Environmental & Motion Timers

$|\Delta Accel| > 0.37$	
Yes	No
Motion Timer = 0	Motion Timer + 5 s

UV Index > 0.03	
Yes	No
UV Timer = 0	UV Timer + 5 s

$|\Delta T| \geq 1$ & $sign(d(T_i)/dt) \,!= sign(d(T_{i-12})/dt)$	
Yes	No
Temp. Timer = 0	Temp. Timer + 5 s

Decision Tree

UPAS Charging — No

Yes

GPS Signal* — No

Yes

Satellites > 8 & UV Timer ≤ 60 s & Accel. Timer ≤ 60 s & Temp. Timer == 0 s

Home Dist. < 500 m & Home Dist. ≤ Work Dist. — No

Home Dist. ≤ 60 m & Home Dist. < Work Dist. — Yes → **Home**

No

Work Dist. ≤ 500 m — No

Work Dist. ≤ 115 m — Yes → **Work**

No

Other

Yes

Satellites > 8 & ME == 'Other' & Work Dist. > 115 & Home Dist. > 60 — Yes

No

Work Dist. ≤ 185 m & Work Dist. < Home Dist. — Yes → **Work**

No

Home Dist. ≤ 120 m — Yes → **Home**

No

Accel. Timer ≤ 150 s & UV Timer | Temp. Timer ≤ 150 s & Work Dist. > 185 m & Home Dist. > 120 m — Yes → **Other**

No → Work Dist. > 500 m & Home Dist. > 500 m — Yes → **Other**

Home

!Home & Home Timer ≤ 30 s	
Yes	No
Home Timer + 5 s	Home Timer = 0

Work

!Work & Work Timer ≤ 30 s	
Yes	No
Work Timer + 5 s	Work Timer = 0

Other

| !Other & Other Timer ≤ 30 s	
Yes	No
Other Timer + 5 s	Other Timer = 0

Figure S1: Adaptive buffer size (ABS) flow chart. (*GPS Signal was considered valid only if the GPS had been connected to more than five satellites for a minimum of 30 s without signal loss).

Figure S2: Modified UPAS. An Ultrasonic Personal Aerosol Sampler (UPAS) was modified to include a pushbutton (mounted on the side) and global positioning system (GPS; mounted on the bottom). Volunteers used the three-point harness to wear the UPAS for multiple days to collect the GPS, environmental (temperature, pressure, relative humidity, UV light), and motion data.
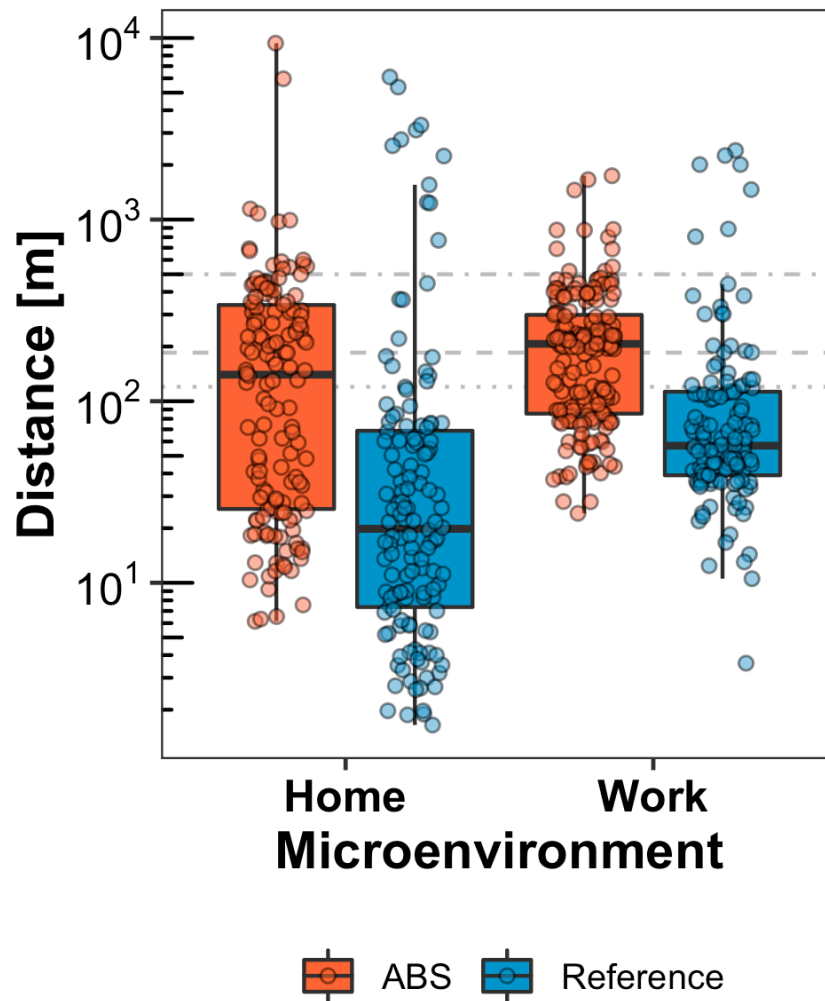
Figure S3: Microenvironment transition distance. Distance from microenvironment centroid at the time of transition. The ABS algorithm buffer sizes were based on the GPS distance recorded in the reference dataset. Distances equal to the 75th percentile (work: 115 m; home: 60 m), 85th percentile (work: 185 m; home: 120 m), and 500 m were used to define the buffer radii. The upper quartile of the volunteer record is the 75th percentile distances and the horizontal lines show the 85th percentile distances and 500 m. Sample sizes: ABS algorithm home, n=199; Reference dataset home, n=140; ABS algorithm work, n=280; Reference dataset work, n=132.
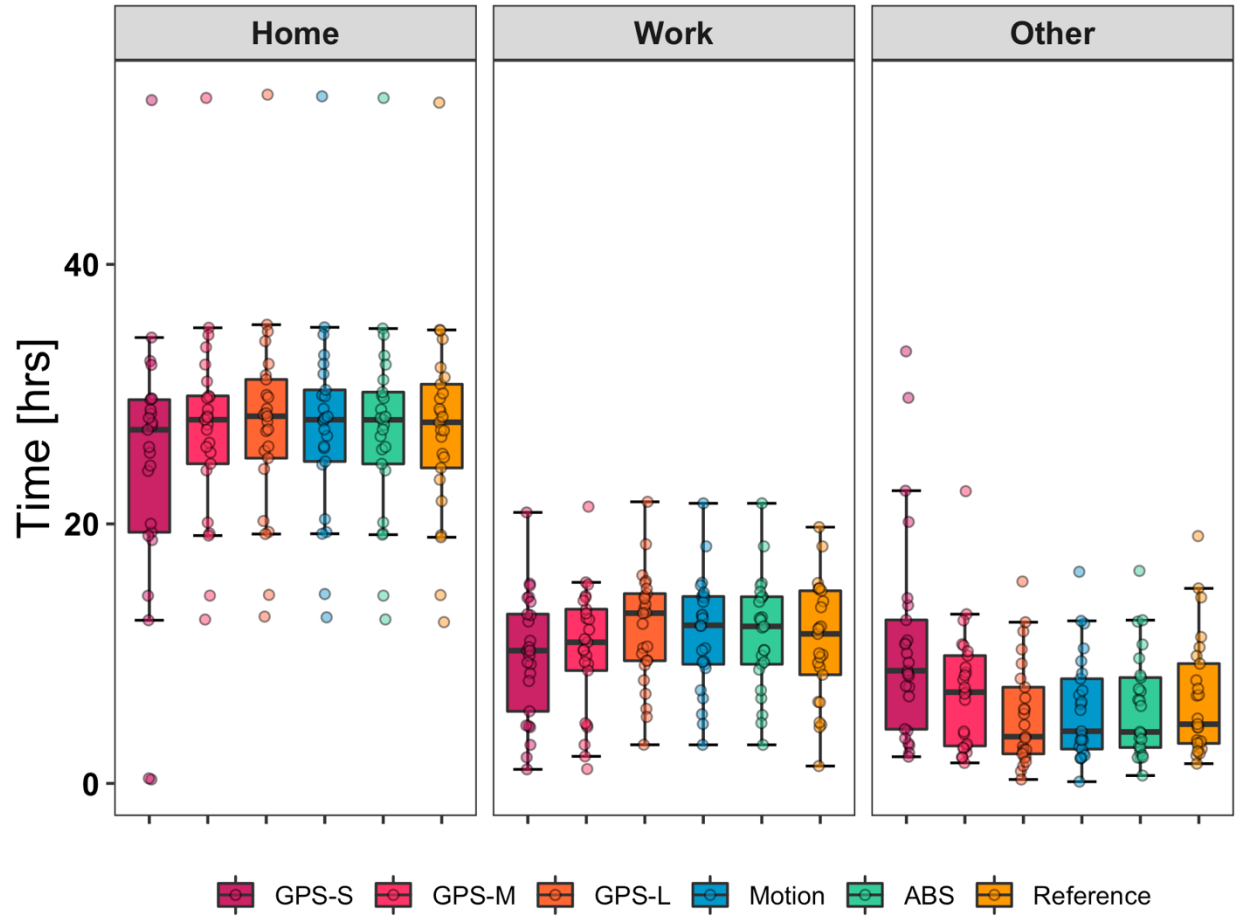
Figure S4: Microenvironment time estimates. The estimated or actual time spent in each microenvironment for all samples (n=25). A description of each algorithm (GPS-S, GPS-M, GPS-L, Motion, and ABS) can be found in the methods section of the main text. The reference dataset times are the times spent in each microenvironment as denoted by the volunteers in their diaries and/or using the pushbutton.
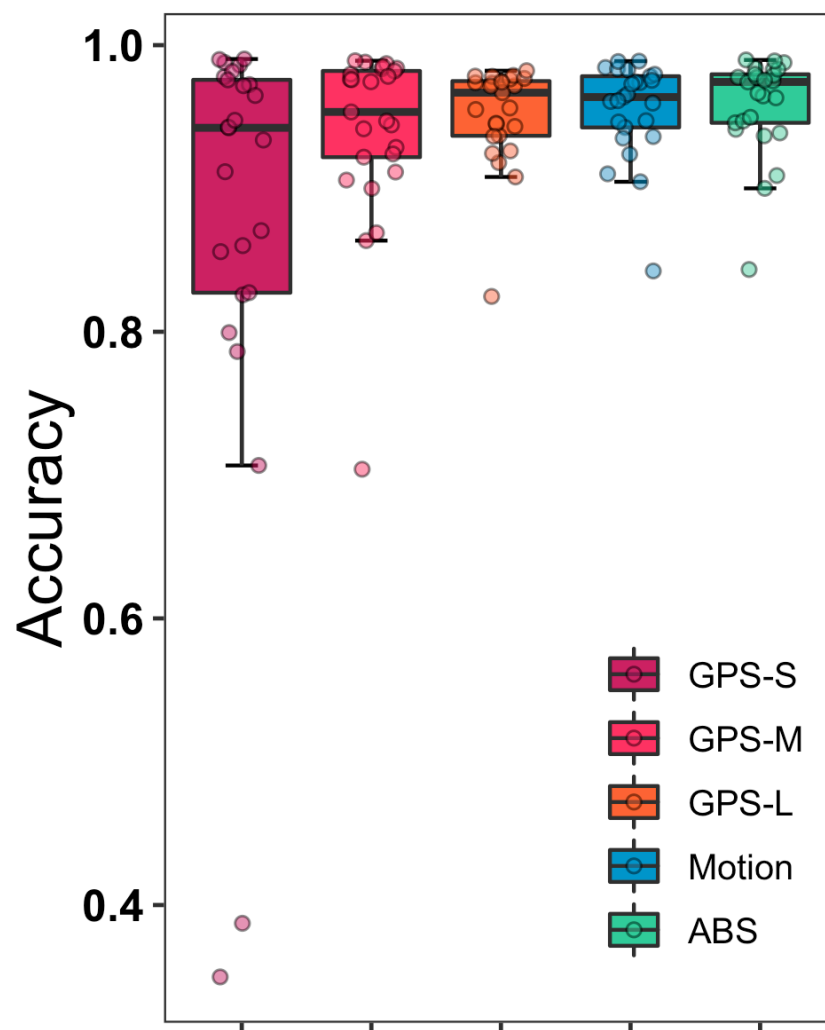
Figure S5: Total algorithm accuracies. The accuracy for each of the five algorithms for predicting microenvironment classifications (n=25). The volunteer record data was used as the baseline.

$$Accel = \sqrt{Accel\_X^2 + Accel\_Y^2 + Accel\_Z^2}$$
Equation S1: Total acceleration.

$$Sensitivity = \left(\frac{TP}{TP + FN}\right)$$
Equation S2: Sensitivity.

$$Specificity = \left(\frac{TN}{FP + TN}\right)$$
Equation S3: Specificity.

$$Accuracy = \left(\frac{TP + TN}{TP + TN + FP + FN}\right)$$
Equation S4: Accuracy).

True positive (TP) is defined as when the volunteer is inside a specific microenvironment and the designation determined by the algorithm developed in this work matches the microenvironment designation noted by the volunteer in their diary and/or via use of the push button.
$$(e.g. (ME_{Diary} = Home) = (ME_{Algorithm} = Home))$$

True negative (TN) is defined as when the volunteer is outside a specific microenvironment and the designation determined by the algorithm developed in this work matches the microenvironment designation noted by the volunteer in their diary and/or via use of the push button.
$$(e.g. (ME_{Diary} \mathrel{!=} Home) = (ME_{Algorithm} \mathrel{!=} Home))$$

False positive (FP) is defined as when the volunteer is inside a specific microenvironment and the designation determined by the algorithm developed in this work does not match the microenvironment designation noted by the volunteer in their diary and/or via use of the push button.
$$(e.g. (ME_{Diary} \mathrel{!=} Home) == (ME_{Algorithm} == Home))$$

False negative (FN) is defined as when the volunteer is outside a specific microenvironment and the designation determined by the algorithm developed in this work does not match the microenvironment designation noted by the volunteer in their diary and/or via use of the push button.
$$(e.g. (ME_{Diary} == Home) == (ME_{Algorithm} \mathrel{!=} Home))$$

Table S1: Modified UPAS sensor components and electronics.

Component	Manufacturer	Part Number
Microblower	Murata	MZBD001
Mass Air Flow Sensor	Honeywell	Omron D6F
Light Sensor (vis., UV, IR)	Silicon Labs	SI1145-A10-GMR
Temp., Pressure, RH Sensor	Bosch Sensortec	BME280
Accelerometer/Magnetometer	STMicroelectronics	LSM303DLHCTR
Bluetooth Low-Energy	Switch Science	HRM1017
MicroSD Card	Molex	5031821852
Memory (EEPROM)	Atmel	AT24CM01-XHM-T
Real-time Clock	Maxim Integrated	DS3231MZ+
Battery (2800 mAh)	Samsung	SAEBBG900BBU
Global Positioning System	Adafruit	746
Pushbutton	Switchcraft Inc.	ED913

Table S2: Microenvironment transitions. The number of microenvironment transitions for the reference dataset or as determined by each of the algorithms.

	GPS-S	GPS-M	GPS-L	Motion	ABS	Reference
# of Transitions	1084	454	334	332	350	274

Table S3: Predicted microenvironment time. The median (25th, 75th percentiles) time spent in each microenvironment for the reference dataset or as determined by each of the algorithms.

	GPS-S	GPS-M	GPS-L	Motion	ABS	Reference
Home	27.3 (19.4, 29.6)	28.0 (24.6, 29.9)	28.3 (25.1, 31.1)	28.0 (24.8, 30.3)	28.0 (24.6, 30.2)	27.8 (24.3, 30.8)
Work	10.2 (5.6, 13.0)	10.9 (8.7, 13.4)	13.1 (9.5, 14.6)	12.2 (9.2, 14.4)	12.1 (9.2, 14.4)	11.5 (8.4, 14.9)
Other	8.7 (4.2, 12.6)	7.0 (2.9, 9.8)	3.6 (2.3, 7.4)	4.0 (2.6, 8.2)	4.0 (2.8, 9.2)	4.6 (3.1, 9.2)

Table S4: Total accuracy. Median (25th, 75th percentile) accuracy for the five microenvironment detection algorithms.

	Accuracy			Total Accuracy
	Home	**Work**	**Other**	**All**
GPS-S	0.981 (0.948, 0.994)	0.984 (0.914, 0.993)	0.942 (0.827, 0.975)	0.942 (0.827, 0.976)
GPS-M	0.989 (0.981, 0.994)	0.982 (0.947, 0.992)	0.953 (0.922, 0.982)	0.953 (0.922, 0.982)
GPS-L	0.987 (0.980, 0.994)	0.979 (0.954, 0.988)	0.967 (0.938, 0.975)	0.967 (0.937, 0.975)
Motion	0.989 (0.978, 0.992)	0.984 (0.960, 0.992)	0.963 (0.942, 0.978)	0.963 (0.943, 0.978)
ABS	0.991 (0.980, 0.994)	0.989 (0.958, 0.994)	0.974 (0.945, 0.980)	0.974 (0.946, 0.980)

Table S5: Total accuracy statistical comparisons. Pairwise comparisons of the total accuracy for all of the algorithms using the Nemenyi multiple comparisons test with q approximation. No p-value adjustment method was used. The green highlighted cells denoted the comparisons with significant differences.

	GPS-S	GPS-M	GPS-L	Motion
GPS-M	0.721	-	-	-
GPS-L	0.984	0.380	-	-
Motion	0.978	0.963	0.797	-
ABS	0.05	0.578	0.010	0.200

Table S6: Microenvrionment accuracy statisitcal comparisons. Pairwise comparisons of the accuracy for all of the algorithms by microenvironment using the Nemenyi multiple comparisons test with q approximation. No p-value adjustment method was used. The green highlighted cells denoted the comparisons with significant differences.

	Home				Work				Other			
	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion
GPS-M	0.747	-	-	-	0.380	-	-	-	0.863	-	-	-
GPS-L	0.721	0.100	-	-	0.001	0.166	-	-	0.992	0.608	-	-
Motion	0.151	0.004	0.842	-	0.820	0.953	0.026	-	0.963	0.998	0.797	-
ABS	0.942	0.992	0.260	0.020	0.999	0.549	0.002	0.929	0.039	0.354	0.010	0.200

Table S7: Microenvironment sensitivity and specificity. Median (25th, 75th percentile) sensitivity and specificity for the five microenvironment detection algorithms.

	Sensitivity			Specificity		
	Home	**Work**	**Other**	**Home**	**Work**	**Other**
GPS-S	0.990 (0.939, 1.000)	0.968 (0.711, 1.000)	0.892 (0.739, 0.947)	0.990 (0.986, 0.996)	0.992 (0.986, 0.996)	0.941 (0.846, 0.990)
GPS-M	0.997 (0.985, 1.000)	0.988 (0.860, 1.000)	0.830 (0.697, 0.934)	0.984 (0.976, 0.991)	0.989 (0.984, 0.995)	0.986 (0.941, 0.996)
GPS-L	1.000 (0.992, 1.000)	1.000 (1.000, 1.000)	0.722 (0.587, 0.816)	0.976 (0.965, 0.983)	0.975 (0.959, 0.985)	0.999 (0.987, 1.000)
Motion	0.997 (0.989, 1.000)	0.996 (0.967, 0.999)	0.801 (0.678, 0.855)	0.979 (0.969, 0.988)	0.981 (0.968, 0.992)	0.996 (0.979, 0.999)
ABS	0.997 (0.989, 1.000)	0.997 (0.988, 0.999)	0.820 (0.724, 0.868)	0.984 (0.980, 0.990)	0.985 (0.969, 0.992)	0.995 (0.979, 0.999)

Table S8: Microenvironment sensitivity statistical comparisons. Pairwise comparisons of the sensitivity for all of the algorithms by microenvironment using the Nemenyi multiple comparisons test with q approximation. No p-value adjustment method was used. The green highlighted cells denoted the comparisons with significant differences.

	Home				Work				Other			
	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion
GPS-M	0.004	-	-	-	0.260	-	-	-	0.002	-	-	-
GPS-L	1.2e-8	0.072	-	-	2.1e-6	0.013	-	-	4.1e-14	6.8e-6	-	-
Motion	0.020	0.992	0.020	-	0.434	0.998	0.004	-	2.1e-9	0.064	0.137	-
ABS	0.072	0.899	0.004	0.992	0.491	0.995	0.003	1.000	0.003	1.000	4.3e-6	0.050

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Table S9: Microenvironment specificity statistical comparisons. Pairwise comparisons of the specificity for all of the algorithms by microenvironment using the Nemenyi multiple comparisons test with q approximation. No p-value adjustment method was used. The green highlighted cells denoted the comparisons with significant differences.

	Home				Work				Other			
	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion	GPS-S	GPS-M	GPS-L	Motion
GPS-M	0.001	-	-	-	0.0005	-	-	-	0.004	-	-	-
GPS-L	7.9e-14	0.0.001	-	-	4.1e-14	4.0e-5	-	-	7.3e-14	6.2e-5	-	-
Motion	8.4e-12	0.007	0.963	-	4.3e-6	0.0.863	0.003	-	0.0001	0.929	0.002	-
ABS	0.003	0.999	0.0002	0.003	0.002	0.995	5.4e-6	0.636	0.008	0.999	2.1e-5	0.842