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Science Methodologies**

**Author(s): Stephen J. Taylor, Emma K. Dutton, Patrick R.
Aldrich, Bryan E. Dutton**

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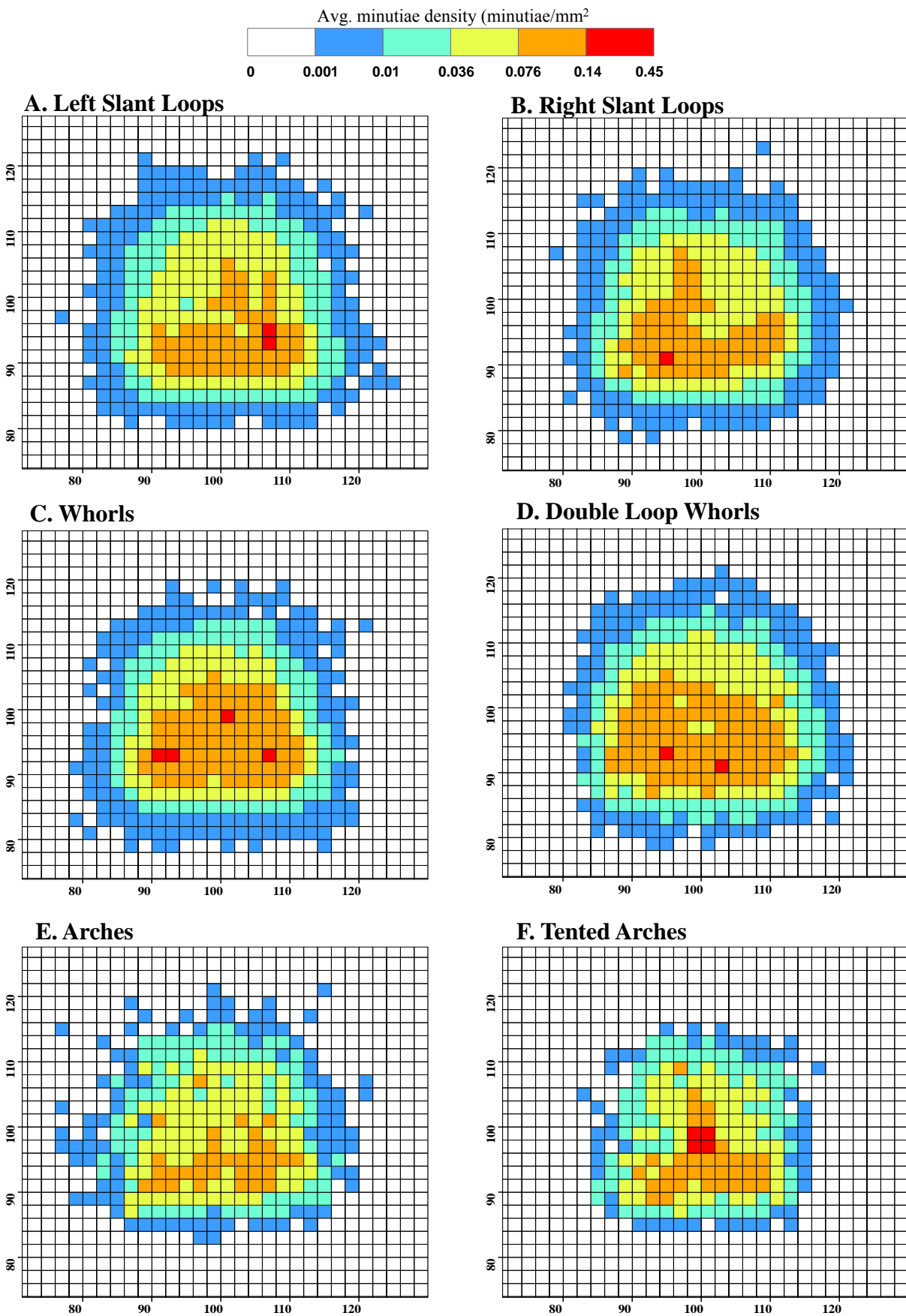


Figure 2-12. Maps showing ridge-ending density (count per mm²) as distributed across a standardized 2-mm grid in georeferenced fingerprint space.

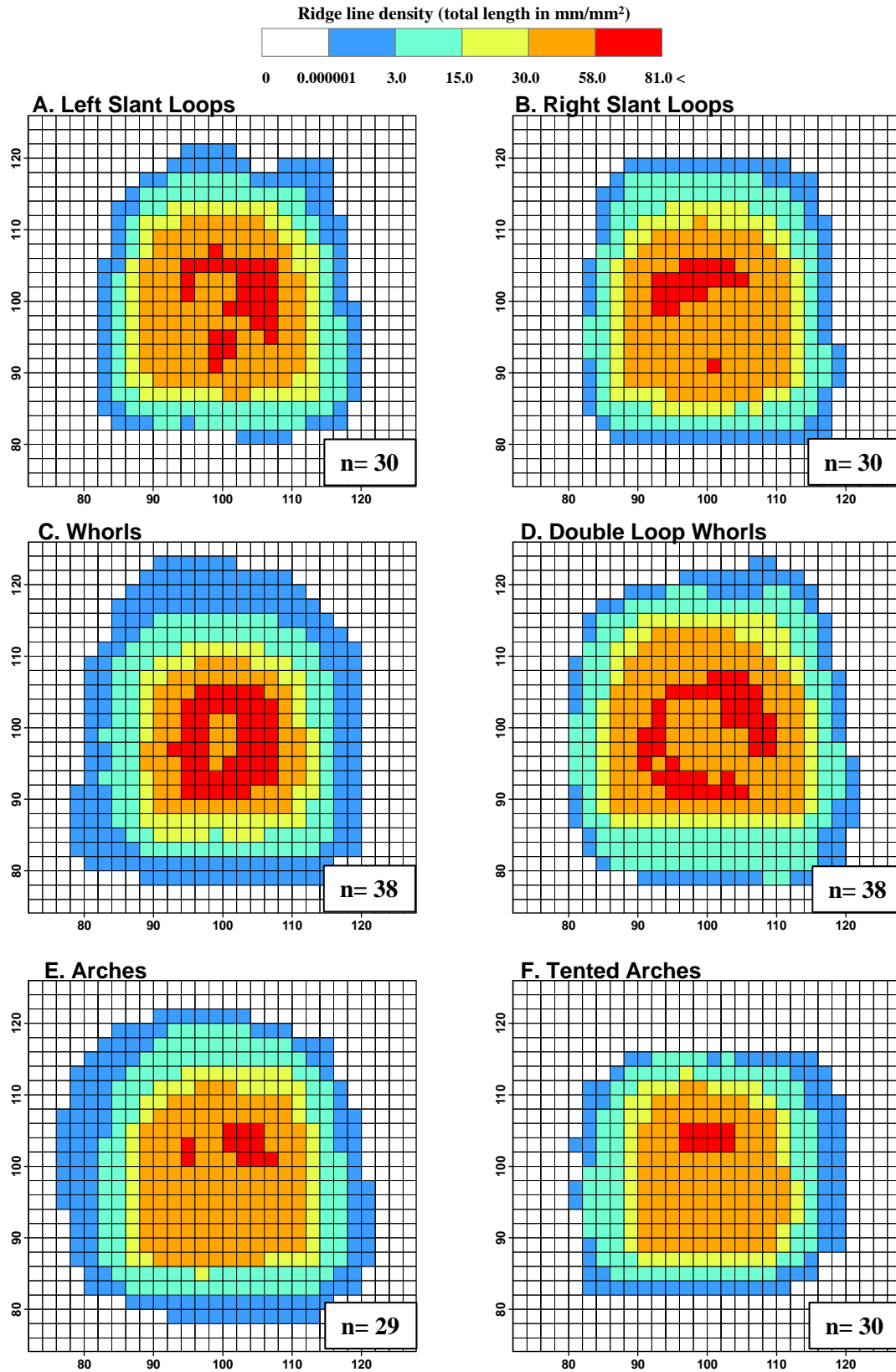
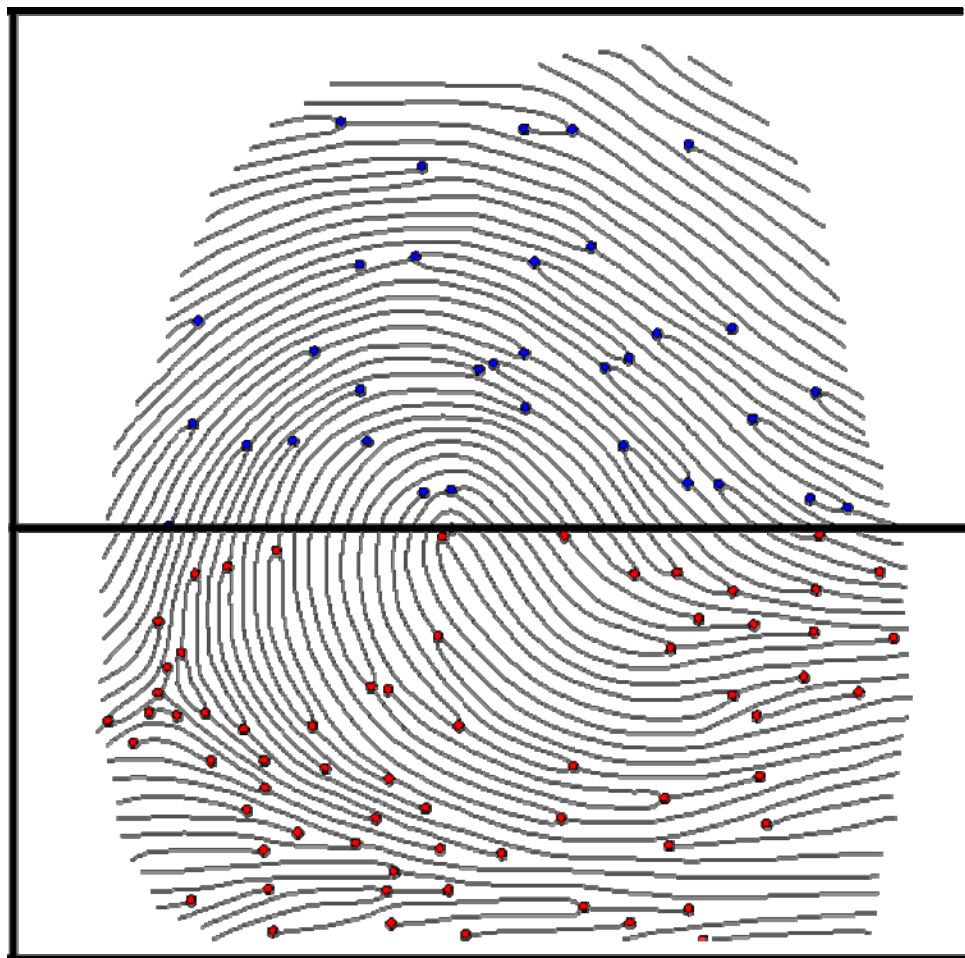


Figure 2-13. Maps showing ridge-line density (total length in mm per mm²) as distributed across a standardized 2-mm grid in georeferenced fingerprint space.



Pattern Type	Minutiae/Ridgeline Ratio Above Core	Minutiae/Ridgeline Ratio Below Core
All Images (n=188)	0.41	0.63
LSL (n=31)	0.47	0.64
RSL (n=33)	0.45	0.63
W (n=41)	0.49	0.71
DLW (n=23)	0.51	0.68
A (n=30)	0.46	0.64
TA (n=30)	0.44	0.66

Figure 2-14. Analysis of minutiae and ridgelines distributions across all fingerprint pattern types, separated by position above and below the core, in the northern and southern hemispheres of fingerprint space, respectively.

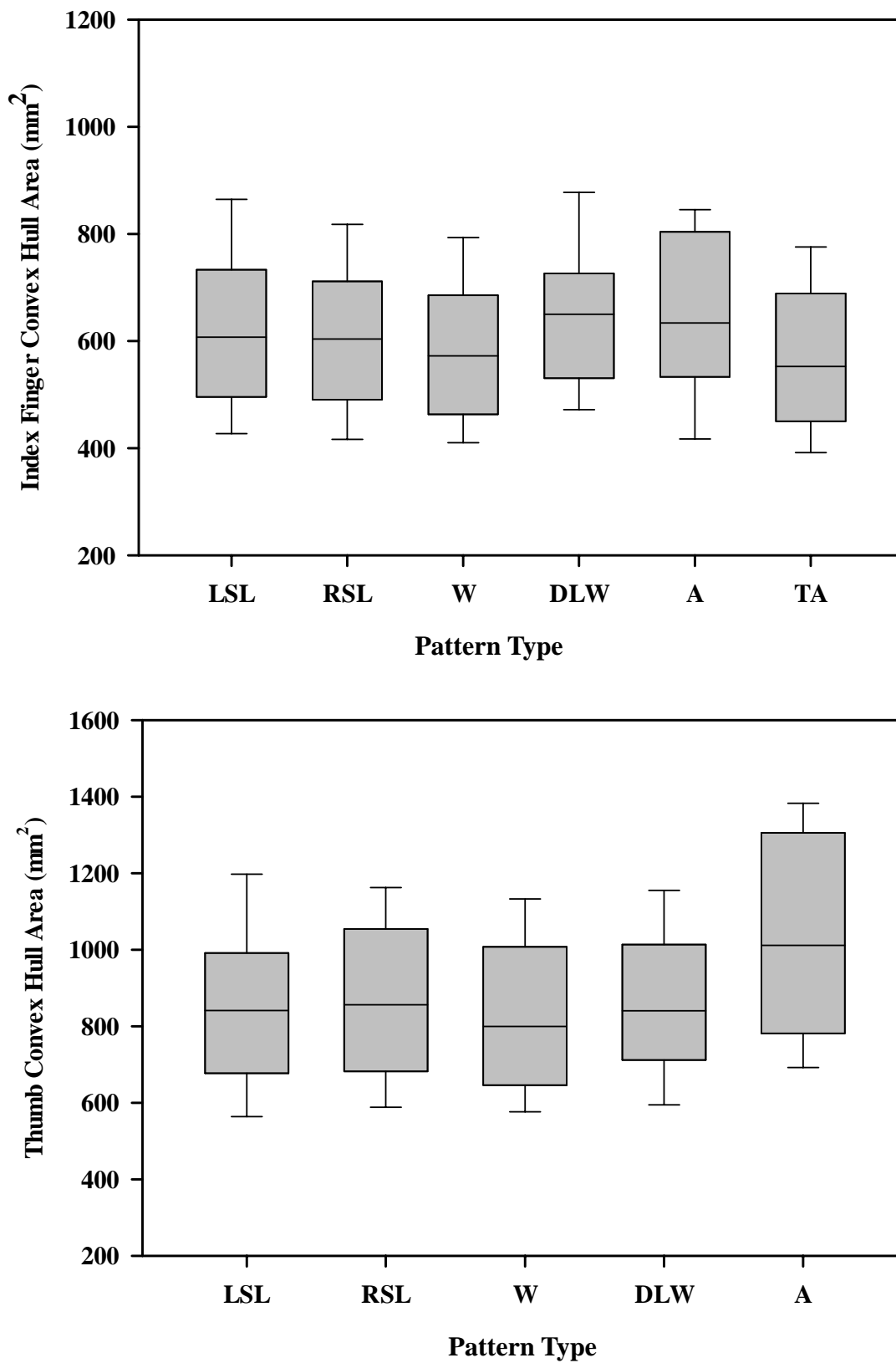
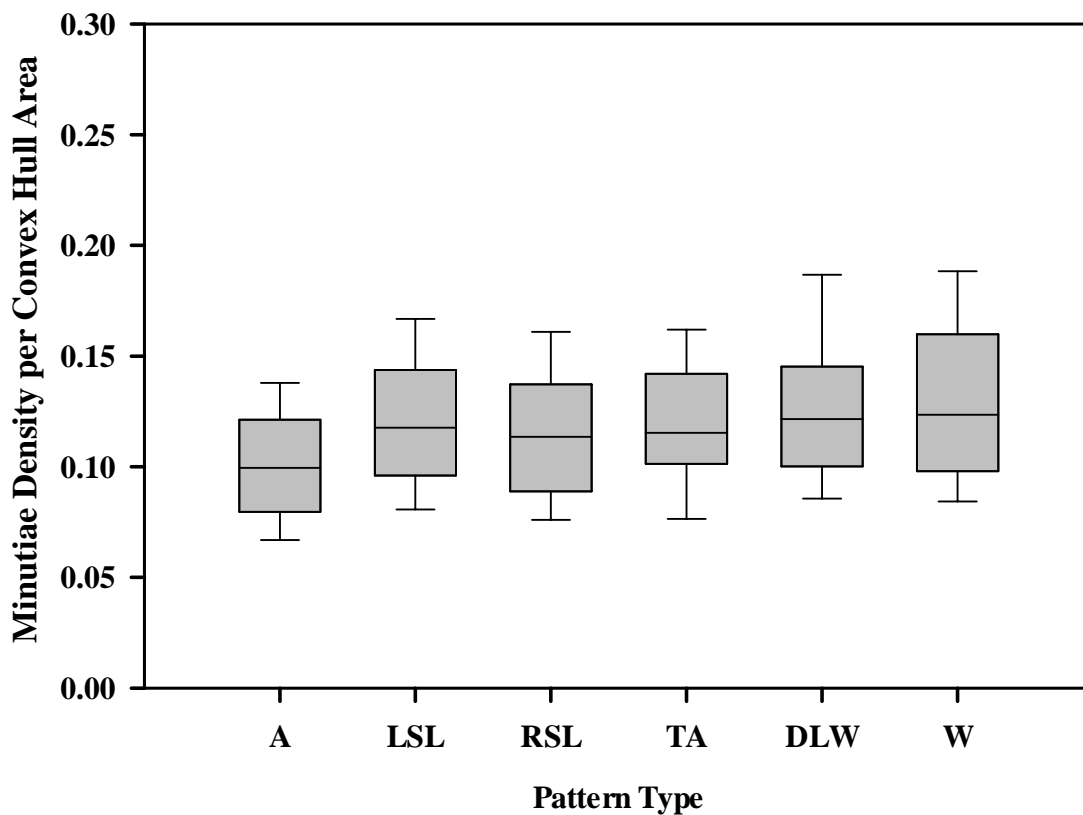


Figure 2-15. Box plots showing distribution of convex hull area (mm²) across all pattern types. Refer to Table 2-4 for related data summary (note: tented arches did not occur on thumbs in dataset).

Total Minutiae Density Over Convex Hull Area



ANOVA: Total minutiae density (no./mm²) over convex hull area separated by pattern type

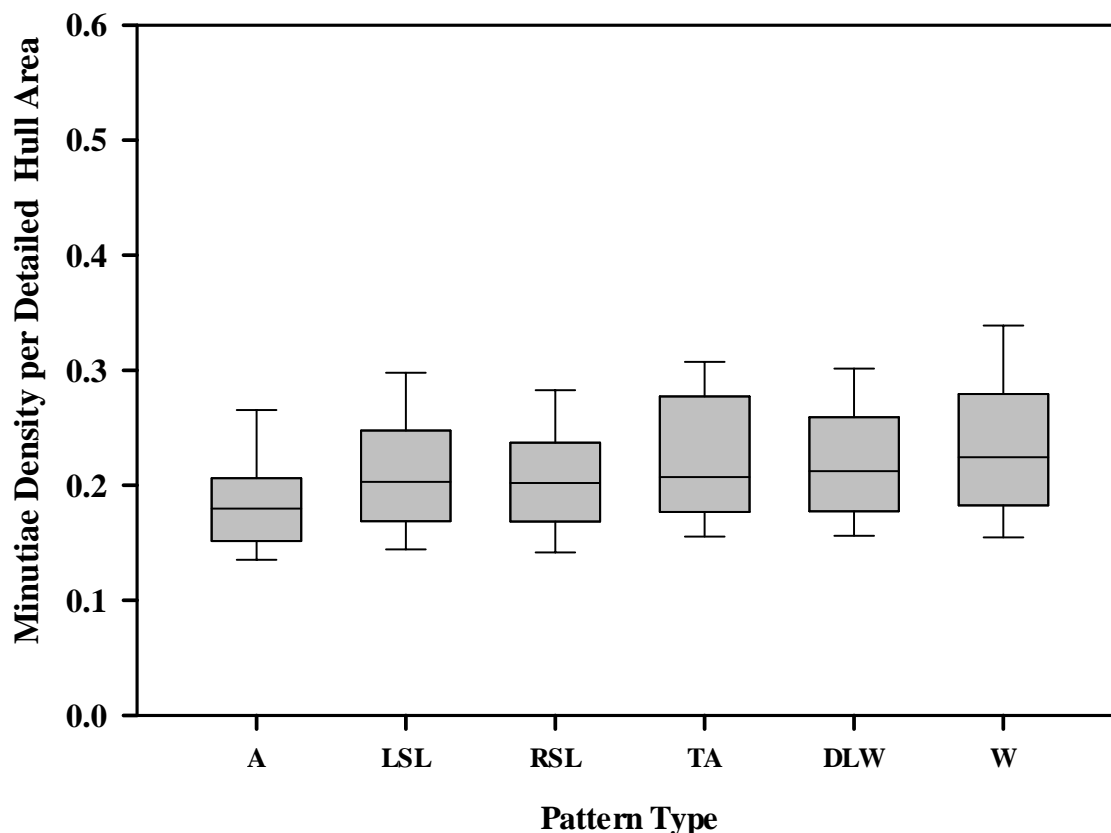
	df	SSE	MSE	F value	p-value
Pattern Type	5	0.0921	0.018425	14.8	0.00000000000000417
Residuals	1194	1.4867	0.001245		

P-values: $\alpha=0.05$

	Arch	LSL	RSL	T.arch	Dbl loop	Whorl
Arch	NA	0.0015032	0.0669361	0.0391189	0.0000092	0.0000000
LSL	0.0015032	NA	0.2955132	0.9999392	0.1971476	0.0000090
RSL	0.0669361	0.2955132	NA	0.9212220	0.0011341	0.0000000
T.arch	0.0391189	0.9999392	0.9212220	NA	0.5482928	0.0172091
Dbl loop	0.0000092	0.1971476	0.0011341	0.5482928	NA	0.3276075
Whorl	0.0000000	0.0000090	0.0000000	0.0172091	0.3276075	N/A

Figure 2-16. Box plots showing distribution of total minutiae density per convex hull area (no. per mm²). Analysis of variance (ANOVA) across pattern types are summarized below. Refer to Table 2-4 for related data summary.

Total Minutiae Density Over Detailed Hull Area



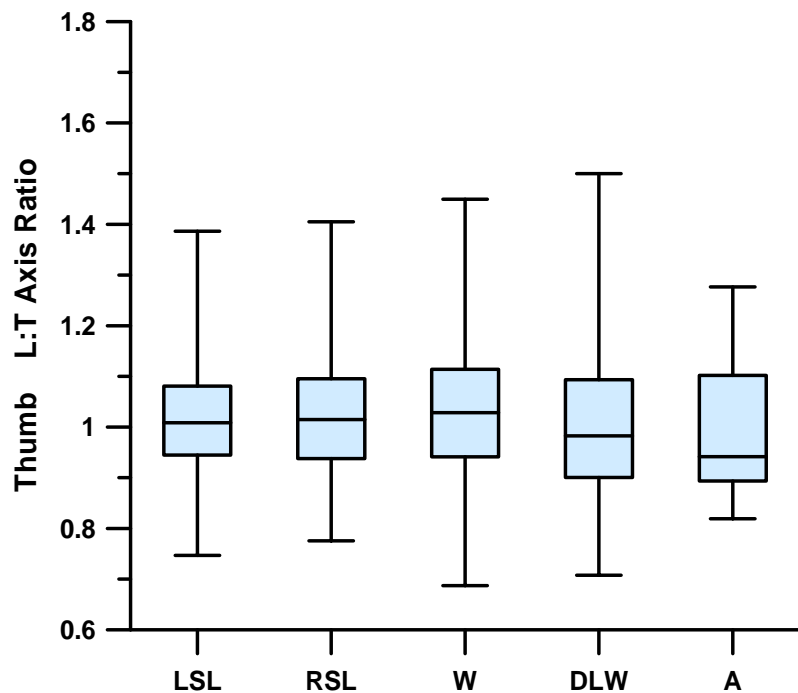
ANOVA: Total minutiae density (no./mm²) over detailed hull area separated by pattern type

	df	SSE	MSE	F value	p-value
Pattern Type	5	0.290	0.05807	15.04	0.0000000000000242
Residuals	1194	4.611	0.00386		

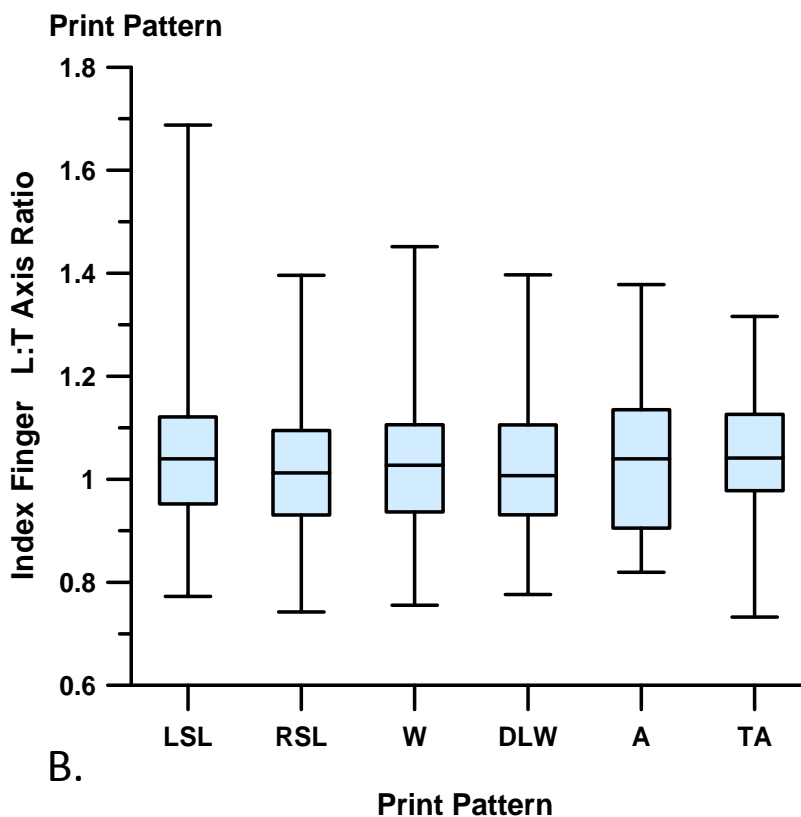
P-values: $\alpha=0.05$

	Arch	LSL	RSL	T.Arch	Dbl loop	Whorl
Arch	NA	0.0144153	0.0855195	0.0041448	0.0003037	0.0000000
LSL	0.0144153	NA	0.8829769	0.7303483	0.3259980	0.0000000
RSL	0.0855195	0.8829769	NA	0.3359697	0.0456987	0.0000000
T.arch	0.0041448	0.7303483	0.3359697	NA	1.0000000	0.1954212
Dbl loop	0.0003037	0.3259980	0.0456987	1.0000000	NA	0.0186161
Whorl	0.0000000	0.0000000	0.0000000	0.1954212	0.0186161	NA

Figure 2-17. Box plots showing distribution of minutiae density per detailed hull area (no. per mm²). Analysis of variance (ANOVA) across pattern types are summarized below. Refer to Table 2-5 for related data summary.



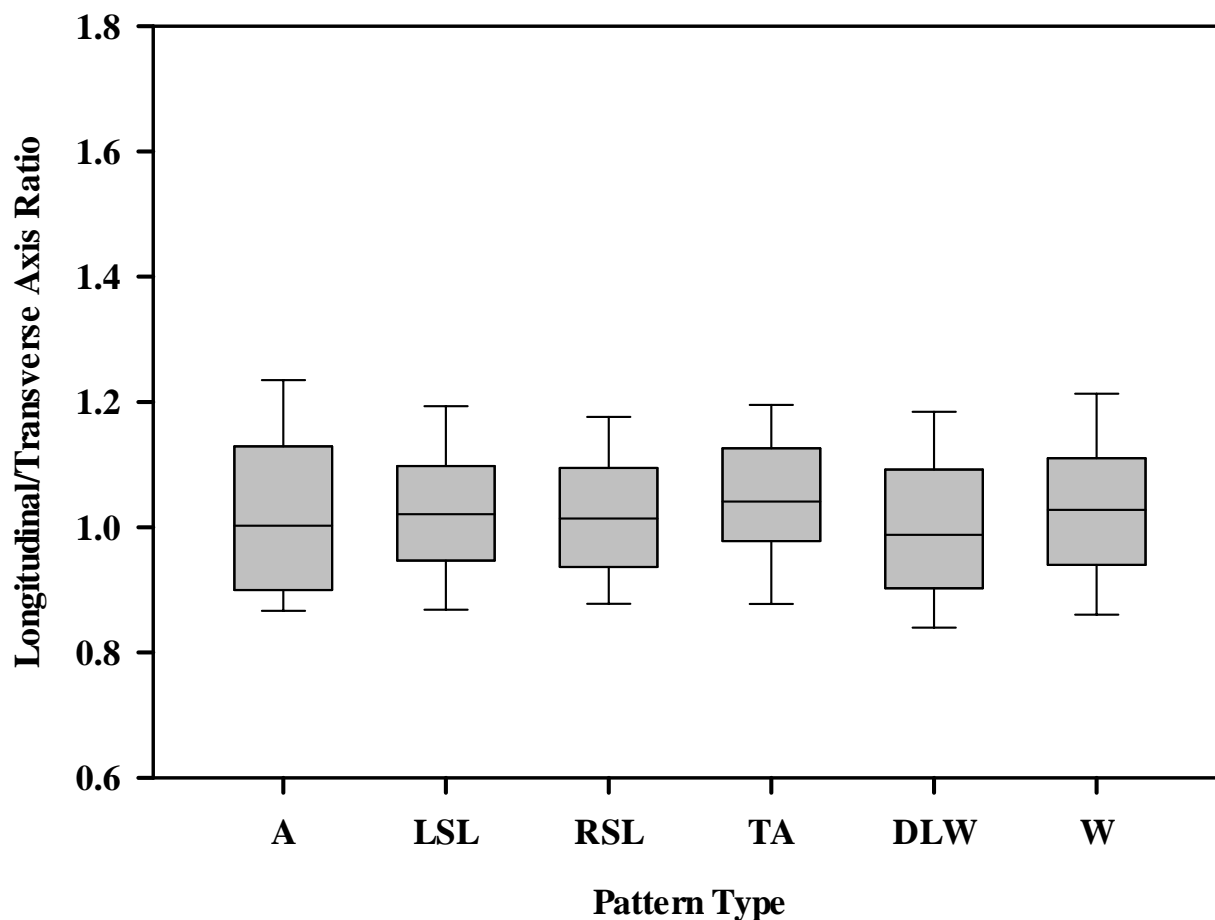
A.



B.

Figure 2-18. Box plots showing distribution of convex hull axial ratios across all pattern types examined in this study. Refer to Table 2-6 for related data summary and to Figure 2-7B for diagrammatic illustration of axial dimensions used to measure hull geometry (L = longitudinal axis length in mm; T = transverse axis length in mm) (note: tented arches did not occur on thumbs in dataset).

Longitudinal-Transverse Ratio by Pattern Type

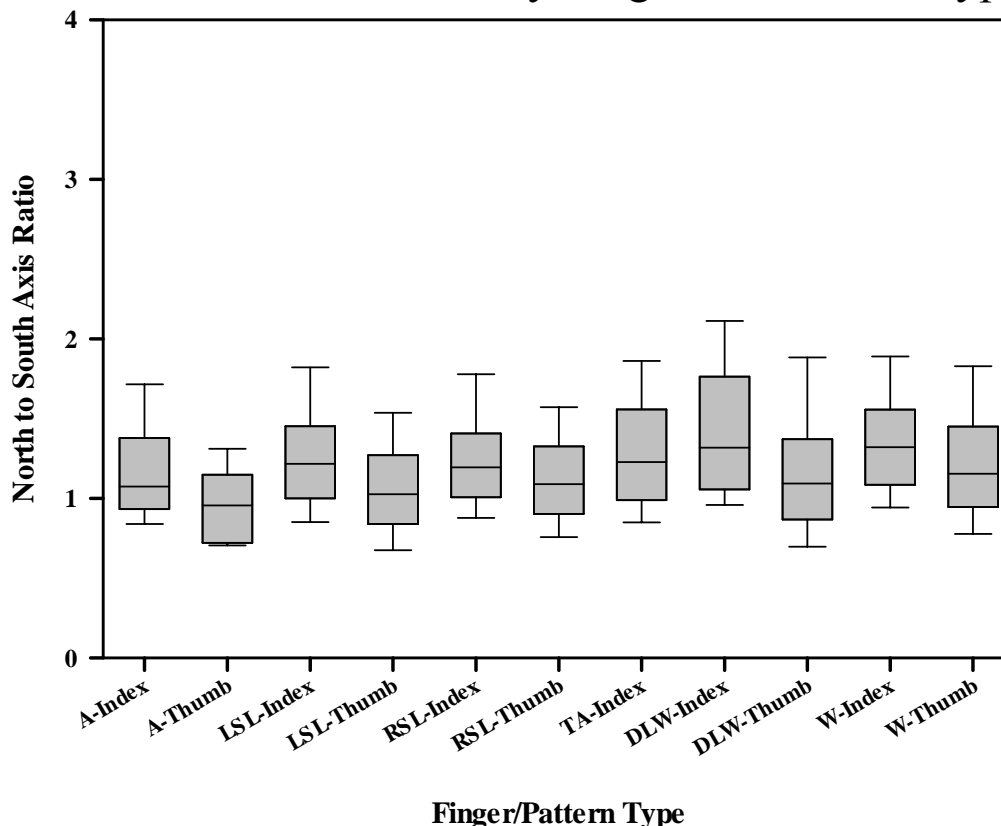


ANOVA: Longitudinal/Transverse axis ratio by pattern type

	df	SSE	MSE	F value	p-value
Pattern Type	5	0.096	0.01923	1.075	0.373
Residuals	1194	21.360	0.01789		

Figure 2-19. Box plots showing distribution of convex hull axial ratios. Analysis of variance (ANOVA) across pattern types are summarized below. Refer to Table 2-6 for related data summary and to Figure 2-7B for diagrammatic illustration of axial dimensions used to measure hull geometry.

North-South Axis Ratio by Finger and Pattern Type



ANOVA: North/South axis ratio by pattern type

	df	SSE	MSE	F value	p-value
Pattern Type	5	6.08	1.217	4.708	0.000291
Finger	1	7.74	7.739	29.951	0.000000054
Pattern Type*Finger	4	1.64	0.410	1.586	0.175578
Residuals	1189	307.23	0.258		

	Arch:I	LSL:I	RSL:I	T.Arch:I	DbI loop:I	Whorl:I	Arch:T	LSL:T	RSL:T	T.Arch:T	DbI loop:T	Whorl:T
Arch:I	NA	0.8835113	0.9973559	0.8192346	0.1758699	0.4679175	0.9499467	0.9967518	1	NA	0.9999969	0.9459585
LSL:I	0.8835113	NA	0.9971687	0.9999987	0.7483235	0.9951065	0.2038209	0.0005255	0.098428	NA	0.8545904	1
RSL:I	0.9973559	0.9971687	NA	0.9863364	0.3084518	0.6751565	0.4644285	0.0435598	0.7182466	NA	0.999867	0.9998494
T.Arch:I	0.8192346	0.9999987	0.9863364	NA	0.9764705	1	0.1710767	0.0087225	0.2034831	NA	0.8296569	0.9999895
DbI loop:I	0.1758699	0.7483235	0.3084518	0.9764705	NA	0.9920498	0.0199723	0.0001542	0.0070114	NA	0.1104891	0.7302978
Whorl:I	0.4679175	0.9951065	0.6751565	1	0.9920498	NA	0.0666095	9.70E-06	0.0051905	NA	0.2525371	0.9921769
Arch:T	0.9499467	0.2038209	0.4644285	0.1710767	0.0199723	0.0666095	NA	0.9982791	0.9426147	NA	0.7121668	0.2700999
LSL:T	0.9967518	0.0005255	0.0435598	0.0087225	0.0001542	9.70E-06	0.9982791	NA	0.9795118	NA	0.4150379	0.0078023
RSL:T	1	0.098428	0.7182466	0.2034831	0.0070114	0.0051905	0.9426147	0.9795118	NA	NA	0.9934509	0.3030109
T.Arch:T	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DbI loop:T	0.9999969	0.8545904	0.999867	0.8296569	0.1104891	0.2525371	0.7121668	0.4150379	0.9934509	NA	NA	0.9624923
Whorl:T	0.9459585	1	0.9998494	0.9999895	0.7302978	0.9921769	0.2700999	0.0078023	0.3030109	NA	0.9624923	NA

Figure 2-20. Box plots showing distribution of convex hull, north/south axial ratios. Two-way analysis of variance (ANOVA) by finger and across print types are summarized below. Refer to Table 2-6 for related data summary and to Figure 2-7B for diagrammatic illustration of axial dimensions used to measure hull geometry.

