Replication Study

Bernasco, W., & van Dijke, R. (2020). Do offenders avoid offending near home? A systematic review of the buffer zone hypothesis. *Crime Science*, *9*:8.

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September 2020

Introduction

In a systematic review of the buffer zone hypothesis published by *Crime Science*, Bernasco and van Dijke (2020) examined 33 studies and concluded two-thirds rejected the hypothesis while one-third supported it.[1] A replication study produced very different findings, the foremost of which was that most of the reviewed articles were inappropriate for this type of analysis.

The final stage of the study selection criteria for the systematic review involved the following three requirements:

> 33 articles were selected that (1) analyzed distances measured with less than 200 m error margins (excluding, for example, articles reporting distances based on neighborhood or census tract centroids) (2) analyzed the distribution of the home-crime distance (excluding articles that only reported means or medians), and (3) drew a (negative or a positive) conclusion on the existence of a buffer zone, or included information detailed enough to allow the coder to draw a conclusion on the buffer zone. (Bernasco & van Dijke, 2020, p. 3)

While several of the reviewed articles mention the term buffer zone in their literature review, only 11 of them discuss the concept in relation to their own research findings.[2] Consequently, for 22 of the studies (2/3 of the sample), the sole determination of the presence of a buffer zone was made by the systematic review's second author on the basis of "information detailed enough to allow the coder to draw a conclusion on the buffer zone" (p. 3). Such information was further elaborated upon in the coding methodology later provided by Bernasco (see Appendix A):

> Can readers observe a buffer zone in the presented data (irrespective of whether the authors draw a conclusion about it)? This can include data presented as graphics (home-crime distance distribution) or tabular data. A buffer zone is observed if the distribution of distance is perfectly or approximately inversely U-shaped (rises monotonically and subsequently falls monotonically).

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[1] The coding methodology used in the systematic review is given in Appendix A. Bernasco and van Dijke's published article did not note which studies supported the presence of a buffer zone and which did not, but this information was later provided by email (see Appendix B). References for the studies are listed in Appendix C.

[2] In addition to being read multiple times for the replication study, all 33 articles were searched using the terms "buffer" (buffer zone), "safety" (safety space/zone), "coal" (coal-sack effect), and "reduced" (area of reduced offending), based on how the concept has been mentioned in the literature. Of the 11 articles that discussed the concept in relation to their own findings, five observed a buffer zone, two did not, and two reported mixed findings; the others did not examine journey-to-crime distances and only tested geographic profiling performance.

Systematic Reviews

When asked for details on the locations of the text, tables, or graphs in the studies used to inform their conclusions, Bernasco responded this was not possible because such specifics were not documented during coding.[3] He noted that systematic review guidelines do not articulate the need for such information. However, most systematic reviews don't require these details because they typically identify and synthesize studies directly related to the subject under review. In this case, none of the 33 studies was originally conducted to primarily test for the presence of a buffer zone. In fact, most of the authors only mentioned the term in the context of their literature review, and only a minority drew any conclusions regarding its presence in their own data. Consequently, it was not a matter of simply recording the published findings of the original researchers; instead, it was necessary to make new subjective interpretation of the data in these studies. Coding decisions were not double-checked for reliability by a second researcher. Given the unusual nature of this particular systematic review, therefore, documentation of the specific rationale for its interpretations is needed for purposes of replication and verification. This becomes all the more necessary given the dramatically different results found by this replication study.

Replication Review Findings

The concurrence level between the findings of this replication study and those of the systematic review was poor, with agreement on 11 studies and disagreement on 22. Six studies originally coded as negative were found to have either positive or mixed evidence for the buffer zone hypothesis; however, the major difference was the discovery that the majority of the studies were unsuitable as they violated the systematic review's selection criteria. These issues are outlined in detail below, followed by a discussion of additional sampling methodology problems, including studies based on simulated or artificial data, nonindependence of data, and the inclusion of crimes without travel (i.e., zero-trip distances).

Three studies coded with negative findings in the systematic review actually had clear evidence of a buffer zone. Lundrigan and Canter wrote, "The 'safety space' was also found to exist for the distances the offenders typically put between their home and their disposal sites" (2001a, p. 431); a buffer zone is also evident from their reported minimum journey-to-crime distances. Sarangi and Youngs observed buffer zones for burglary in both Rourkela and Keonjhar in their minimum distance data and crime frequency distance graphs (2006, Figure 2 and 3, pp. 109-112). And Hammond shows a buffer zone in her sex crime trips distance graph (2014, Figure 2, pp. 363, 365).

Another three studies coded as negative in the systematic review actually had mixed results (i.e., a buffer zone was present for some offender groups, but not for others). There was evidence of buffer zones for damage, display, and destroy arsonists, but not despair arsonists in Fritzon (2001); for offenders travelling by bicycle or public transportation, but not those travelling by foot,

[3] At a minimum, the results of the coding methodology should be available, particularly the assessments of the quality of the evidence for or against the buffer zone hypothesis. Strong evidence was defined as involving statistical tests of large samples or regression modeling of the probability density distance function; medium evidence as conclusions based only on visual or tabular inspection; and weak evidence as "less explicit" (not further explained). Medium and weak evidence categories were merged following coding (see Appendix A).

motor vehicle, or motorcycle in Haginoya (2014); and for burglars but not thieves or auto thieves in Emeno and Bennell (2013).

In total, there was disagreement on 22 cases (3 in which the systematic review found a buffer zone, 19 in which it did not), and agreement on 11 cases (8 in which the systematic review found a buffer zone, 3 in which it did not). Table 1 summarizes the comparative results between the findings of the systematic review and the replication study.

Table 1. Buffer Zone Systematic Review and Replication Study – Comparison of Findings.

Systematic Review Finding		**Replication Study Finding**			
		Present	**Mixed**	**Not Present**	**Indeterminate**
Buffer Zone Present	11	8	0	0	3
Buffed Zone Not Present	22	3	3	3	13
Total	33	11	3	3	16

Table 2 summarizes the selection criteria failures for the 19 studies in which there was disagreement regarding the systematic review's finding of no support for the buffer zone hypothesis. These studies are grouped into three categories according to the replication findings: (1) buffer zone present; (2) buffer zone evidence mixed; and (3) buffer zone indeterminate. Of great concern is the fact that not one of these studies met all the selection criteria required for the systematic review; moreover, some had multiple failures.

This table is then followed by a full detailing of the issues for all 22 disagreed-upon studies, including details and relevant page numbers for the articles. These are grouped into four categories: (1) buffer zone present [according to the replication study] but coded as not found [in the systematic review]; (2) buffer zone evidence mixed but coded as not found; (3) buffer zone indeterminate but coded as not found; and (4) buffer zone indeterminate but coded as found. As the three studies in the last group are not listed in Table 19, their relevant page numbers are listed directly after the reference.

Table 2. Buffer Zone Systematic Review Replication Findings.

Article	Article Discussion	Criteria Failure	Relevant Page Numbers	Comments
Buffer Zone Present				
Lundrigan & Canter (2001a)	yes	3, 4	p. 431	analyzed body dump sites, not crime sites
Sarangi & Youngs (2006)		1	pp. 109-112	
Hammond (2014)	lit review	1	pp. 363, 365	
Buffer Zone Evidence Mixed				
Fritzon (2001)	lit review		pp. 49-50	
Haginoya (2014)	yes	1	pp. 525-526	
Emeno & Bennell (2013)	GP function	1	pp. 215, 220-224, 227-228, 230	
Buffer Zone Indeterminate				
White (1932)		2, 3	p. 507	distances measured between census tract centroids
Godwin & Canter (1997)	lit review	3	pp. 32-34	
Canter et al. (2000)	GP function	3	pp. 463-464, 470-471, 476	analyzed body dump sites, not crime sites
Paulsen (2006)	lit review	3, 4	pp. 306, 313	
Canter & Hammond (2007)	lit review	4	p. 371	no distance data reported
Westerberg, Grant, & Bond (2007)	lit review	3	pp. 113-114	
Iwanski et al. (2011)		4	pp. 71, 73, 75	crime to simulated travel route distances
Andresen, Frank, & Felson (2014)		3, 4	p. 319	
Baudains, Braithwaite, & Johnson (2013)		1, 2	pp. 263, 266	distances measured between LSOA census centroids
Canter et al. (2013)		4	pp. 423, 430	no distance data reported
Drawve, Walker, & Felson (2015)	lit review	3	p. 130	
Mburu & Helbich (2015)	GP function	1	pp. 110, 115, 118	
Gönültas & Sahin (2018)	lit review	3	p. 1171	

1 – distances measured with error margins greater than 200 meters (distance bins in graph)

2 – distances measured from neighborhood or census tract centroids

3 – only reported mean, median, or other summary descriptive distance statistics

4 – did not measure or report any journey-to-crime distances

Buffer Zone Present But Coded as Not Found

Lundrigan, S., & Canter, D. V. (2001a). A multivariate analysis of serial murderers' disposal site location choice. *Journal of Environmental Psychology*, *21*, 423-432.

- analyzed body disposal sites, not crime sites (no mention of excluding cases where victims were buried on the offender's property)
- mean, minimum, and maximum distances reported
- "The 'safety space' was also found to exist for the distances the offenders typically put between their home and their disposal sites" (p. 431).

Sarangi, S., & Youngs, D. E. (2006). Spatial patterns of Indian serial burglars with relevance to geographical profiling. *Journal of Investigative Psychology and Offender Profiling*, *3*, 105-115.

- mean, median, minimum, and maximum JTC distances, and JTC distance graphs reported
- graphs have distance bins of 0.5 km and 0.25 km
- buffer zone present for both Rourkela and Keonjhar burglaries

Hammond, L. (2014). Geographical profiling in a novel context: Prioritising the search for New Zealand sex offenders. *Psychology, Crime & Law*, *20*, 358-371.

- mean and median JTC distances, and JTC distance graph (for New Zealand sex offenders only) reported
- graph has distance bins of 0.5 km
- graph shows presence of buffer zone

Buffer Zone Evidence Mixed But Coded as Not Found

Fritzon, K. (2001). Examination of the relationship between distance travelled and motivational aspects of firesetting behavior. *Journal of Environmental Psychology*, *21*, 45-60.

- buffer zones found for three out of four arsonist types (damage, display, and destroy), 61% of the sample
- buffer zone not found for one arsonist type (despair), most of whom set fire to their own home or the immediate surrounding area

Haginoya, S. (2014). Offender demographics and geographical characteristics by offender means of transportation in serial residential burglaries. *Psychology, Crime & Law*, *20*, 515-534.

- mean, median, minimum, and maximum JTC distances, and JTC distance graphs reported
- graphs have distance bins of 1 km and 5 km
- buffer zones found for offenders traveling by bicycle and by public transportation
- buffer zone not found for offenders traveling by foot, motor vehicle, motorcycle

Emeno, K., & Bennell, C. (2013). The effectiveness of calibrated versus default distance decay functions for geographic profiling: A preliminary examination of crime type. *Psychology, Crime & Law*, *19*, 215-232.

- buffer zone found for burglary
- buffer zone not found for theft or auto theft
- 25% of burglary, 47% of auto theft, and 44% of theft offenders were classified as commuters – meaning a buffer zone was almost certainly present
- only tested geographic profiling performance
- used distance intervals of 0.25 miles for this purpose
- graphs have distance bins of 1 mile

<u>Buffer Zone Indeterminate But Coded as Not Found</u>

White, R. C. (1932). The relation of felonies to environmental factors in Indianapolis. *Social Forces*, *10*, 498-509.

- only mean JTC distances reported
- distances measured from the middle of the residence census tract to the middle of the offense census tract

Godwin, G. M., & Canter, D. V. (1997). Encounter and death: The spatial behavior of U.S. serial killers. *Policing: An International Journal of Police Strategy and Management*, *20*, 24-38.

- only mean JTC distances (overall and by temporal order) reported

Canter, D. V., Coffey, T., Huntley, M., & Missen, C. (2000). Predicting serial killers' home base using a decision support system. *Journal of Quantitative Criminology*, *16*, 457-478.

- analyzed body disposal sites, not crime sites (no mention of excluding cases where victims were buried on the offender's property)
- only mean, minimum, and maximum distances reported
- tested geographic profiling performance
- concluded increased search costs did not support the assumption of a simple buffer zone of the form studied – defined as an area with zero offending
- the finding of no buffer zone is inconsistent with the findings of a buffer zone in Lundrigan and Canter (2001b) and Canter and Hammond (2006), as these studies analyzed many of the same cases

Paulsen, D. J. (2006). Connecting the dots: Assessing the accuracy of geographic profiling software. *Policing: An International Journal of Police Strategies & Management*, *29*, 306-334.

- only mean JTC distances reported
- only tested geographic profiling performance

Canter, D., & Hammond, L. (2007). Prioritizing burglars: Comparing the effectiveness of geographical profiling methods. *Police Practice and Research*, *8*, 371-384.

- no distance data reported
- only tested geographic profiling performance

Westerberg, K., Grant, T., & Bond, J. W. (2007). Triangulation mobility of auto-theft offenders. *Journal of Investigative Psychology and Offender Profiling*, *4*, 109-120.

- only mean and median JTC distances reported
- distances measured between postcode center points

Iwanski, N., Frank, R., Dabbaghian, V., Reid, A., & Brantingham, P. (2011). Analyzing an offender's journey to crime: A Criminal Movement Model (CriMM). *Proceedings – 2011 European Intelligence and Security Informatics Conference*, Athens, Greece (pp. 70-77). doi: 10.1109/EISIC.2011.13.

- only reported distances measured from crime locations to simulated travel routes between offenders' homes and major attractors

Andresen, M. A., Frank, R., & Felson, M. (2014). Age and the distance to crime. *Criminology and Criminal Justice*, *14*, 314-333.

- only median and quartile JTC distances reported

Baudains, P., Braithwaite, A., & Johnson, S. D. (2013). Target choice during extreme events: A discrete spatial choice model of the 2011 London riots. *Criminology*, *51*, 251-285.

- JTC distances measured between LSOA (Lower Super Output Area) centroids, unless offender residence and offense were in the same centroid; distances were then measured between actual locations
- graph has distance bins of 715 meters

Canter, D., Hammond, L., Youngs, D., & Juszczak, P. (2013). The efficacy of ideographic models for geographical offender profiling. *Journal of Quantitative Criminology*, *29*, 423-446.

- no distance data reported
- map shows the presence of a buffer zone (Figure 3, p. 430)
- only tested geographic profiling performance

Drawve, G., Walker, J. T., & Felson, M. (2015). Juvenile offenders: An examination of distance-to-crime and crime clusters. *Cartography and Geographic Information Science*, *42*, 122-133.

- only median and quartile JTC distances reported

Mburu, L., & Helbich, M. (2015). Evaluating the accuracy and effectiveness of criminal geographic profiling methods: The case of Dandora, Kenya. *The Professional Geographer*, *67*, 110-120.

- focused on testing geographic profiling performance
- JTC distance graph reported
- graph has distance bins of 2 km

Gönültas, B. M., & Sahin, B. (2018). Event locations in extra-familial child sexual molestation cases: The Istanbul example. *International Journal of Offender Therapy and Comparative Criminology*, *62*, 1164-1178.

- only mean, median, minimum, and maximum JTC distances reported

<u>Buffer Zone Indeterminate But Coded as Found</u>

Stile, J., & Brown, D. (2003). Geographic profiling with event prediction. *SMC'03 Conference Proceedings*. 2003 IEEE International Conference on Systems, Man and Cybernetics, Washington, DC (pp. 3712-3719). doi: 10.1109/ICSMC.2003.1244466. (p. 3717)

- no distance data reported
- only discusses a prediction model that combines geographic profiling with crime forecasting methodologies
- illustrated with an artificial data set of crime incidents

Lundrigan, S., & Canter, D. V. (2001b). Spatial patterns of serial murder: An analysis of disposal site location choice. *Behavioral Sciences and the Law*, *19*, 595-610. (pp. 600-602)

- analyzed body disposal sites, not crime sites (no mention of excluding cases where victims were buried on the offender's property)
- mean, median, minimum, and maximum distances, and distance graph reported
- graph has distance bins of 40 km

Canter, D. V., & Hammond, L. (2006). A comparison of the efficacy of different decay functions in geographical profiling for a sample of US serial killers. *Journal of Investigative Psychology and Offender Profiling*, *3*, 91-103. (pp. 91, 96-97)

- analyzed body disposal sites, not crime sites (no mention of excluding cases where victims were buried on the offender's property)
- distance graph reported
- graph has distance bins of 1 km

Sampling Problems

The systematic review suffered from further problems with its sampling frame by including studies with non-independent data, crimes involving no travel (i.e., zero distances), and articles with no journey-to-crime data.

Crimes Without Travel

The systematic review selection criteria did not require data that actually involved a journey to crime. This creates a major problem as zero-distance crimes (i.e., those that occurred at the offender's residence) distort travel distributions and obscure buffer zones. They therefore have to be excluded. The literature is clear that the buffer zone concept does not apply to all crime types. It is less likely to be present with high-affect and violent crimes, high-risk offenses, and crimes with no victim search behavior such as domestic homicide (Brantingham & Brantingham, 1981, pp. 31-33, 1984, p. 346; Rossmo, 2000, pp. 102, 119-122; Turner, 1981, pp. 13, 15, 17, 24-25). Criminals who offend in their own homes have control over the environment, and by definition have a suitable target, so the postulated reasons for the existence of a buffer zone – anonymity and target access – are not applicable. To include studies of crimes in which the buffer zone was never meant to apply is highly misleading. Moreover, such cases have no relevance for geographic profiling; either zero-distance crime locations are not known to police investigators, or they have been discovered – along with the identity of the offender.

No Journey-to-Crime Data

Nine of the studies used in the systematic review did not collect or report journey-to-crime data. Stile and Brown (2003) discuss a prediction model, based on the integration of geographic profiling and forecasting methodologies, that they only illustrate with an artificial data set of crimes. Iwanski, Frank, Dabbaghian, Reid, and Brantingham (2011) report distances measured from crime locations to simulated travel routes between offenders' homes and major attractors.

Five of the articles examined distances to the body disposal sites of serial murderers – not to their crime sites. There are multiple problems with including these data. First, the distance from a killer's home to the place where he disposes of a murder victim is not a journey-to-crime distance. Body dump sites are analogous to stolen vehicle recovery locations – both require a "journey after crime." Moreover, such distances are typically much longer than the usual crime trip, with the exception of those cases where the offender buries victims on his property and the distance is zero. Second, as noted below, these studies are not independent. Third, serial murder is a very rare phenomenon; bodies buried on the property of a serial killer tell us little about the geography of the typical crime and generalizing to more common offenses is highly specious.

Nonindependence

Systematic reviews should canvass independent studies and not double-count those using the same data. However, five of the studies here were based on identical or correlated data:

- Godwin and Canter (1997) – 54 US serial killers (630 victims)
- Canter, Coffey, Huntley, and Missen (2000) – 79 US serial killers (87 victims)

- Lundrigan and Canter (2001a) – 120 US serial killers (898 victims)
- Lundrigan and Canter (2001b) – 126 US serial killers (898 victims) + 29 UK serial killers (207 victims)
- Canter and Hammond (2006) – 96 US serial killers (480 victims)

Despite these data overlaps, the systematic review came up with conflicting results between some of the studies regarding evidence of a buffer zone. Finally, as noted above, these are not journey-to-crime studies; instead of analyzing the relationship between offender residence and murder scenes, they analyzed the distance to body dump sites.

Conclusion

Leaving aside the important issue of an ecological fallacy, this systematic review miscoded several of the studies and failed to follow its own methodology. Efforts to replicate its findings failed. Moreover, not one of the disagreed-upon 19 studies for which the review reported no evidence for the buffer zone hypothesis met all the specified selection criteria. The authors are not able to provide detail on the specific content in the 33 studies they used to support their subjective interpretations.

Replication is the foundation of science. Given the radically different findings of this replication study, and the inability of the authors to support the original conclusions of their systematic review, the proper course of action is for the article to be retracted. *Crime Science* is published by Springer Nature and is therefore a member of the Committee on Publication Ethics (COPE) (https://publicationethics.org). COPE has recommended procedures and flowcharts for situations involving cases in which readers raise concerns over data integrity and replication failures. These should now be followed.

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Appendix A – Systematic Review Coding Methodology

Coding Methodology

(1) Is the 'buffer zone' mentioned in the text, either literally or in a paraphrase apparently intended to express the phenomenon (e.g., "an area of reduced offending near offender's home")? [YES / NO]

(2) Can readers observe a buffer zone in the presented data (irrespective of whether the authors draw a conclusion about it)? This can include data presented as graphics (home-crime distance distribution) or tabular data. A buffer zone is observed if the distribution of distance is perfectly or approximately inversely U-shaped (rises monotonically and subsequently falls monotonically). [YES / NO]

(3) Based on their own data, do the authors draw a conclusion about the presence/absence of a buffer zone (either positive or negative)? Again, the buffer zone can be mentioned literally or paraphrased. [YES / NO]

(4) If the authors draw a conclusion (answer to 3), is it positive, negative or uncertain?

[POSITIVE / NEGATIVE / UNKNOWN]

(5) What is the methodological quality of evidence provided pro or against the buffer zone hypothesis? STRONG quality is when a (buffer zone) hypothesis is statistically tested on a large sample (> ~100 offences). Statistical tests also include regression modeling of frequency/probability/density as a function of distance, if it allows estimation of the shape of the distance decay function. MEDIUM quality is when conclusions are based on visual or tabular inspection only, and WEAK is when less explicit evidence is provided. (NOTE: After the coding it was decided that the distinction between MEDIUM and WEAK was not useful, and we merged the categories together). [STRONG / MEDIUM-WEAK]

Appendix B – Systematic Review Article Buffer Zone Conclusions

Year	Author 1	Source	BZ Conclusion
1932	White	Social Forces	non-exist
1997	Godwin	International Journal of Police Science & Management	non-exist
1998	Warren	Journal of Quantitative Criminology	exist
2000	Canter	Journal of Quantitative Criminology	non-exist
2001	Fritzon	Journal of Environmental Psychology	non-exist
2001	Lundrigan	Journal of Environmental Psychology	non-exist
2001	Lundrigan	Behavioral Sciences and Law	exist
2002	Potchak	Criminal Justice Policy Review	exist
2003	Santtila	Forensic Science International	exist
2003	Stile	International conference of Systems	exist
2006	Bernasco	Journal of Investigative Psychology and Offender Profiling	exist
2006	Canter	Journal of Investigative Psychology and Offender Profiling	exist
2006	Edwards	Australian Psychologist	exist
2006	Paulsen	An International Journal of Police Strategies & Management	non-exist
2006	Sarangi	Journal of Investigative Psychology and Offender Profiling	non-exist
2007	Canter	Police Practice & Research	non-exist
2007	Rattner	The Annals of Regional Science	exist
2007	Van Patten	Journal of Forensic Science	non-exist
2007	Westerberg	Journal of Investigative Psychology and Offender Profiling	non-exist
2008	Malm	Security Journal	exist
2011	Bichler	Journal of Research in Crime and Delinquency	exist
2011	Iwanski	European Intelligence and Security Informatics Conference	non-exist
2012	Wheeler	Journal of Quantitative Criminology	non-exist
2013	Andresen	Criminology and Criminal Justice	non-exist
2013	Baudains	Criminology	non-exist
2013	Canter	Journal of Quantitative Criminology	non-exist
2013	Emeno	Psychology Crime and Law	non-exist
2014	Drawve	Cartography and Geographic Information Science	non-exist
2014	Haginoya	Psychology Crime and Law	non-exist
2014	Hammond	Psychology Crime and Law	non-exist
2015	Mburu	The Professional Geographer	non-exist
2018	Chopin	Sexual Abuse	non-exist
2018	Gönültas	International Journal of Offender Therapy and Comparative Criminology	non-exist

Appendix C – Systematic Review Article References

Andresen, M. A., Frank, R., & Felson, M. (2014). Age and the distance to crime. *Criminology and Criminal Justice*, *14*, 314-333.

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Canter, D., Hammond, L., Youngs, D., & Juszczak, P. (2013). The efficacy of ideographic models for geographical offender profiling. *Journal of Quantitative Criminology*, *29*, 423-446.

Chopin, J., & Caneppele, S. (2019). The mobility crime triangle for sexual offenders and the role of individual and environmental factors. *Sexual Abuse*, *31*, 812-836.

Drawve, G., Walker, J. T., & Felson, M. (2015). Juvenile offenders: An examination of distance-to-crime and crime clusters. *Cartography and Geographic Information Science*, *42*, 122-133.

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Lundrigan, S., & Canter, D. V. (2001b). Spatial patterns of serial murder: An analysis of disposal site location choice. *Behavioral Sciences and the Law*, *19*, 595-610.

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