes the perception of space is the transport network used by the individual. Standardised shortest paths are determined on a modified system of coordinates, with home location in the origin, and home-work axis the positive x-axis. The vertical plane is the home-work plane.

2.2.4 Polygon of activities

Schöenfelder and Axhausen (2003) highlighted that the area of the polygon of visited locations should be a more accurate measure of the activity space than the confidence ellipse. As the confidence ellipse depends very much on the centre and the "edges" (most remote activities from the centre), it may overestimate the area of urban space. However, the ellipse can be weighted by frequency or duration of activities, leaving the outliers outside its area. In this work we adopt the definition presented by Schöenfelder and Axhausen (2003), which is different from the potential action space described by van Eck, Burghouwt, and Dijst (2005).

3 Case Study

3.1 Case location and data

A case study applied activity space measures to Sydney travel. A pooled data set from the years 1997 to 2002 of a rolling survey of household travel (HTS) in the greater Sydney urban area, by the NSW Transport and Population Data Centre, provided information about travel activities, together with individual and household characteristics, on surveyed "travel days," across the week and across the year.

The dispersion of the activities, as well as the standard distance (square root of the distance between each activity location and their centre of gravity) were determined. Both work and non-work, mandatory and discretionary activities are included in the measure. The size of an activity space illustrates the degree of accessibility enjoyed by an individual/household, accounting for the importance of different locations in the scheduled activities and for the available transport supply. For confidentiality reasons, the size of the activity space was estimated analytically, as confidence ellipse representing the part of the urban area visited by an individual or household on a certain day of the week, without any mapping. Therefore, the shape of the ellipse (ratio of the two axes) could not be used for comparison between individuals on different days of the week (Dijst 1999).

3.2 Modelling approach

3.2.1 Factors influencing activity spaces

By definition, the activity space embeds home and work as the main 'pegs' of daily schedule (Cullen and Godson 1975), and all other activities that the individual or the household is visiting within a day. This means that the activity space depends on travel times/speeds by transport modes, the characteristics of the built environment (location of various urban services), and the intrinsic structure of the decision making unit for scheduling.

Hence we might expect to identify gender, age, employment, car use, mobility restrictions or household size, status, and life cycle as determinants of travel patterns and use of urban space. At the individual level, women may have reduced activity spaces, as a result of their *"multiple roles and primary responsibilities for child care and domestic work, more constrained opportunities in paid employment, and a much greater likelihood of being engaged in part time and/or casual employment, usually local"* - Hine and Grieco (2003).
Older, retired people, may have smaller activity spaces than working age people. When income is higher, the duration and frequency of certain activities (recreation, shopping) increases (Lee and McNally 2003), with the higher purchase power facilitating more intensive participation and spatial freedom.

At the household level, presence of children implies more activities than in houses without children, as well as caring for others and voluntary activities may increase the activity space. Single-parent families tend to have their travel closer to home, similarly (but for different reasons) households without car - due to their limited access. Households with high income, located in the outer suburbs may be likely to have larger activity spaces than households in the city.

With respect to time, activity spaces are expected to vary due to the space-time negotiation within households and scheduling of activities during a week – Doherty and Miller (2000). On workdays, maintenance activities such as domestic chores and shopping, and recreational activities are generally scheduled in shorter time windows because of the work activities. There are also temporal constraints due to institutional hours' regime that need to be coupled with the individual's work/education and with the joint participation within household. Activity scheduling by individuals and households is a multi-day (weekly) problem solving process, arisen from the need to deal with experienced shortages of time (Axhausen and Gärling 1992). Some days, out-of-home activities are substituted for in-home activities, some days have higher TV and IT usages, and shopping and children's activities are usually scheduled on specific days.

Finally, there are numerous trade-offs occurring within household: when one person spends more time travelling, shopping, others may spend more time taking care of the household obligations – drop-off, pick-up. Unfortunately, this web of interactions and constraints at the household level has not received extensive attention in transport planning and accessibility research. By applying the activity space concept at the household level, there is some hope to overcome a common limitation of disregarding co-ordination and synchronisation space-time among family members (Zhang, Timmermans, and Borgers 2005).

3.2.2 Structure of the model

A general linear model was used to test a series of hypotheses rooted in the literature or formulated by the authors. These considered how activity spaces and travel time and distance were affected by urban services distribution, transport system, and socio-economic characteristics of individuals and households. At the individual level, the socio-economic factors used in the model were: gender, language barrier, possession of drivers licence, stated restrictions in mobility, and employment status, with age and personal income as

covariates. At the household level, the model included the type of household (life cycle stage), type of dwelling (house versus apartment), and household income as covariate.

Both household and individual models accounted for travel time expenditure and number of trips, considered as measures of social involvement. Transport accessibility and location have also been included, assuming that less accessible and far from the city locations may grow the activity space. The structure of the model is presented in Figure 1: and an example of confidence ellipse is provided in Figure 2:

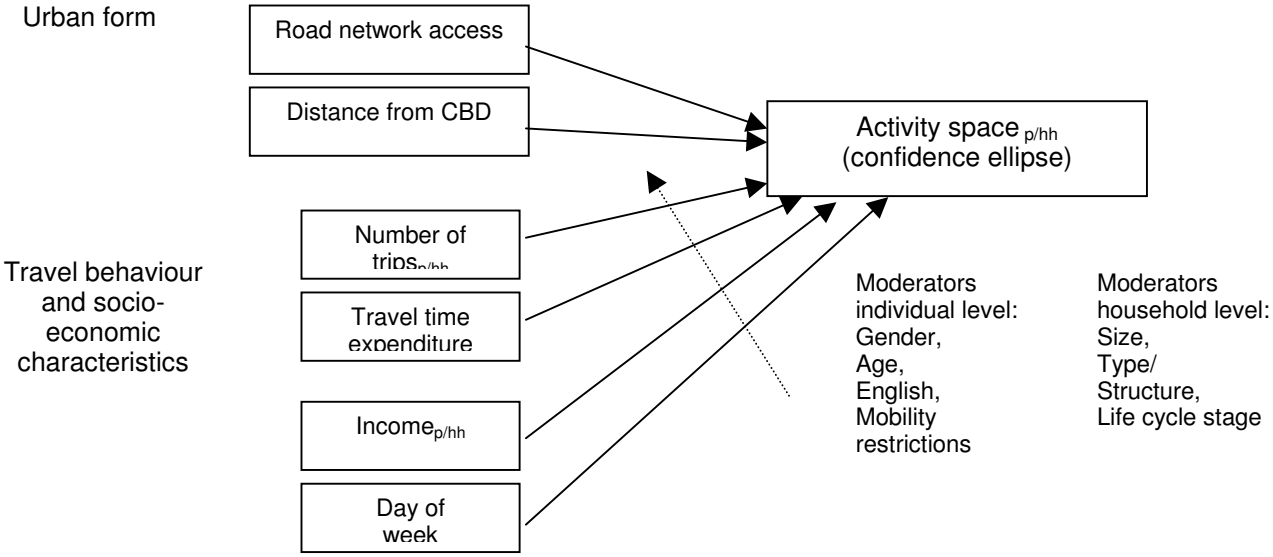

Figure 1: Structure of the model at individual level (p) and household level (hh)

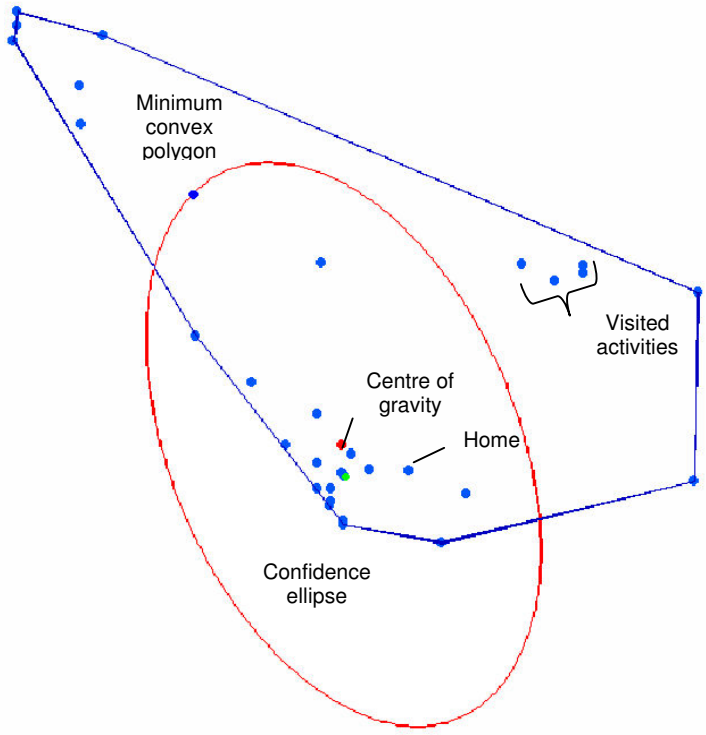

Figure 2: Example of activity spaces measured as confidence ellipses

4 Findings

4.1 Individual activity space

Table 1: presents averages for activity space differentiated by gender, English speaking background, and drivers licence (restricted mobility). A more detailed presentation of travel time expenditure and activity space by day of the week is given in **Error! Reference source not found.** Note these results are based on data from individuals with completed survey responses rather than all members of all households.

After controlling for travel time expenditure, distance traveled, home location, and road transport access (Appendix – Tables 3 and 4), explanatory variables such as gender and language fade in their importance. The parameter estimates have in general the expected signs (non-English speaking individuals may have smaller activity spaces, drivers are expected to use extensively the urban space, traveling further and for a longer time may increase the activity space), although in statistical terms they are not significant.
The findings strongly suggest that location in the urban area and car options (driver licence) are significantly determining the resulting ellipses and they should be thoroughly considered in the planning process.

The analysis results show:

Gender: Men have larger weekday activity spaces than women. Women travel closer to home, and have shorter trips. The smaller activity space may also be linked to the lack of availability of transport services, to enable them to take opportunities beyond the local area. The disparities are less prominent during weekends.

Primary Language: Persons with a primary language other than English have reduced activity spaces. Their schedule is bound to house and children. During weekends, however, the common scheduling enables their families to access further facilities, and the language differences diminish.

Drivers licence: There is a strong positive relation between activity space and driver licence holding (Lu and Pas 1999). The activity space for drivers is almost twice as big as for captives of public or non-motorised transport. The relation holds for the weekends as well.

Working at home: Activity spaces seem smaller. As workers range from “out workers” to “true telecommuters” this cannot address the issue of whether telecommuting is encouraging relocation further away from work (Ory and Mokhtarian 2005).

Age (covariate): As a continuous variable, age influences the activity space to a lesser extent. When used as a discrete factor, we noticed sharper differences amongst various age groups. People over 60 use cars less than the other age groups, but walk or catch public transport more. Their activity spaces are around their houses. People younger than 20 years display similar activity spaces and mobility characteristics.

Income: A hypothesized positive relationship between activity spaces and income was not confirmed for weekday mobility.

Time: Activity spaces increase before weekends – beginning on Thursday with extended shopping hours (see **Error! Reference source not found.**). This is consistent with the individual/household routine and is related to the operation of urban facilities. Similarly, the busiest times for restaurants and pubs (which are Friday nights and weekends) and closure on Mondays of urban services/facilities are reflected in the activity spaces.

Travel time expenditure & number of trips: The greater the need and desire for travel, and the more dispersed the activities, the larger the activity space becomes.

Access: Urban form dictates the activity space in some of the following ways: when urban amenities are readily accessible, individuals do not have to travel far away for various opportunities; if their neighbourhood provides them with good shopping, recreational services, most non-work, out-of-home activities, may be found around home. However, widely spread activities may indicate a rather good transport access that enables the individuals to accrue greater benefits within the time budget.

Location: Persons and households living in the outer suburbs of lower population density have lower "centrality" and they travel further to access employment and other services.

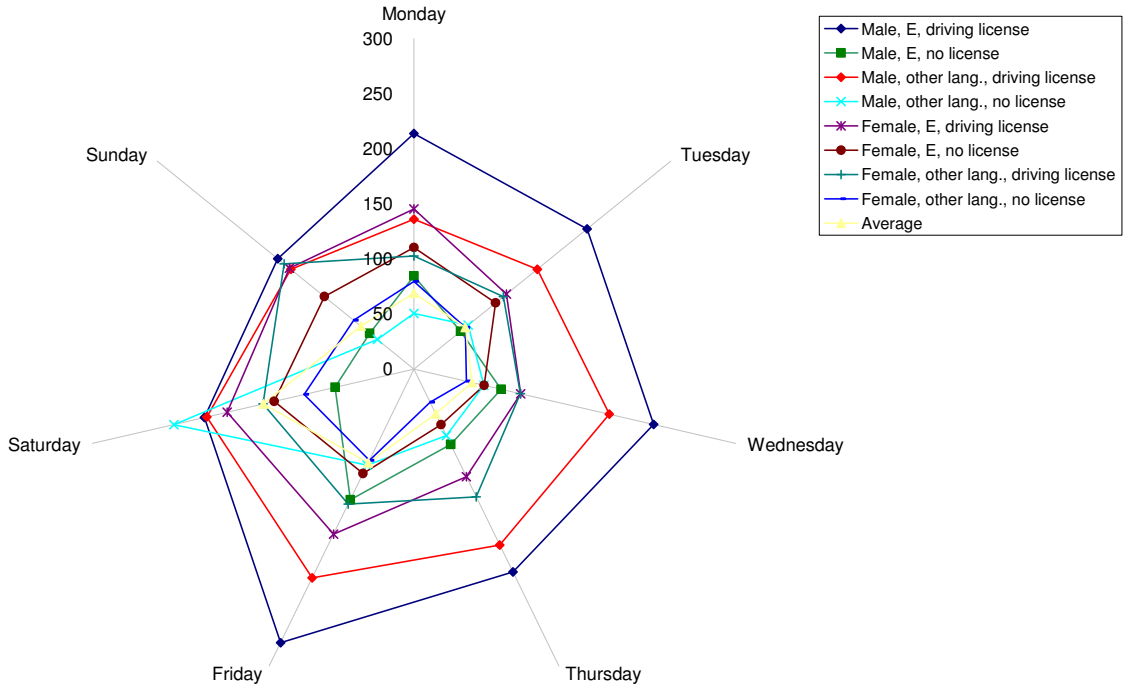

Figure 3: Activity spaces for individuals (km^2) Monday – Sunday

4.2 Household activity space

The household is the appropriate unit for activity space analysis, as at this level the activity-travel decisions are made. Household structure and roles are correlated with the activity spaces (which include the most attractive destinations that all household members can reach given the travel time). The activity space for households can be seen as the envelope of the activity spaces for all its members. Table 2: presents results at household level. Parameter estimates and goodness-of-fit statistics of the model are presented in Appendix

The *a priori* beliefs that structure and size of family, income, and urban characteristics influence the activity space, were empirically supported. Parameter estimates of the general linear model are provided in Tables 5 and 6 of Appendix.

Life Cycle Stage: Single person households have the smallest activity spaces, followed by the "other" category. The reason for this is that they cannot cover a geographical area as large as households with numerous members within the confined 24 h-day, and they do not have anybody else to negotiate time and space with. Couples without children usually have a high car-use that enables them to combine their paid work with leisure and other activities. Since they can have diverse destinations their activity spaces are double than those for single person households, except Sundays. Families with children use significant urban space due to their high number of trips. Because of the interaction between family members and trip chaining (one member of the family may travel less by having somebody else travelling more, linked to the existing scheduled trips), their weekend activity space is not as high as that for sole parents.

Table 1: Activity space for individuals

Day	Activity space for individuals (km^2)												
Monday	Gender	Male				Female				Avg. Monday				
	Language	English		Other		English		Other		English		Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	214	85	136	50	145	110	103	80	180	101	120	69	**137**
	St. dev.	719	264	579	125	514	708	344	411	626	593	483	337	540
	N	933	102	1,215	159	929	193	1,089	281	1,862	295	2,304	440	4,901
Tuesday	Gender	Male				Female				Avg. Tuesday				
	Language	English		Other		English		Other			English	Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	202	55	144	63	108	96	104	60	156	90	125	60	**133**
	St. dev.	609	96	459	157	409	623	334	430	522	823	405	534	497
	N	942	106	1,228	135	915	192	1,106	313	1,857	298	2,334	448	4,937
Wednesday	Gender	Male				Female				Avg. Wednesday				
	Language	English		Other		English		Other			English	Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	224	81	182	65	99	65	99	49	165	70	142	54	**139**
	St. dev.	878	258	916	154	266	340	484	151	666	318	742	152	663
	N	1,018	84	1,245	145	913	206	1,144	290	1,931	290	2,389	435	5,045
Thursday	Gender	Male				Female				Avg. Thursday				
	Language	English		Other		English		Other			English	Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	205	76	178	67	109	56	129	33	157	63	154	45	**140**
	St. dev.	654	202	564	238	350	129	573	101	528	159	569	164	513
	N	943	96	1,180	169	926	171	1,116	310	1,869	267	2,296	479	4,911
Friday	Gender	Male				Female				Avg. Friday				
	Language	English		Other		English		Other			English	Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	276	132	211	97	167	106	137	92	223	112	176	95	**178**
	St. dev.	971	433	674	593	627	276	532	211	825	336	613	373	676
	N	978	101	1,230	136	916	213	1,090	303	1,894	314	2,320	439	4,967
Saturday	Gender	Male				Female				Avg. Saturday				
	Language	English		Other		English		Other		English		Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	195	73	193	124	174	130	141	103	185	111	168	140	**169**
	St. dev.	550	286	608	834	727	802	480	468	642	669	551	839	625
	N	934	100	1,121	128	881	188	1,033	283	1,815	288	2,154	411	4,668
Sunday	Gender	Male				Female				Avg. Sunday				
	Language	English		Other		English		Other		English		Other		Total
	Driving license	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
	Mean	159	52	144	43	146	105	152	70	152	87	148	62	**138**
	St. dev.	651	153	650	149	676	484	855	380	663	405	756	326	673
	N	907	90	1,082	132	883	181	1,012	295	1,790	271	2,094	427	4,582

Table 2: Activity space for households

Day	Activity space for households (km^2)										
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Monday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Monday	Mean	114	83	231	87	237	70	175	197	168	112	**190**
	St. dev.	437	434	785	180	545	129	509	549	345	293	554
	N	264	143	550	91	948	59	195	40	255	85	2,645
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Tuesday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Tuesday	Mean	133	71	202	63	231	77	134	68	195	116	**179**
	St. dev.	481	251	464	98	589	122	393	98	622	231	501
	N	314	156	531	103	940	62	176	31	259	77	2,659
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Wednesday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Wednesday	Mean	71	105	229	194	227	164	178	49	173	99	**187**
	St. dev.	208	446	685	843	528	370	426	97	264	197	516
	N	266	146	573	85	958	67	181	36	256	77	2,657
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Thursday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Thursday	Mean	177	64	191	100	257	59	161	41	181	64	**191**
	St. dev.	669	161	602	165	558	95	387	55	321	79	513
	N	276	164	525	83	940	66	171	41	237	80	2,596
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Friday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Friday	Mean	121	51	276	127	278	63	315	70	284	104	**232**
	St. dev.	500	133	955	312	564	98	1,026	85	802	209	691
	N	285	172	530	83	924	60	172	24	258	91	2,616
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Saturday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Saturday	Mean	131	121	302	172	364	133	420	236	322	112	**297**
	St. dev.	419	611	1082	410	1029	249	932	633	991	290	921
	N	229	158	503	79	916	68	224	85	170	34	2,479
	Type	alone		couple		couple with children		sole parent with children		other		Avg. Sunday
	Dwelling	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	house	apmnt.	
Sunday	Mean	106	166	164	72	320	92	360	110	195	256	**233**
	St. dev.	407	796	603	223	1,323	249	1056	169	683	1,401	982
	N	272	137	469	88	947	54	239	88	159	44	2,509

Dwelling Type: When comparing the activity spaces by structure of dwelling, the household income and size play a critical role. Families living in houses are generally larger (in average one more family member) and they earn about 10,000 AUD more per year than the other households. These factors have implications in mobility needs (more travel for bigger families, further, and extended activity space).

Time: The study of activity spaces over time reveals important regularities and irregularities in activity and travel patterns that may be used to formulate projections for planning. Activity spaces are smaller during weekdays, compared to weekends, with peak on Thursdays – Saturdays, as it is presented in **Error! Reference source not found.**).

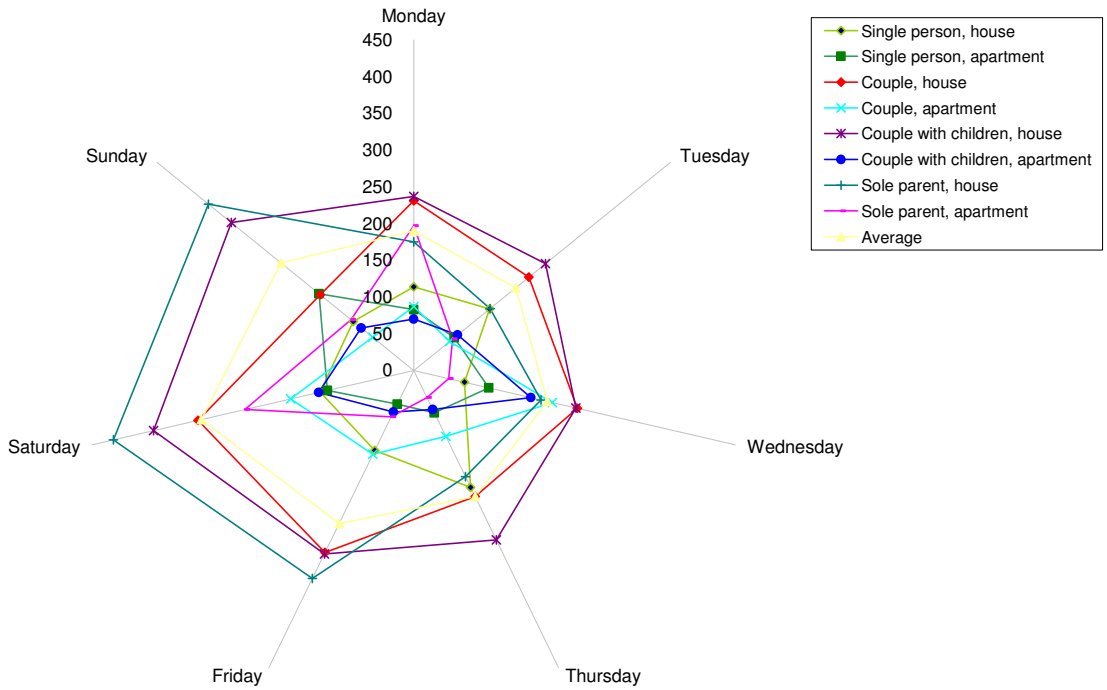

Figure 4: Activity spaces for households (km^2) Monday - Sunday

Income: Although at first glance more money means possibility to spend more time out-of-home, household income is only marginally significant.

License numbers: Number of licenses (and car availability) affects the activity participation across days of the week.

Full-time employees may be engaged in more out-of-home activities and have larger activity spaces.

The strength of the link between travel behaviour and activity space is moderate. In contrast location is a significant predictor of the size of confidence ellipses. When home location (relative to transport services) is more remote, the individuals are less likely to fully participate in society.

5 Implications for analysts and researchers

5.1 Case study outcomes

This study has shown that useful insights can be found by investigating activity spaces across time and population groups at different stages of life cycle, with different ethnic backgrounds, and various statuses and mobility restrictions:

- Activity space in integrating time and space dimensions, represent one extra step in the accessibility-based planning;
- Activity-travel behaviour *does* vary over the week, so that a single day or even weekday-weekend analysis cannot adequately characterise the individuals and households' daily routines;
- Activity spaces are related to travel time expenditure, urban features, and socio-economic characteristics. Particularly, life cycle stages affect the extent to which household activities are spread around main pegs of daily activity; but
- The interactions between variables make interpretation less immediately obvious than comparing individual effects.

This suggests that activity spaces, determined as confidence ellipses, can, and should, be incorporated into transport planning, as they reflect the spatial ramifications of the activity-travel behaviour within temporal constraints.

5.2 Limitations and future research

This paper focuses on activities and spatial configuration and opportunities, and explores with a general linear model the relationships between daily travel, urban facilities, and activity spaces for individuals/households (as dependent variable). With a structural equations model, allowing feedback relationships and measurement of latent constructs (such as urban form), it would be possible to discern more consistencies in the activity spaces of different groups of population and get a clearer perspective of the intricate relationships space – time - human activities & environment. As they have different focuses, activity spaces measured in various ways would need to be combined and tested in a latent construct.

This study used traffic zone-based data (centroids) for distances and activity spaces due to privacy issues. Therefore, the information about activities within the traffic zone and the spatial relationship with other urban opportunities is lost (Kwan 2000). Activity spaces by purpose and mode may be a natural extension of the current formulation and trip chaining analysis may contribute to a more accurate description of the activity space, by accounting of the real sequence of the trips and their path/route.

Although time is an essential element in structuring individual and household family patterns, this study focuses only on the day-to-day variability, without regard to the within-day time-space negotiations. As Axhausen and Schoenfelder (2003) recommend, it would be beneficial that data sets be specifically constructed for this purpose. In the same way data sample size limitations mean that data must often be aggregated, as in our case study, across urban areas, thus differences in locational opportunities may affect results Better data is needed to address both temporal and spatial differences which may impact transport policy decisions.

6 Acknowledgements

We acknowledge the support provided by the Transport and Population Data Centre, DIPNR NSW by facilitating the access to the HTS data for this analysis.

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Appendix

Table 3: Parameter estimates individual level (weekdays)

Parameter	B	Std. Error	t	Sig.	95% CI		Noncent. Parameter	Observed Power(a)
					Lower Bound	Upper Bound		
Intercept	-151.17	22.92	-6.60	0.00	-196.09	-106.24	6.60	1.00
[DAY_NO=1] Monday	-16.17	11.19	-1.45	0.15	-38.10	5.77	1.45	0.30
[DAY_NO=2] Tuesday	-3.66	11.17	-0.33	0.74	-25.56	18.24	0.33	0.06
[DAY_NO=3] Wednesday	-9.81	11.08	-0.89	0.38	-31.53	11.97	0.89	0.14
[DAY_NO=4] Thursday	-10.45	11.16	-0.94	0.35	-32.33	11.43	0.94	0.16
[DAY_NO=5] Friday	0.00	.	.	.	.	.	.	.
[SEX=1] Male	-5.42	7.38	-0.74	0.46	-19.88	9.03	0.74	0.11
[SEX=2] Female	0.00	.	.	.	.	.	.	.
[LANGUAGE=English]	-3.72	7.12	-0.52	0.60	-17.67	10.24	0.52	0.08
[LANGUAGE=Other]	0.00	.	.	.	.	.	.	.
[WORK_ATHOME=Y]	13.77	15.31	0.90	0.37	-16.23	43.77	0.90	0.15
[WORK_ATHOME=N]	0.00	.	.	.	.	.	.	.
[HOLD_LICENCE=Y]	51.98	12.88	4.03	0.00	26.71	77.24	4.03	0.98
[HOLD_LICENCE=N]	0.00	.	.	.	.	.	.	.
AGE years	0.33	0.28	1.18	0.24	-0.22	0.87	1.18	0.22
INCOME	0.00	0.00	0.07	0.95	0.00	0.00	0.07	0.05
TRAVEL_TIME_EXPenditure.	0.54	0.08	7.13	0.00	0.39	0.82	7.13	1.00
ROAD_DIST*	8.85	0.13	67.76	0.00	8.59	9.10	67.76	1.00
DIST_TO_CBD*	2.95	0.31	9.52	0.00	2.36	3.56	9.52	1.00
DIST_ACCESS*	0.61	0.18	3.43	0.00	0.26	0.96	3.43	0.93
Computed using alpha = .05								

Table 4: Parameter estimates individual level (weekend days)

Parameter	B	Std. Error	t	Sig.	95% CI		Noncent. Parameter	Observed Power(a)
					Lower Bound	Upper Bound		
Intercept	67.78	25.94	2.61	0.01	16.93	118.64	2.61	0.74
[DAY_NO=6] Saturday	29.12	13.44	2.17	0.03	2.77	55.47	2.17	0.58
[DAY_NO=7] Sunday	0.00	.	.	.	.	.	.	.
[SEX=1] male	9.55	14.09	0.68	0.49	-18.07	37.17	0.68	0.10
[SEX=2] female	0.00	.	.	.	.	.	.	.
[HOLD_LICENCE=Y]	41.67	19.45	2.14	0.03	3.53	79.80	2.14	0.57
[HOLD_LICENCE=N]	0.00	.	.	.	.	.	.	.
AGE years	-1.03	0.40	-2.60	0.09	-1.81	-0.25	2.60	0.74
INCOME	0.00	0.00	2.48	0.01	0.00	0.00	2.48	0.70
DIST_TO_CBD*	1.61	0.20	8.08	0.00	1.22	1.99	8.08	1.00
Computed using alpha = .05								

* ROAD_DIST = is the distance on the road network travelled by the individual in a week day
DIST_TO_CBD = distance on the road shortest path between the home zone centroid and the CBD
DIST_ACCESS = location accessibility (average distance on the road network from the home TZ to all other TZ)

Table 5: Parameter estimates household level (weekdays)

Parameter	B	Std. Error	t	Sig.	95% CI		Noncent. Parameter	Observed Power(a)
					Lower Bound	Upper Bound		
Intercept	255.7	58.47	4.37	0.00	141.16	370.38	4.37	0.99
[DAY_NO=1] Monday	-22.67	12.23	-1.85	0.06	-46.64	1.30	1.85	0.46
[DAY_NO=2] Tuesday	-21.39	12.19	-1.75	0.08	-45.28	2.51	1.75	0.42
[DAY_NO=3] Wednesday	-19.88	12.20	-1.63	0.10	-43.78	4.03	1.63	0.37
[DAY_NO=4] Thursday	-20.73	12.26	-1.69	0.09	-44.76	3.30	1.69	0.39
[DAY_NO=5] Friday	0.00	.	.	.	.	.	.	.
[HH_CODE=alone]	-66.08	19.04	-3.47	0.00	-103.41	-28.75	3.47	0.93
[HH_CODE=couple]	-21.81	17.09	-1.28	0.22	-55.31	11.70	1.28	0.25
[HH_CODE= couple & children]	-35.06	16.55	-2.12	0.03	-67.50	-2.63	2.12	0.56
[HH_CODE=other]	3.16	18.20	0.17	0.86	-32.52	38.83	0.17	0.05
[HH_CODE=sole parent & children]	0.00	.	.	.	.	.	.	.
[STRUC=house & detached]	-9.78	11.76	-0.83	0.41	-32.80	13.30	0.83	0.14
[STRUC=apartment]	0.00	.	.	.	.	.	.	.
AGE_HH	-0.05	0.29	-0.19	0.85	-0.63	0.51	0.19	0.05
USUAL_VEHICLE_NUM	5.75	5.69	1.01	0.31	-5.41	16.90	1.01	0.17
HH_INCOME	0.00	0.00	1.68	0.10	0.00	0.00	1.67	0.39
LICENCE_NUM	30.04	6.54	4.59	0.00	17.22	42.86	4.59	1.00
TRAVEL_TIME_EXP.	0.29	0.05	6.41	0.00	0.20	0.38	6.41	1.00
HH_NUM_TRIPS	15.80	0.65	24.37	0.00	14.53	17.07	24.37	1.00
FT_WORKER_NUM	15.28	6.50	2.35	0.02	2.55	28.02	2.35	0.65
DIST_TO_CBD	0.04	0.12	0.33	0.74	-0.20	0.28	0.33	0.06
DIST_ACCESS	3.41	0.06	57.57	0.00	3.30	3.52	57.57	1.00

Computed using alpha = .05

Table 6: Parameter estimates household level (weekend days)

Parameter	B	Std. Error	t	Sig.	95% CI		Noncent. Parameter	Observed Power(a)
					Lower Bound	Upper Bound		
Intercept	13.67	193.40	0.071	0.94	-365.48	392.81	0.07	0.05
[DAY_NO=6] Saturday	35.13	25.59	1.37	0.17	-15.05	85.33	1.37	0.28
[DAY_NO=7] Sunday	0.00	.	.	.	.	.	.	.
[HH_CODE= alone]	1.90	61.58	0.03	0.98	-118.83	122.63	0.03	0.05
[HH_CODE= couple]	-70.34	50.97	-1.38	0.17	-170.27	29.58	1.38	0.28
[HH_CODE= couple & children	-67.68	42.21	-1.60	0.11	-150.43	15.07	1.60	0.36
[HH_CODE= other]	12.83	59.48	0.22	0.83	-103.78	129.45	0.22	0.06
[HH_CODE= sole parent & children]	0.00	.	.	.	.	.	.	.
[STRUC=house & detached]	-2.78	38.28	-0.07	0.94	-72.84	72.27	0.07	0.05
[STRUC=apartment]	0.00	.	.	.	.	.	.	.
AGE_HH	1.06	0.94	1.1	0.26	-0.78	2.91	1.13	0.21
RESIDENT_NUM	21.27	16.26	1.3	0.19	10.61	53.14	1.31	0.26
HH_INCOME	0.00	0.00	2.2	0.03	0.00	0.00	2.18	0.59
LICENCE_NUM	66.83	18.35	3.6	0.00	30.86	102.80	3.64	0.95
TRAVEL_TIME_EXP.	1.80	0.08	21.6	0.00	1.64	1.97	21.61	1.00
HH_NUM_TRIPS	10.90	2.10	5.2	0.00	6.79	15.03	5.20	1.00
DIST_TO_CBD	2.89	0.39	7.4	0.00	2.13	3.65	7.44	1.00

Computed using alpha = .05