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Exploring gender-based spatio-temporal patterns of informal street vending

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Gendered Spatio-Temporal Patterns of Informal Street Vendors: A Case Study in Fangshan District, Beijing, China

Abstract: Many studies have shown that, due largely to family and cultural influences, women prefer part-time and flexible employment, which aligns with the nature of informal street vending. However, unlike many other workers, female vendors must consider the temporary use of space and co-produce an ever-changing environment that interacts with a diverse range of people with heterogeneous demands, a phenomenon that has received little research attention. Using spatial-temporal behavior mapping and on-site observations at three street spaces in Fangshan District, we examined the spatio-temporal behavioral patterns of female vendors and explored gender differences in the types, modes, spatial meanings, and times of informal vending in the Chinese urban context. Our results indicate that when vending space is limited, male vendors tend to cluster; female vendors are more dispersed, and more likely to occupy spaces with unfavorable selling environments. When there are fewer female vendors on the site, female vendors sell closer to the inner side of the street, while male vendors occupy positions further away from the street. Most female vendors sell relatively lightweight and small goods with low profit margins. Male vendors tend to occupy fixed stalls and utilise heavy transport equipment, while female vendors are more likely to be flexible in location and use lightweight transport equipment. Moreover, female vendors are more likely than male vendors to operate during weekdays and in daylight hours than on the weekends and at night. Our study provides a scientific basis for creating an inclusive, vibrant, and healthy urban environment by considering the overlooked groups of informal female vendors and their temporary uses of space.

Keywords:

Informal street space; Gender differences; Street vending behavior; Spatio-temporal data; GIS

1. Introduction

Urban space is not neutral, but distinctly gendered (Massey, 2013). Female groups often adapt their employment and their behavioral activities to suit their use of space based on their own perceptions (Valentine, 1992). Female vendors in informal street markets are more likely to choose part-time, temporary, and flexible forms of informal employment, often due to family or cultural factors, and consistent with the temporary and dynamic nature of their work. This is significantly different from the nature of more formal types of employment. A female vendor working in an informal street market is making an adaptive dynamic choice.

Some research has revealed gender differences among vendors operating in informal street markets in terms of mobility behavior, selling behavior, and the temporal, spatial, and relational strategies they use to maintain access to public space (Adama, 2020; Mao, 2022; Ortese et al, 2016). However, these studies tend to focus on distinguishing types of vendors based on their behavioral strategies and context and their impact on public space and urban planning, while ignoring the impact of gender differences among vendors on informal street space. How female vendors adjust their spatio-temporal behavioral patterns of selling in dynamic informal street spaces, within the gendered constraints of family and culture, remains unclear. From the spatial perspective, it is important to conduct dynamic, real-time, micro-level research on the behavioral activities of male and female traders in urban informal spaces.

Our study was designed to fill this knowledge gap and to extend research on the gendered variability of behavioral patterns of vendors in informal street spaces. To understand the patterns and empirical foundations of female spatio-temporal behavior related to multiple forms of employment, we sought to answer the following research questions:

- considering the informal street vending profession as an adaptive dynamic choice, what are the spatial and temporal behavioral patterns of female vendor groups in street vending spaces?
- How do the types, methods, and timing aspects of vending used by women's groups operate in a complex, ad hoc and dynamic network?

In this paper, using spatio-temporal behavioral data from three street vendors in Fangshan District, Beijing, we describe our use of spatio-temporal behavioral mapping (STBM) to compare the spatio-temporal behavior of female and male street vendors in time as well as space. We make several valuable contributions. We explored informal street vendors' daily spatio-temporal behaviors from a micro point of view, producing novel data that can enrich the planning and management of informal spaces. In addition, our focus on gender differences in the vendor community enables a re-examination of urban space construction and policies from a gender perspective, can guide the creation of an equal and inclusive selling environment for female vendors, and provides a scientific basis for enhancing urban vitality through better street vendor.

2. Literature review

2.1 Informal street vending in urban spaces

In global contexts, informal street vending is widely recognized as one of the most prevalent forms of economic exchange (Peimani and Kamalipour, 2022). Vendor groups influence people's walking and purchasing behavior through the daily rhythms and spatial layout of their selling behavior, which in turn has an impact on urban spatial planning (Sun, 2021). In China,

informal street vendors have always represented a challenge for governance in urban spaces due to their "temporary" and "dynamic" characteristics, but they are also a common and largely accepted form of urban daily life. Previous research on informal street vendors has focused on spatial planning, urban governance and policymaking in relation to the general behavior of vendors (Mao, 2022; Ortese et al., 2016). Scholars have noted that some informal vendors sell poor-quality goods in unhygienic conditions (Huang et al., 2014), others that a lack of effective licensing and practice management pose distinct problems for urban spatial governance (Li et al., 2018), including street congestion and uncertainty (Xue and Huang, 2015).

Vendors' spatio-temporal behaviors are closely linked to the spatial planning of streets and urban governance, a relationship that has been ignored in previous investigations of this topic. Groups of dynamic street vendors usually gather spontaneously in urban commercial districts or neighborhoods to provide residents with convenient and affordable shopping choices, adopting various selling methods, product typologies, and selling times to form their own unique and flexible selling strategies (Sun et al., 2018). Groups of street vendors build group pluralism in urban society and present an increasingly complex urban social dynamic (Recchi, 2021). In recent years, local governments in China have introduced urban policies that encourage the emergence of temporary stalls and street vendors (Yang et al., 2018). In May 2023, the Chinese Central Civilization Office issued a policy excluding temporary roadside businesses, street markets, and itinerant vendors from the National Civilized Cities Assessment, which is intended to promote the development of civilized cities and urban spaces as part of a move to improve economic and social services within regulated urban contexts, signaling a positive governance perspective on informal street vending. As urban researchers within the

Chinese context, we argue that this culturally well-established and appreciated economic, urban spatial practice offers vital service provision within Chinese neighborhoods. We contend that it is important to explore and understand the spatial, temporal, and dynamic behaviors of urban street vendors in order to influence the planning and management of urban space to place greater value on the service vendors provide in Chinese contexts.

2.2 Gender differences and behavioral patterns

Gender-based research, one of the core products of social and cultural studies in Western contexts, often involves socio-spatial phenomena (Wang and Xu, 2021). The spatial distribution of urban policy, economic activities, and social relations in particular contexts often results in interactions between these factors that influence gender relations and space use (Massey, 2013). Thus, both in China and the West, in metropolises and smaller urban centers, women's spatial agency and experience will vary and is often distinctly different from men’s (Chai, 2003; Sun et al., 2019; Ta et al., 2019). Women are typically much more concerned than men about potential threats and personal safety (Zhou, 2014), and consequently limit their access to and daily use of urban public space (Wesely and Gaarder, 2004). Furthermore, women and men differ in their perceptions of the urban environment, particularly high-mobility spaces (Han et al., 2023). Women often consciously avoid traveling alone and reduce the amount of time spent in streets with low connectivity (De Koning, 2009). Many studies have focused on occupation of and behavior in high-mobility urban spaces and spatial safety, exploring gender differences in spatial access, length of stay, and subjective spatial experience (Kwan, 2013).

The extensive literature on gendered behavioral activities highlights that gender differences in

high mobility spaces and spatial security are substantial. However, much of the gender behavioral activity gap has long been attributed to the familial and socio-cultural constraints that women face in employment settings. As the socio-economic structure of Western countries has changed, women's participation in the labor market has generally increased (Hanson and Pratt, 1988), a structural change that has given rise to spatial and temporal constraints on women's employment in urban contexts. Esping-Andersen (2019) pointed out that in some countries, women's wider participation in the labor market has not diminished inequality.

Women's and men's labor supply and demand differ significantly, because women are more likely to experience job disruption and irregular employment trajectories throughout their working lives (Ferragina, 2019). For example, to balance family and work relationships, women are more likely than men to opt for informal forms of employment that are part-time, temporary, and highly flexible (Mao, 2019). This corresponds to the employment characteristics of street vendors in informal Chinese contexts. Many women must balance multiple daily activities such as work, household responsibilities, and childcare, and as a result are often more restricted in their spatio-temporal behaviors than men (Wang and Xu, 2021). In addition, women's daily travel tends to be centered around domestic needs. Women travel more frequently than men, but the distance, time, and speed of traveling are typically lower (Gu et al., 2012).

Gender differences in vendors' behaviors have subtle effects on urban spaces. In informal street spaces, female vendors' spatio-temporal behaviors are more limited than men's. A better understanding of the spatial and temporal behaviors of male and female vendors is needed to optimize policy planning for urban informal streets.

3. Methodology

3.1 Research design

Our review of the literature and identification of its shortcomings suggested that we should delve into the urban informal street space to observe daily street life behaviors, using the STBM methodology for data collection. The research design took full account of street space with dynamic characteristics, and enabled analysis of the spatio-temporal behavioral patterns of gender differences in vendors through comparisons at the temporal, spatial and spatio-temporal levels. We explored the spatio-temporal behavioral patterns of female street vendors, and gender differences in vending patterns (type, method and time).

3.2 Study sites and their characteristics

Fangshan District is located in the southwest of Beijing, and has a total area of 2019 square kilometers. In 2021, Fangshan District had a residential population of 1,131,000 people; the male/female ratio in Fangshan District was 0.94.

This study began with on-site observation of a range of common informal vending spaces in Fangshan District, which allowed us to determine the following site criteria:

- high mobility – high flow of people, high activity behavior, and high heterogeneity of behavioral activities;
- location near residential areas.

Based on these criteria, we selected three streets in Fangshan District as study sites. The spatial distribution of the three sites and their surroundings are illustrated in Figure 1, and their characteristics are listed in Table 1.

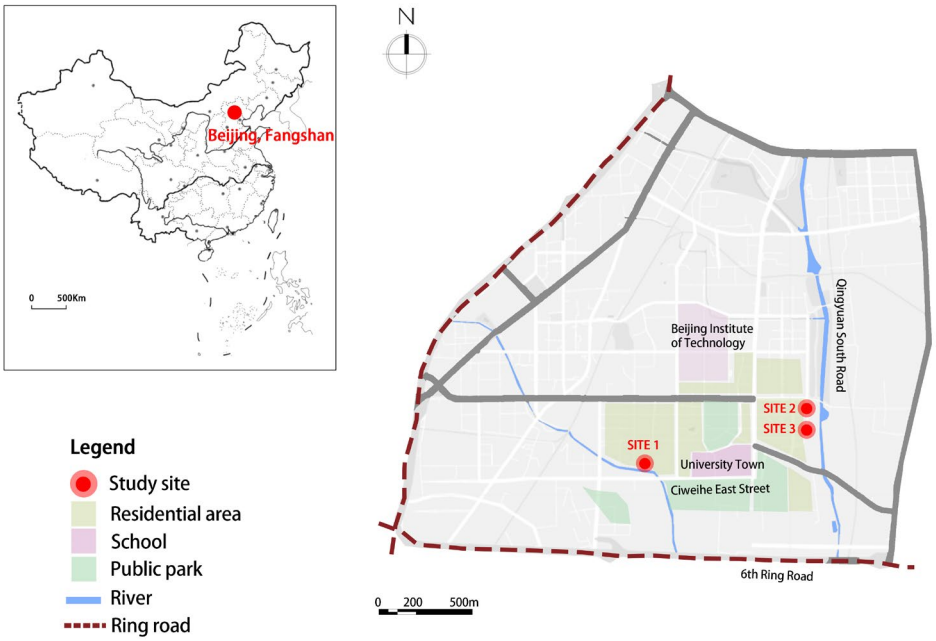
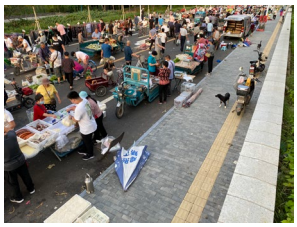


Figure 1. Location of the study sites

Table 1. Specific information about the study site

	Site 1	Site 2	Site 3
Location	Located on the outer section of the district, adjacent to the university campus to the east and the river to the south	Close to the crossroads outside the main entrance to the neighborhood, east of the park	Located in the middle of two neighborhoods, east of the park
Observed area	406 sqm	279 sqm	289 sqm
Spatial characteristics	Less developed street Low spatial enclosure 20 meters wide Wide space	One-way street High spatial enclosure 7 meters wide Approaching the crossroads	One-way street High spatial enclosure 7 meters wide Middle of the street
Photos of the site			

Note: Photo taken on 23 August,2022.

Site 1 is part of a two-way carriageway that is not yet open to traffic, with green belt to the north and south, low levels of enclosure and a street width of 20 meters. It is close to the main entrance and exit of a neighborhood. Sites 2 and 3 are part of the same non-motorized carriageway, with green belt and the main carriageway to the west, and a footway to the east.

Compared to Site 1, Sites 2 and 3 have greater enclosure, with a street width of seven meters. Site 2 is close to the main access points of two neighborhoods, and Site 3 is close to the secondary access point of one neighborhood.

3.2 Spatial temporal behavior mapping and on-site observations

We adopted mixed research methods, following the STBM model (Sun et al., 2020). We photographed the sites using a tripod-mounted camera at fixed points, and recorded observations of the spatial environment, gender differences, and behavioral activities at each. The research had four phases: pilot study, data collection, geographic information system (GIS) database establishment, and data comparison/dimension establishment with statistical analysis.

Pilot study: we conducted fieldwork on a series of common informal vending spaces in Fangshan district, identified three pilot sites based on the selection criteria defined earlier, conducted spatial mapping of the sites, and drew field base maps for each using computer-aided design.

Data collection: using STBM methodology, we took fixed-point photographs during four time slots (6:30–7:30, 10:30–11:30, 16:30–17:30, 18:30–19:30) over nine days (20–28 August 2022, including weekdays and weekends). Each observation period lasted for one hour, based on the daily rhythm of behavioral activity at the study sites. We generated 468 images for each site, totaling 1,404 fixed-point observation.

GIS database creation: The database had five categories: site, date, time period, gender, and type of sale. After establishing the database, containing the 1,404 fixed-point observation photographs, the first image was selected for entry in the unit of two photographs in 10 minutes. (If the first image did not allow recognition of crowd information, the second photo per unit

was selected for entry.) We entered 756 photos from the three sites to the database.

Data comparison dimension establishment and statistical data analysis: We compared the data related to three comparison factors: time, space, and Spatial-Temporal comparison.

3.3 Data analysis

We used statistical analysis, spatial analysis, photo analysis research methods to make temporal, spatial and spatio-temporal comparisons between male and female vendors. Temporal comparisons were between different times of the day and weekends versus weekdays. Spatial comparisons were between the three sites. Spatio-temporal comparisons were between the three sites at different times of the day, and between the three sites for weekends and weekdays. The outcomes of these comparisons were combined in analyses of the patterns of gender differences of the vendors by categories of vending, types of vending, and vending activity times.

4. Empirical findings

Fixed-point observations yielded 13,000 marker points for the three sites in the GIS database (Table 2). The activities captured in each image were categorized into five major types with 33 sub-types. The total number of marker points for the vendor groups was 4,665 (Table 3), with 1,914 in Site 1, 1,505 in Site 2, and 1,246 in Site 3.

Table 2. Gender distribution of marker points, sites 1–3

8.20-8.28	Male	Female	M/F	F/T
Site 1	3125	3047	1.03	49.4%
Site 2	1653	1753	0.94	51.5%
Site 3	1841	1581	1.16	46.2%
Total	6619	6381	1.04	49.1%

Note: M/F: Male/Female; F/T: Female/Total.

4.1 Gender differences across sites

Table 3 shows the gender distribution of the vendor groups across the three sites. There were more male vendors than female vendors overall, and at sites 1 and 3, and fewer male vendors than female vendors at site 2. Site 3 had the greatest disparity in the ratio of male and female vendors. The male/female ratio for vendors observed at the three sites is similar to the male/female ratio of the population of Fangshan District.

Table 3. Gender distribution of vendors, sites 1–3

8.20-8.28	Male	Female	M/F	F/T
Site 1	1051	863	1.22	45.1%
Site 2	707	798	0.89	53.0%
Site 3	779	467	1.67	37.5%
Total	2537	2128	1.19	45.6%

Note: M/F: Male/Female; F/T: Female/Total.

The spatial characteristics of the three sites are as follows. Site 1 has a 20-metre-wide street with adequate vending space resources. Site 2 and Site 3 are both 7-meter-wide streets with relatively few vending space resources; however, Site 2 is located at a crossroads and is a more favorable vending space. Site 3 falls in the middle of the street.

Combining with behavioral mapping (Figure 2) showed that in site 1, which is open and rich in vending space resources, there was no obvious difference between the spatial behavioral characteristics of male and female vendors. When the space is narrower (sites 2 site 3), male vendors show a tendency to cluster, whereas female vendors are more dispersed in a linear distribution at the edges of the space (on the side of the street where the selling environment is unfavorable).

Figure 2 The spatial distributions of male and female vendors at sites 1 and 3

We believe that the patterns shown above are related to the spatial characteristics of the site. Site 1 is more open, with wider streets, so the vending space is more flexible. Sites 2 and 3 have narrower streets and constrained vending space, restricting women's vending locations. In addition, the intersection at Site 2 has a high flow of people and is an advantageous vending location, and was mostly occupied by male vendors. In contrast, female vendors were mostly located in spaces with unfavorable vending environments. This finding is in line with Menon's

238 (2016) idea of “capacity constraints”; in informal street spaces, female vendors’ freedom of
239 movement is limited by socio-cultural or gender norms.
240 Next, we used behavioral mapping to compare spatial and behavioral aspects of gender at a
241 micro level for the four time periods at each site (Figure 3).
242

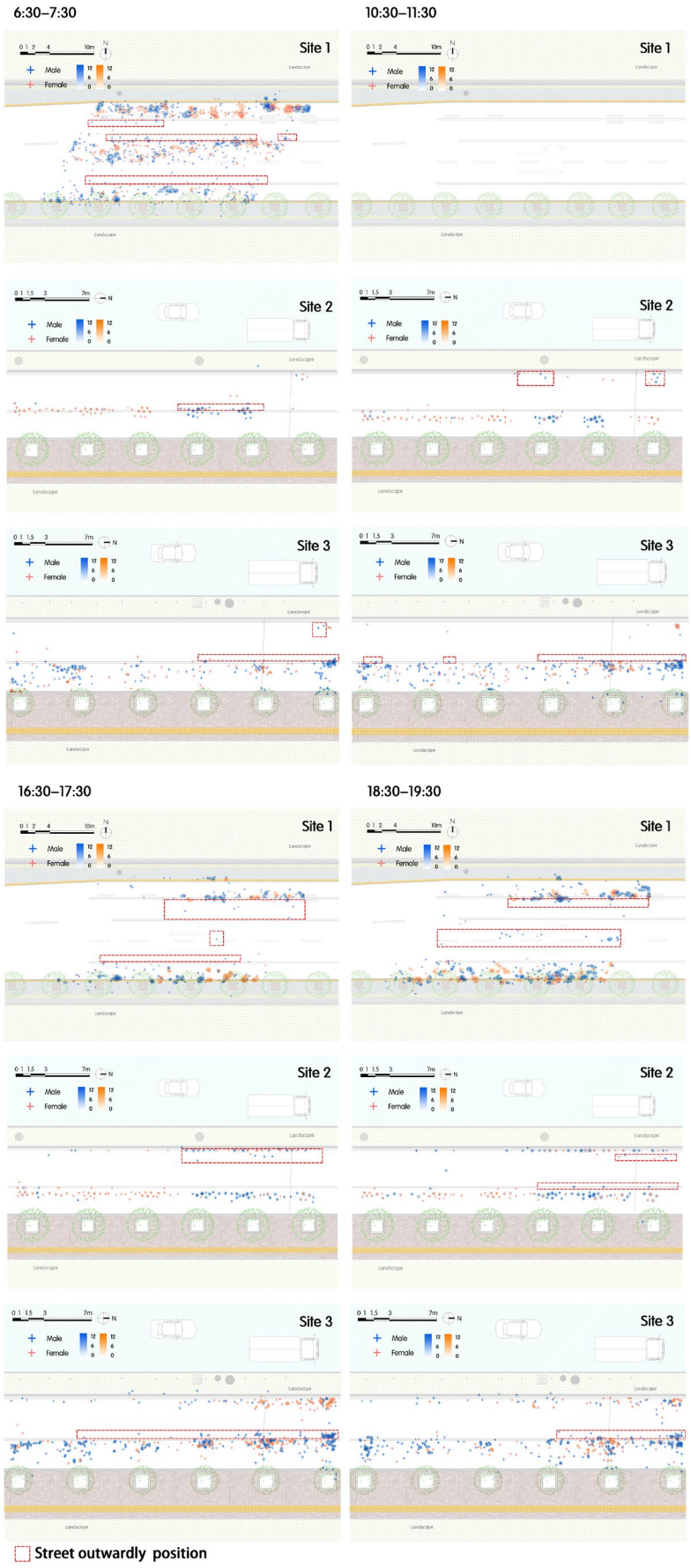


Figure 3 The spatial distribution of vendors by time of the day

245 Behavioral mapping showed that during the four time periods of the day when the numbers of
246 female vendors were low, they operated closer to the inner edges of the street, while males
247 occupied more outwardly oriented positions. At the time of day when the number of female
248 vendors at each site was highest, there was a clear tendency for female vendors to occupy street
249 frontage. Hence, we argue that informal female vendors are more constrained in their choice of
250 vending locations.
251
252 **4.2 Gender differences in vending product typologies**
253 We created nine categories of goods being sold: cooked food, food cooking, groceries, fruit,
254 vegetables, meat, seafood, pets and plants (P&P), and sundries. Cooked food, food cooking,
255 meat and seafood were designated "more profitable", while fruit, vegetables, sundries and P&P
256 "less profitable". Table 4 shows the distribution of the nine types of commodities sold in the
257 three sites by vendor gender. Higher proportions of female than male vendors sold fruit,
258 vegetables, groceries, sundries, seafood, and insects. The proportions of female vendors selling
259 fruit, sundries, and P&P were higher than 0.5 at site 1, and similarly for groceries and vegetables
260 at site 3 and for fruit and groceries at site 2. All these vending types are low-quantity, perishable
261 and low-profit goods.
262 The finding that female vendors mostly sell less profitable items is in line with Adama (2020).
263 Female vendors are usually more cautious and careful in business and are less willing to
264 financial risks than their male counterparts; they are more inclined to choose low-margin, easy-
265 to-sell goods to minimize inventory build-up and potential financial losses (Amankwaa, 2017).
266 Many female vendors focus on developing relationships and trust with their customers in order

to gain long-term profitability via repeat patronage, despite low margins (Menon, 2016).

Table 4. Distribution of gender of vendors in different vending categories

8.20-8.28	Site 1			Site 2			Site 3		
	Male	Female	M/F	Male	Female	M/F	Male	Female	M/F
Cooked food	164	135	1.21	179	70	2.56	14	7	2.00
Food cooking	120	13	9.23	0	0	/	0	1	0.00
Groceries	6	5	1.20	19	0	/	20	26	0.77
Fruit	156	150	1.04	98	337	0.29	343	106	3.24
Vegetables	462	365	1.27	340	287	1.18	392	324	1.21
Sundries	60	97	0.62	55	96	0.57	10	3	3.33
Meat	31	34	0.91	0	0	/	0	0	/
Seafood	49	59	0.83	0	0	/	0	0	/
P&P	3	5	0.60	16	8	2.00	0	0	/
Total	1051	863	1.22	707	798	0.89	779	467	1.67

Note: M/F: Male/Female; P&P: pet and plant.

We found that of the nine types of vending, vegetables, fruit, sundries, and P&P belonged to the lighter type, whereas cooked food, food cooking, groceries, meat, and seafood belonged to the more burdensome type. The proportions of female vendors selling vegetables, fruits, groceries, and P&P were higher than 0.5 at all three sites (Table 4).

The findings also suggest that female vendors mostly sell lighter and smaller items. Cla (2018) found that the behavioral activities of female vendors are directly related to physiological factors and physical activities. Female vendors can move and unload light goods rapidly, using little equipment, and small-sized goods are easy to store, transport and display. This also explains why there were fewer female than male vendors in the cooked food, meat categories. We believe that female vendors' selection of goods to be sold is consistent with the nature of provisional choice; they use public space to sell in a way that takes account of their (on average) lower physical strength.

4.3 Gender differences in vending modes

Table 5 shows the distribution of vending methods by gender across the three sites. We randomly selected a sample of photographs taken at the three sites on the same day for comparative analyses. At all three sites, male vendors (labelled in red) have more fixed stall locations and a larger per capita footprint; female vendors (labelled in yellow) have flexible stall locations and a smaller per capita footprint. Moreover, the photographs show that most male vendors used varied and relatively complex equipment for transporting and selling goods (e.g., cars, pickup trucks, carts), while most female vendors used one type of less sophisticated equipment (e.g., human-powered or electric tricycles).

Our study was supported by sentinel observations as well as data, following Cla (2018). We suggest that gender differences in vending behavior are closely related to physiological factors. Women face more limiting factors when engaging in physical activity, i.e., they are more likely to be fatigued than men for the same amount of time and at the same intensity of physical activity. As a result, vendors selling the same type of goods in different spatial environments will have different gender ratios, and this difference is related to the effect of space on physical activity. Differences in means of transport also have a direct impact on floor space and duration of selling in the street. Stalls that are fixed and larger in size are more attractive to customers and have a greater capacity for them, while women's unstable and smaller size presents unfavorable aspects in terms of attracting customers. At the same time, the findings of this study reaffirm the closeness of female vendors' choice of less profitable, lighter, and smaller items in terms of type of vending with physiological factors and physical activity.

Table 5. Vendors, vending stalls, and transport equipment by gender

Time	Site 1	Site 2	Site 3
6:30-7:30			
10:30-11:30			
16:30-17:30			
18:30-19:30			

Legend: Male vendor Female vendor

4.4 Gender differences by time

4.4.1 Weekends and weekdays

We calculated the mean daily number of vendors by gender over the weekend and weekdays, generating the distribution shown in Table 6. The mean daily number of female vendors was higher during the week than at weekends at all sites. In contrast, the mean daily number of male vendors was much more similar on weekdays and weekends, and higher on weekends at site 2.

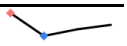
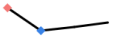
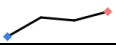
316 *Table 6. Vendor numbers on weekdays and weekends by gender*

Location	Gender	Average vendor（weekday/5 days）	Average vendor（weekend/4 days）
Site 1	Male	122.8	109.3
	Female	103.6	86.3
	M/F	1.19	1.27
Site 2	Male	74.6	83.5
	Female	94.6	80
	M/F	0.79	1.04
Site 3	Male	89.2	83.3
	Female	63.2	37.8
	M/F	1.41	2.21

317 Note: M/F: Male/Female; weekday/5 days: total number of weekday/5 days; weekend/4 days: total number of weekend/4 days.

318 Fewer female vendors were observed on weekends than weekdays. This is likely to be due to
319 childcare duties: women can work when children are in school during the week, but must care
320 for them at weekends. Other authors have shown that the social division of labor influences
321 gender differences in vendor activity (Ross and Bird, 1994), and that women are more likely
322 than men to work part-time (Maffii et al., 2014). While they may sell goods on the street alone
323 or with a partner during weekdays, Chinese women are likely to work part-time on weekends.
324 In addition, deep-rooted cultural influences mean women usually have more family
325 responsibilities, such as childcare and housework, than men (Kwan, 1999). Women may prefer
326 to organize their work on weekdays so that they can spend more time with their families at the
327 weekend.
328
329 **4.4.2 Differences in the gender of vendors at different times of the day**
330 Table 7 shows that the average number of female vendors peaked at 6:30–7:30 at Site 1, 16:30–
331 17:30 at Site 2, and 16:30–17:30 at Site 3 (162), all daytime hours. Overall, more female
332 vendors were observed during daytime than evening periods.
333
334

Table 7. Distribution of vendors at times of the day by gender

Location	Gender	Time of day				
		6:30-7:30	10:30-11:30	16:30-17:30	18:30-19:30	Trend
Site 1	Male	599	0	170	282	
	Female	573	0	88	202	
	M/F	1.05	/	1.93	1.4	
Site 2	Male	152	160	207	188	
	Female	169	202	221	206	
	M/F	0.9	0.79	0.94	0.91	
Site 3	Male	92	183	246	221	
	Female	113	112	162	117	
	M/F	0.81	1.63	1.52	1.89	

Note: M/F: Male/Female.

This temporal pattern is inextricably linked to women's perceptions of the safety of their environment (Han and Sun, 2023; Mao, 2019); spaces with high mobility and uncertainty can be perceived as threatening (Bork-Hüffer et al., 2016). Perceived safety risk is higher during evening hours than daytime hours. Women are generally more concerned about their safety than men, especially in less open or unstable areas (Zhang et al., 2021).

5. Discussion and conclusion

We examined the spatial occupation of street vendors as an adaptive dynamic choice through a combination of physical observation and spatio-temporal behavioral mapping. We explored the spatial and temporal behavioral patterns of female vendors in informal street spaces, and the differences between their type, mode, and timing of vending and those of their male counterparts. We found that when vending space is limited, male vendors cluster. Female vendors are more dispersed and tend to occupy spaces with unfavorable selling environments. In addition, when there are fewer female vendors at a site, they sell closer to the inner side of the street, while male vendors occupy positions further away from the street. Female vendors mostly sell lower-margin, lighter and smaller types of goods; male vendors are more likely to

occupy fixed stalls and use heavy transport equipment, while female vendors have more mobile stalls and lightweight transport equipment. Finally, the mean number of female vendors is higher on weekdays than on weekends, and in the daytime than in the evening.

The study's two research questions were answered by comparing and analyzing female spatial-temporal data obtained through the STBM method. As an informal occupation with the characteristic of provisional choice, street vending differs from other forms of employment that have the characteristic of permanent choice. Moreover, women, due to family or cultural factors, tend to prefer part-time, temporary, and flexible informal employment, which accords with the nature of street vending. This is consistent with the fact that the female vendors in our study were more likely to be active during weekday and daytime hours. Vending, as a provisional choice, offers women flexibility and control, but places higher demands on women's behavior and activities in public spaces. Female vendors prefer low-margin, lightweight and small goods that are easy to store, transport and display, and tend to use basic transport equipment, which makes it easy to move their stalls and gives them a high degree of flexibility in their location. This contrasts with male vendors, who tend to use heavy transport equipment and occupy fixed stalls.

Our study shows that female and male vendors use informal street spaces differently. Female vendors' use of informal street space is shaped by the type of selling, the method of selling, and timing, adapted to their physiology, the social division of labor, and the safety of their environments. We provide a fine-grained picture of the behavioral activities of female vendors in informal street spaces in urban China, going beyond studies of informal street spaces that focus only on government policy, urban spatial planning, and the general behavior of vendors.

It is crucial that gender is considered in the formulation and implementation of urban planning and authority policies related to street vending. We recommend that urban planners and managers seek to optimize the use of informal street vending space in cities to create an equitable and inclusive vending environment for female vendors that enhances urban vitality.

This research has several limitations. Line-of-sight obstructions, site facilities obstructions, and light and shade conditions affected some image data, but were minimal overall. Photographs with repeated occurrence of the same vendor were repeated several times to ensure an accurate count of the number of people captured. In the subsequent statistics, we follow the calculation of the number of people is proportional. In order to study gender behavioral differences and their causes in informal vending spaces in more depth, future researchers could add semi-structured interviews and other methods of personal inquiry. In addition, some of the underlying reasons for the patterns presented herein are complex; we will explore them in more detail through in-depth and long-term studies. Nevertheless, we succeeded in identifying the spatial and temporal behavioral patterns of Chinese female street vendors and their operational strategies in terms of the types, modes, spatial meanings, and time periods of selling, and in comparing them to patterns for their male counterparts.

Disclosure statement

The authors report no potential conflict of interest.

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