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Apple Pie Proxemics: Edward T. Hall in the Kitchen Work Triangle

Heidi Overhill

“I hate being touched or bumped, even by people who are close to me. That’s why this kitchen makes me so mad when I’m trying to get dinner and someone is always in my way.”

Kitchen user quoted by Edward T. Hall, 1966.¹

Introduction

A prototype for the common kitchen “work triangle” may be seen in a 1913 diagram drawn by American home economist Christine Frederick, who used a thin dotted line to describe the “chains of steps” taken while doing chores. Frederick’s abstraction of the working body to a moving point in space is still used today to describe kitchen work, establishing a two-dimensional linear rhetoric that obscures the importance of three-dimensional body mass in proper planning. An attempt to review that oversight using the 1960s “proxemics” concepts of anthropologist Edward T. Hall reveals that his heritage suffers from significant citation distortion. To refresh his insights, and to introduce the context of the kitchen, this new study measures the effect of a hot apple pie on domestic body spacing inside the author’s home. The study’s method permits access to qualitative insider “emic” insights, as well as quantitative outsider “etic” observations. The results reveal flaws in accepted principles of proxemics, kitchen function, and ergonomics.

Design planning suffers when complex problems are oversimplified.² The common kitchen work triangle is one such oversimplification. As a geometric shape linking the stove, sink, and fridge on an architectural floor-plan, a work triangle describes kitchen walking distances. But distance is not the only factor affecting kitchen actions, which must also consider the tangible human body and its adjacent “bubble” of empty “personal space.” However, dimensions are hard to establish for personal working space. Anthropometric body measurements neglect the effects of posture, as when jutting elbows increase effective body width. Anthropological studies review social distances in conversation but neglect non-conversational activities. Both neglect architecture, motion, and the manipulation of objects. In short, no

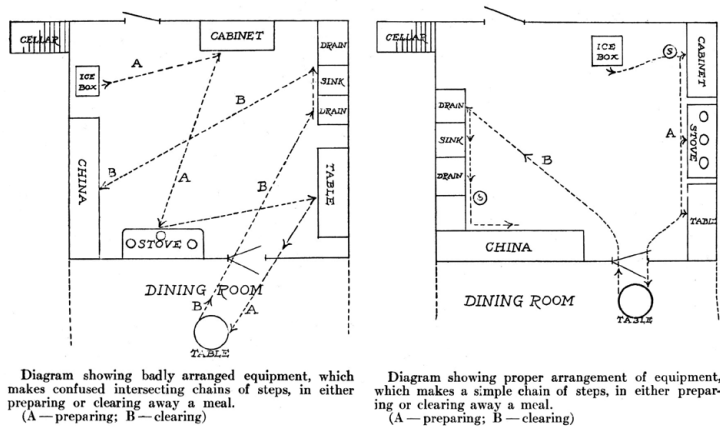
1 Edward T. Hall, *The Hidden Dimension* (New York: Random House, 1966), 53.

2 Kevin B. Bennett and John M. Flach, *Display and Interface Design: Subtle Science, Exact Art* (Boca Raton, FL: CRC Press, 2011), 7.

Figure 1

Christine Frederick, diagram of “badly arranged” and “proper” equipment in the kitchen, 1912.

- 3 Dina Allen, Archives Research Specialist, University of Illinois Archives Department, email message to author, November 1, 2011. See also “History of the Building Research Council,” School of Architecture, University of Illinois at Urbana-Champaign, www.arch.illinois.edu/programs/engagement/brc/history/ (accessed July 20, 2012).
- 4 Catharine Beecher and Harriet Beecher Stowe, *The American Woman's Home* (New York: J. B. Ford and Company, 1869), 36.
- 5 Martha Van Rensselaer, *Saving Steps: Reading-Lesson No. 1 for Farmers' Wives* (1901; repr., Ithaca, NY: Cornell University, 2000).
- 6 Nancy Hillier, “The Hoosier Cabinet and the American Housewife,” *Indiana Magazine of History* 105, no. 1 (2009): 1-30.
- 7 Christine Frederick, *The New Housekeeping: Efficiency Studies in Home Management* (New York: Curtis Publishing, 1912).
- 8 Bruno Taut, *Die Neue Wohnung: Die Frau Als Schöpferin [The New Apartment: The Woman as Creator]* (Leipzig: Verlag Klinkhardt und Bierman [Publisher Klinkhardt and Bierman], 1926).
- 9 Ellen Lupton and J. Abbott Miller, *The Bathroom, the Kitchen and the Aesthetics of Waste: A Process of Elimination* (Cambridge, MA: MIT List Visual Center, 1992), 48.
- 10 Patrick J. Galvin, with Ellen Cheever, *Kitchen Basics: A Training Primer for Specialists* (Hackettstown, NY: National Kitchen and Bath Association, 1998), 48.
- 11 “Time-motion studies by RISD researchers found that it takes only 100 steps to prepare a spaghetti dinner in the universally design kitchen.” Design Features, *Metropolis Magazine*, December 1998. www.metropolismag.com/html/content_1298/de98pdcs.htm (accessed January 12, 2013). [Note: the original source no longer shows the diagram. This is a slightly different diagram from a different source making the same point].
- 12 Donald R. Priestly, *Kitchen Remodeling for Dummies* (New York: Wiley, 2003).



data exist to describe the spatial needs of moving people as they handle hot and/or wet things within the confined interior of the domestic kitchen.

Christine Frederick's Kitchen

The phrase “kitchen work triangle” was coined around 1947 by the Building Research Council of the University of Illinois,³ but the desirability of short walking distances had been established earlier. In 1869, advice writer Catharine Beecher published a kitchen design that would “save many steps in setting and clearing [the] table.”⁴ In 1901, home economist Martha Van Rensselaer of Cornell University issued *Saving Steps: Reading-Lesson No. 1 for Farmers' Wives*, establishing “footsteps” as a metonymic symbol representing kitchen duties in general.⁵ Contemporary advertising for Hoosier brand kitchen cabinets illustrated the idea with tiny footprints on kitchen floorplans,⁶ a visual argument refined in Christine Frederick's *The New Housekeeping* (1912) into a ruler-straight dotted line. Drawn onto before-and-after floorplans, her line demonstrated how a “proper arrangement of equipment” transformed “confused intersecting chains of steps” into a crisp triangle of non-overlapping motion (see Figure 1).⁷ The diagram achieved lasting success. Copied and republished by Bruno Taut in Germany in 1926,⁸ it influenced design internationally.⁹ It continues to be used today and can be seen in the *Training Primer* of the U.S. National Kitchen and Bath Association (1998),¹⁰ in the experimental *Universal Kitchen* of the Rhode Island School of Design (1995),¹¹ and in *Kitchen Remodeling for Dummies* (2003).¹² But while counting footsteps is effective as rhetoric, it is not really a good summary of kitchen activity.

Frederick's diagram made no attempt to indicate body mass, but its popularity may in part derive from its suggestion of better interpersonal spacing. The “A” and “B” lines supposedly show the same person at different times: first preparing a meal and then clearing up after it. But the superimposition suggests simultaneity, and if “A” and “B” represent two people at the same

- 13 Jane Lancaster, *Making Time: Lillian Moller Gilbreth: A Life Beyond "Cheaper by the Dozen"* (Boston: Northeastern University Press, 2004), 261.
- 14 Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: McGraw-Hill, 1964), 22.
- 15 Janice Williams Rutherford, *Selling Mrs. Consumer: Christine Frederick and the Birth of Household Efficiency* (Athens, GA: University of Georgia Press, 2003).
- 16 George Mucho, "The Single Family Dwelling of the Staatliche Bauhaus," in *The Bauhaus: Weimar, Dessau, Berlin, Chicago*, Paperback edition. ed. Hans M. Wingler, trans. Wolfgang Jabs and Basil Gilbert (1962; repr., Cambridge MA: MIT Press, 1978), 66. Originally published in *Velhagen und Klasings Monatsheft [Velhagen and Klasings Monthly Bulletin]* 38, no. 9 (1924): 331.
- 17 Ernest Irving Freese, "Geometry of the Human Figure," *American Architect and Architecture*, (July 1934), 57–60. Stylized drawings of key body dimensions were added to the Architectural Graphic Standards in 1941. Lance Housey, "Hidden Lines: Gender, Race, and the Body in Graphic Standards," *Journal of Architectural Education* 55, no. 2 (2001): 101–12. See also American Institute of Architects, *Architectural Graphic Standards*, 11th ed. (Hoboken, NJ: Wiley & Sons, 2007) and Stephen B. Wilcox, "Introduction," in *The Measure of Man and Woman: Human Factors in Design*, ed. Alvin R. Tilley and Henry Dreyfuss Associates (Hoboken, NJ: Wiley & Sons, 2001), 3–8.
- 18 Edward T. Hall, "Proxemics: The Study of Man's Spatial Relations," in *Man's Image in Medicine and Anthropology*, ed. Iago Galdston (New York: International Universities Press, 1963). See also Robert Sommer, *Personal Space: The Behavioural Basis of Design* (Englewood Cliffs, NJ: Prentice Hall, 1969).
- 19 Edward T. Hall, "Proxemics," *Current Anthropology* 9 nos. 2/3 (1968): 85.
- 20 Edward T. Hall, *The Hidden Dimension* (New York: Random House, 1966), 116.
- 21 For a close study of the progress of citation distortion in medical settings, see S. A. Greenberg, "Understanding Belief Using Citation Networks," *Journal of Evaluation in Clinical Practice* 17 (2011): 389–93.

time, then the "proper arrangement" is superior because users no longer bump into each other. Frederick marketed her book to solitary housewives working without servants, but multiple workers were common even in servantless households, as unmarried adult daughters and aunts helped with domestic chores.¹³

Misinterpretation of the diagram is facilitated by its simplified style. In media terms, this diagram is a piece of "cool" communications. Whereas a polished rendering would permit passive gazing, a schematic diagram forces viewers to project their own interpretations onto the unspecified details.¹⁴ For example, a modern reader might conclude that the "proper arrangement" shows a continuous, L-shaped countertop in the bottom left corner—but photographs of Frederick's test kitchen show only late Victorian loose tables and cabinets.¹⁵ The first continuous kitchen countertop would only appear ten years later, in 1924, at the Haus am Horn of the Weimar Bauhaus.¹⁶ Frederick's sketchy diagram style allows viewers to interpret its meaning based on their own assumptions.

Hall's Proxemics

When Frederick created her diagram, reference information about the human body was not readily available. The first publications describing body size for use by architects appeared only in the 1930s.¹⁷ Using side views or elevations to illustrate body dimensions these specifications did not translate well onto architectural plan views. They also do not adequately describe architectural requirements for body space because people tend to adopt a territorial attitude toward a small personal volume of space surrounding their bodies. The nature of that space was explored by American anthropologist Edward T. Hall in the 1960s.¹⁸ Hall's experiences in international diplomacy had made him aware of cultural differences in body spacing, as when North and South Americans mistakenly interpret each other as being "pushy" or "cold" for standing either too close or too far away. Working with volunteers from his immediate social circles, Hall measured what he called "proxemic" distances for middle-class North Americans, using a qualitative toolkit of "observation, experiment, interviews (structured and unstructured), analysis of the English lexicon, and the study of space as it is recreated in literature and in art."¹⁹ His results revealed a spatial hierarchy that started with "close intimate" (up to six inches), then went to "intimate" (up to 18 inches), "personal" (up to 4 feet), "social" (up to 12 feet), and "public" (effective at 25 feet). Recognizing that his research was limited, he wrote: "These descriptions represent only a first approximation. They will doubtless seem crude when more is known."²⁰

Despite his reservations, Hall's numbers continue to be used today. However, references citing only secondary and tertiary interpretations of his work have introduced progressive errors that distort his original data.²¹ For example, an incorrect metric

Table 1 | Incorrect Metric Conversion of Hall's Imperial Dimensions

Zone	Hall's dimension	Metric conversion	Correct rounding	Distorted citation
Intimate	18 inches	0.4572 m	0.46 m	0.45 m
Personal	4 feet	1.2192 m	1.2 m	1.2 m
Social	12 feet	3.6576 m	3.7 m	3.6 m
Public	25 feet	7.62 m	7.6 m	7.5 m

“equivalent”—very possibly the result of a single past mathematical error—invariably specifies Hall’s dimensions as 0.45 meters, 1.2 meters, 3.6 meters, and 7.5 meters (see Table 1). These numbers have “escaped into the wild” and can be found in sources that describe them as measuring “northern Europeans,”²² that credit the incorrect metrics to Hall himself (when he worked only in feet and inches),²³ or that do not mention Hall at all.²⁴ As some readers might note, this error probably is not significant. It introduces a variation of at most 0.12 meters over 7.6 meters (about 4¾ inches across 25 feet). Given the inexact nature of the qualitative research methods, and the suspiciously tidy original numbers, the modified metric distances are probably close enough.

More serious distortions are introduced by misleading illustrations. Current visual representations of Hall’s numbers show the proxemic zones as concentric circles ringing a central body.²⁵ This depiction probably reflects Hall’s intent to some degree in that, when writing about animals, he observed that “[p]ersonal distance can be likened to a bubble that surrounds the organism.”²⁶ However, his research into human social space concentrated on conversation, and his own diagram consisted of a bar graph of linear distances only, illustrated with thumbnail sketches showing two people standing face-to-face or side-by-side—but never back-to-back or front-to-back.²⁷ In other words, Hall appears not to have measured human spacing to the rear, meaning that the back half of any circle diagram has no basis in research. Hall did comment elsewhere on distance to the rear in terms of office furniture, but he provided no dimensions.²⁸

Significant distortion is also introduced into the bubble diagrams when they start their measurements at the midpoint of the central body. This approach is easy to draw, but it almost certainly does not represent Hall’s findings. His own diagram did not specify a starting point, but his research methods were mainly verbal; and saying that another person is “18 inches away” can only describe the distance between body surfaces—not between hypothetical internal midpoints.

22 David Lambert, *Body Language* (Glasgow: Harper Collins, 2004).

23 Toshitaka Amaoka et al., “Personal Space Modeling for Human-Computer Interaction,” in *Entertainment Computing – ICEC 2009 8th International Conference, Paris, France, September 3-5, 2009. Proceedings*. Lecture Notes in Computer Science, eds. Stéphane Natkin and Jérôme Dupire. (Berlin: Springer of publication, 2009), 60–72.

24 M. L. Walters et al., “Exploratory Studies on Social Spaces Between Humans and a Mechanical Looking Robot,” *Connection Science* 18, no. 4 (2006): 429-49.

25 For a typical example, see Wikipedia, “Proxemics,” <http://en.wikipedia.org/wiki/Proxemics> (accessed July 5, 2012). To date, I have been unable to find any illustration style for Hall’s proxemics zones that shows them as anything other than concentric circles centered on the body mid-point.

26 Hall, “Proxemics: The Study of Man’s Spatial Relations,” 436.

27 Hall, “Proxemics,” 83-108.

28 Hall, *The Hidden Dimension*, 50-51.

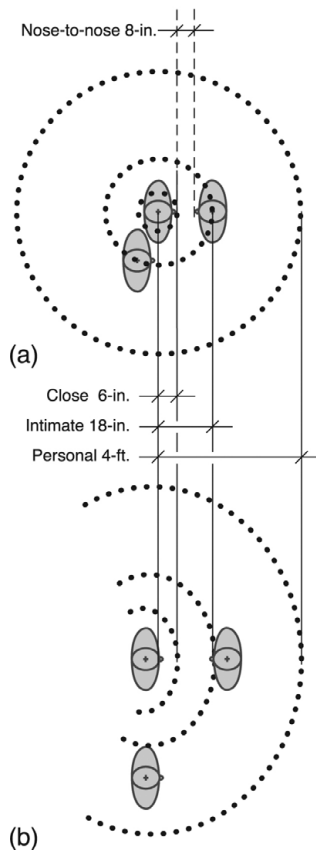


Figure 2
Edward T. Hall's 1968 proxemic dimensions interpreted as (a) body midline-to-midline and (b) body surface-to-surface.

Figure 2, drawn approximately to scale, contrasts surface-to-surface and midline-to-midline interpretations of Hall's data. The sagittal plane or body thickness dimension used in this illustration is based on me. I stood against the wall, pulled a chair against my body, and measured the gap, which came to roughly 10 inches, or 25 centimeters, including bathrobe. When two bodies of that thickness are positioned 18 inches apart, measured from both midlines, the resulting nose-to-nose "intimate" distance is only 8 inches—intuitively too close—and is furthermore physically impossible at the side—the bodies overlap. However, the alternative surface-to-surface interpretation also presents problems. Nose-to-nose, 18 inches feels correct for intimate conversation, but 18 inches shoulder-to-shoulder feels distant. Pragmatically, Hall's findings might be valid only for surface-to-surface and face-to-face measures.

When distorted interpretations of Hall's data introduce an error of at least plus or minus 10 inches on initial measurements as small as 6 inches, they extrapolate those measurements into directions not originally researched. It can only be concluded that their current use is essentially nonsensical.

That Hall's definitions remain in use might be the result of the difficulty of getting better data. His own continued research suffered from chronic observer bias.²⁹ He admitted that "[u]nless one is blessed with an unusual amount of patience and persistence, is highly motivated, and has some natural aptitude for observing, proxemic research may not be rewarding."³⁰ Hall's conceptualization of the subject as a cultural issue demanded attention to multiple variables. His "System for the Notation of Proxemic Behavior" required memorization of a complex numerical code in which the record, "55, 0, 101, 0, 23, 2, 2, 1," documents "two men standing, facing each other, close enough to touch, but not touching, looking at each other intermittently, feeling some radiant heat, smelling some body odor, and speaking softly."³¹

More recent proxemic research concentrates on distance alone, using three main methods: natural observation, simulation with models, and laboratory experimentation. Natural observation of unaware subjects is theoretically ideal but suffers from practical problems around accuracy of measuring, uncontrollable variables, and ethical issues. Research using representations like floorplans is easy to organize but requires participants to rely on subjective impressions of distance and to work from memory on scaled-down dimensions, all of which are known to affect accuracy. For these reasons, most proxemic research takes place in laboratories, using a "stop distance" methodology in which an intruder walks toward a test participant until he or she is asked to stop.³²

29 Michael O. Watson, "Proxemics: A Complex Science," *Reviews in Anthropology* 2, no. 4 (1975): 517.

30 Edward T. Hall, *Handbook for Proxemic Research* (Washington, DC: Society for the Anthropology of Visual Communication, 1974), 16.

31 Edward T. Hall, "A System for the Notation of Proxemic Behavior," *American Anthropologist* 65, no. 5 (1963): 1021.

32 Robert Gifford, *Environmental Psychology, Principles and Practice*, 3rd ed. (Colville, WA: Optimal Books, 2002), 125-26.

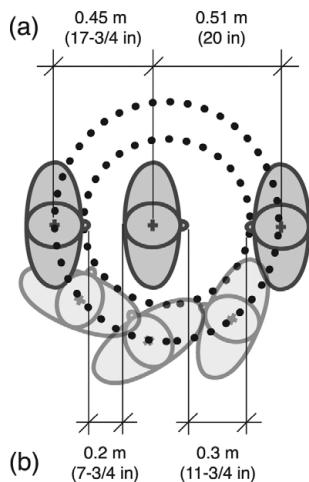


Figure 3
Proxemic distances from Bailenson et al (2003) showing (a) original measurements midline-to-midline and (b) extrapolated surface-to-surface dimensions.

New applications for proxemic research are beginning to emerge in digital areas.³³ For example, proxemic distances can help simulate “natural” social behavior by a robot or avatar to promote “affinity” with a human.³⁴ Current work at the University of Calgary explores “proxemic interactions” between human users and interactive devices, in which a machine’s response can be programmed to vary depending on the human’s distance and orientation.³⁵ Computer visualization has improved the representation of proxemics data, permitting distance preferences to be diagrammed as a smoothly mounting gradient, rather than as a sharp edge between zones.³⁶

Digital tools also offer new opportunities for proxemics laboratory research. An innovative study at the University of California used 3D sensors to measure “stop distances” for human subjects who wore a head-mounted, virtual-reality helmet as they physically approached a digital avatar. To ensure test validity, participants were misinformed about the purpose of the study and instructed to memorize labels on the front and back of the avatar. This technique permitted unprecedented test consistency. As the authors observe:

Past proxemics studies have typically employed observational methods with little or no experimental control, confederates who may behave inconsistently, and projective measurement techniques. In contrast, IVET [immersive virtual environment technology] allows investigators to maintain complete control.³⁷

The results showed participants consistently avoiding an oval-shaped zone around the avatar, an area that the researchers interpreted to “represent personal space.”³⁸ Diagrams illustrating that space use the standard midline measuring point for dimensions, showing a preferred distance of 0.51 meters in front, and 0.45 meters to the rear. Raw data documenting the location of both avatar and human show their positions as dots, so that movement appears as a series of sequential dots—creating a broken line not dissimilar to that of Christine Frederick. To interpret these results with consideration for body shape, Figure 3 adds estimated body thicknesses for human and avatar, revealing surface-to-surface distances of about 0.3 meters in front (under 12 inches) and 0.2 meters in back (under 8 inches). These measures situate the social encounter with the avatar well within Hall’s “intimate” interpretation, which is counter-intuitive. The test thus might have recorded something other than “personal space”—perhaps a comfortable reading distance.

33 A Citation Report done on the Web of Knowledge suggests that interest in Hall’s work began to emerge in computer science after 2000. http://apps.webofknowledge.com.myaccess.library.utoronto.ca/CitationReport.do?product=UA&search_mode=CitationReport&SID=4D4fdNfoI0lc2EJHFMa&page=1&cr_pqid=13&viewType=summary (accessed December 15, 2011 and January 12, 2013).

34 William Steptoe and Anthony Steed, “High-Fidelity Avatar Eye-Representation,” in *Virtual Reality IEEE Annual International Symposium* (Washington DC: IEEE Computer Society, 2008), 112.

35 Saul Greenberg et al., “Proxemic Interactions: The New Ubicomp?” *Interactions Magazine* 18, no. 1 (2011): 42.

36 Toshitaka Amaoka, Hamid Laga, and Masayuki Nakajima, “Modeling the Personal Space of Virtual Agents for Behavior Simulation” in *CW’09 Proceedings of the 2009 International Conference on CyberWorlds* (Washington DC: IEEE Computer Society, 2009), 364–70.

37 Jeremy N. Bailenson, et al., “Interpersonal Distance in Immersive Virtual Environments,” *Personality and Social Psychology Bulletin* 29, no. 7 (2003): 819.

38 *Ibid.*, 824–25.

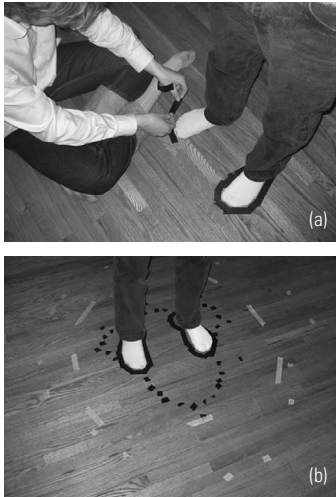


Figure 4
Masking tape data capture: (a) method and (b) final result, showing overhead dimensions carried to the floor with the plumb bob. Note evidence of experimental error in the shifted location of left foot in final photograph.

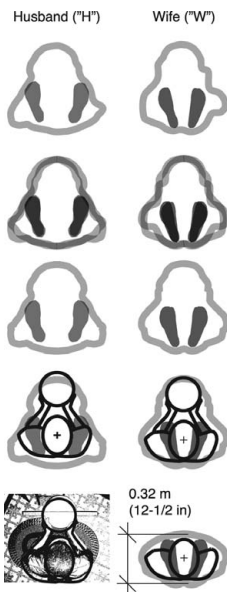


Figure 5
Body size summaries for “H” (husband) and “W” (wife).

New Proxemic Study

To address gaps in earlier research, this study aimed to capture the proxemic reactions of a 60-year-old male subject (my husband: “H”), who was holding a plate in his hands as he was approached by me (his wife: “W”) while I was carrying a dangerously hot apple pie. Because our kitchen is cluttered, trials were conducted in the dining room. Measurements were recorded by our research assistant (Max, age 25, no relation), using a plumb bob to transfer overhead dimensions to the floor, where they could be recorded with masking tape (see Figure 4).

The first step documented body sizes for “H” and “W.” Masking tape outlines were made using the plumb bob, photographed with a ruler for scale, adjusted for lens distortion in Adobe Photoshop, and traced in Illustrator. Asymmetry was removed by mirror-reversing and merging the tracings. Details of the plate were added from a tracing of an overhead photograph of “H” carrying a ruler on the plate. Because “H” knelt for that photo, his body stance shows the plate held further forward to counter-balance the feet, and elbows tucked in rather than cocked outward (see Figure 5).

Note that the sagittal body dimension obtained by this process for “W” (myself) is about 2½ inches thicker than that obtained by the chair/wall measurement. Although some variation can be attributed to masking tape error (plus-or-minus ¾ inches), the change mainly seems to originate in the impatient swaying seen in both subjects while being measured. For this reason, a thick gray line is used to indicate the body edge as a “soft” or variable dimension. This edge is “rubbery” as well as “soft” because of the possibility of nudging aside a fellow kitchen user. In other words, the body is critical but to some extent negotiable.

The influence of small motions on kitchen body size represents an important finding. Precise anthropometric measurements are usually collected in order to plan products that fit closely to the body, like chairs or helmets.³⁹ They are obtained from a motionless human body by measuring along the surface of the skin. But people in life are seldom stationary, and when describing the area needed to contain a swaying body, “size” becomes a probability—the zone within which physical contact might be anticipated. Figure 6 shows that small motions can alter such a probable “body size zone” by up to 8 inches. Anything extending into this zone might get bumped at any time without warning.

39 Roger Ball, “SizeChina: A 3D Anthropometry of the Chinese Head” (PhD diss., Faculty of Industrial Design Engineering, TU Delft, 2011), 37-38.

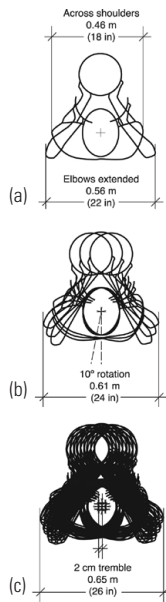


Figure 6
Probable body size zone affected by small motions: (a) jutting elbows, (b) rotation, (c) tremble.



Figure 7
“Stop-distance” (top) and “push-distance” (bottom) test methods.

With body “size” established, apple pie proxemic testing began, using the “stop distance” methodology to ascertain the closest approach that the male subject would permit for the hot pie. In Trial 1, wife “W” approached him from each of the eight compass directions (front, back, sides, and diagonals). As stop-points were called, the pie position was established with the plumb bob and marked on the floor. The second trial repeated the test without the pie as “W” approached empty handed. Finally, a third trial introduced a new reverse “push-distance” methodology. In this case, the trial began with physical contact. Wife “W” leaned annoyingly against “H,” who then pushed her backward until he achieved a satisfactory distance. This method demonstrated a high level of conviction for the distances chosen by “H,” in contrast to more tentative “stop” decisions (see Figure 7).

Measurements from the trials were photographed, adjusted, and traced, and body diagrams superimposed (see Figures 8 and 9). The perimeters identified could be visually approximated using a series of circles centered on either the front surface of the body or the body midpoint. This consistent circularity confirms the impression that Hall’s proxemic dimensions do not apply to the sides of the body. Shoulders seem to be relatively insensitive to approach, confirming the fact that “rubbing shoulders” carries benign meanings that a “butt-brush” does not.⁴⁰

Stop-distance and push-distance perimeters can be interpreted as a pair. The distance to which “H” pushed “W” seems to represent a more-or-less ideal condition of how far away he would like her to stand. The closer stop-distance seemed to represent an acceptable condition of how close he can tolerate her. Superimposed, the two perimeters establish three zones (see Figure 10). A person intruding inside the stop-perimeter is annoying. A person located between the stop- and push-perimeters is tolerable, but still in the way. Ideally, a second person will be located outside the push perimeter, out of the way.

Note that these zones are defined by human physicality. Because subject “H” did not move his feet, the push-distance represents no more than the length of his arm. A larger or smaller man would have set a different perimeter—suggesting that the push-diameter might be understood as an “affordance” in the sense established by James J. Gibson.⁴¹ Technically, an affordance is a feature in the environment that matches the physical abilities of a living organism. To a dog, a stick is “chewable,” while to a person it is “graspable” (see Figure 11). Affordances are determined by body characteristics. For example, taller people perceive higher steps to be more “climbable” than do shorter people.⁴² As an affordance, the push-perimeter defines an area that is “reachable.”

40 Paco Underhill, *Why We Buy: The Science of Shopping* (New York: Simon and Schuster, 2000), 17.

41 James J. Gibson, *The Ecological Approach to Visual Perception* (Hillsdale, NJ: Lawrence Erlbaum, 1979).

42 William Warren, “Perceiving Affordances: Visual Guidance of Stair-Climbing,” *Journal of Experimental Psychology: Human Perception and Performance* 10 (1984): 683–703.

Figure 8

Trial results: (a) hot pie stop-distance trial, (b) body stop-distance trial, and (c) body push-distance trial.

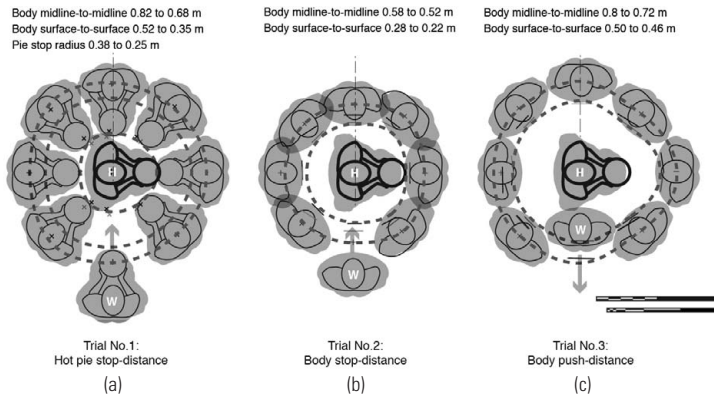


Figure 9

Circle approximations of trial results: (a) hot pie stop-distance, (b) body stop-distance, and (c) body push-distance.

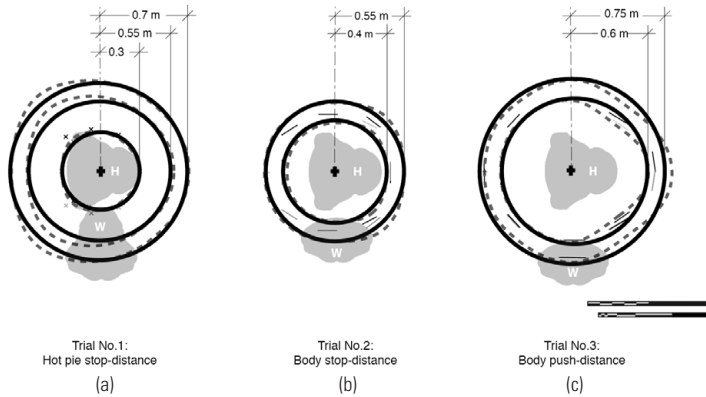


Figure 10

Proposed kitchen proxemic zones.

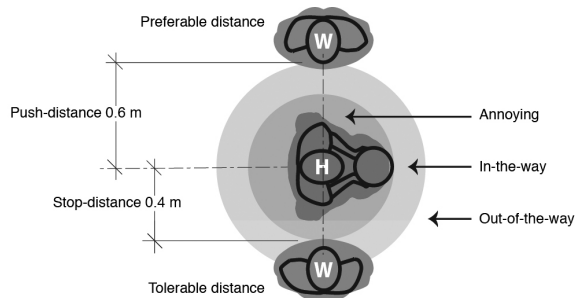
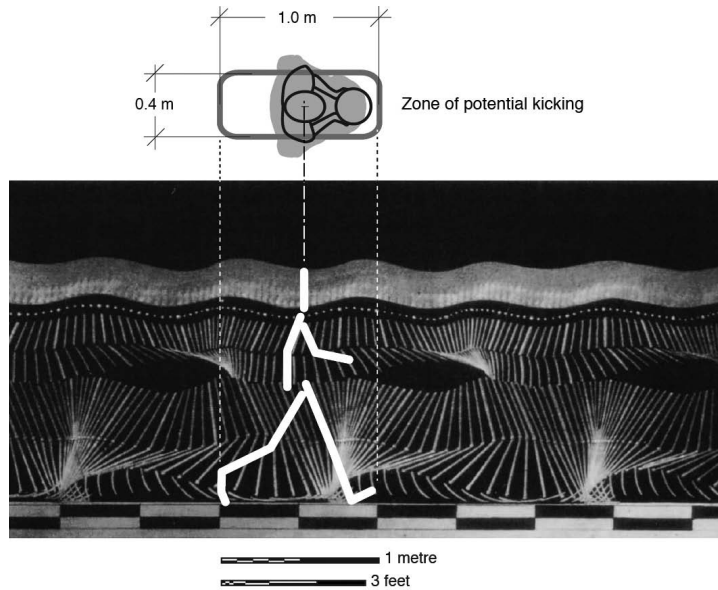


Figure 11

Affordances: for Xena, the American Bulldog, a stick affords chewing, while to her friend Rob, the same stick affords grasping.

Figure 12

Étienne-Jules Marey, chronophotograph of French soldier walking, 1883, with superimposed diagram extrapolating space occupied by moving feet.



The influence of arm's length is also evident in the pie stop-distance, although here it represents the arm of wife "W." Because her arm was bent to carry the pie, this diameter is correspondingly smaller than that of the push-distance. Nevertheless, neither pie nor plate seems to have made much difference to subject "H." His assessment of space seemed to depend only on the relational bodies. Whether arm-space was actively in use, or whether it was simply available for potential use, seemed to have made little difference. This discovery was not anticipated.

Extrapolation of Study

The apple pie study reviewed spatial preferences around a motionless body. However, people walk around in kitchens, meaning that: 1) the feet protrude, establishing a zone within which fellow workers might get kicked; and 2) the moving body will shortly enter a new space, which is therefore not reliably "empty" from the point of view of anyone seeking to avoid collisions. How far do feet stick out when walking? A preliminary answer may be found in the motion photography of French physiologist Jules-Étienne Marey. An 1883 "chronophotograph" shows progressive movements of a man walking across a black background while wearing a black costume with white strings attached to head, arm, and leg. Repeated exposures capture only the angles of the white strings and no other detail.⁴³ Traced and superimposed, these string lines describe an area relative to the torso into which moving feet project—the "zone of potential kicking" (see Figure 12).

43 Marta Braun, *Picturing Time: The Work of Etienne-Jules Marey (1830-1904)* (Chicago: University of Chicago Press, 1994), 84.

Figure 13
Proxemic kitchen walking zones.

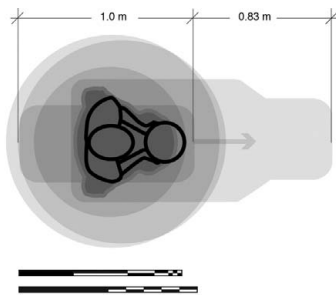
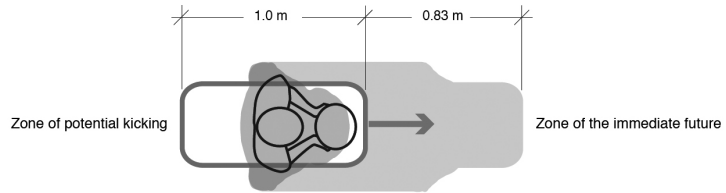


Figure 14
Superimposed static and moving proxemic zones.

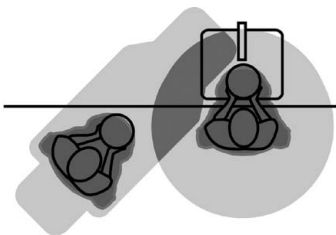


Figure 15
Zone of potential conflict.

Of course, walking also generates motion. If someone inside a house is walking at 3 kilometers/hour, then a one-second margin of safety requires 0.83 meters of empty space to the front. Clearly, people monitor both their own “zone of the immediate future” and those of others to ensure both are free of obstacles. We aim to avoid “stepping on toes” or “treading on heels.” Figure 13 illustrates these moving proxemics zones, showing the zone of potential kicking and the zone of the immediately future relative to the moving body.

When zones of proxemic motion are superimposed on the apple pie static zones, the zone of potential kicking fits comfortably, which is perhaps not surprising as arm and leg length are related. The physicality of spatial zones defined by arms and legs also points to a method for establishing possible statistical validity for the findings of this study. Statistical validity was not one of the initial goals. However, the study suggests a relationship between proxemic space preferences and physiological body size; and statistically valid measurements of anthropometric body size are readily available through sources like the U.S. military.⁴⁴ The findings of this study therefore suggest an approach to a statistically valid close proxemics, defining zones in terms of known anthropometric dimensions (see Figure 14).

The physicality of spatial zones defined by arm and leg motion also points to the interaction of bodies with their physical environment. “Physical proxemics” defines the area needed to make tea or walk down a hallway⁴⁵—activities not considered in Hall’s original research. Like Hall’s “social proxemics,” physical proxemics are relational, defined by neither body nor object alone, but only by their interaction.

Both types of proxemics affect kitchens, where space is confined and multiple users share fixed features like stoves and sinks. Conflict emerges when two people aim to occupy the same space. When one user initiates an action that causes his or her “zone of the immediate future” to overlap with any proxemic zone of a second user, that intersection can be described as the “zone of potential conflict.” Both parties perceive the potential and share responsibility for finding a solution. A static worker who refuses to step aside is being just as aggressive as a moving worker pushing forward (see Figure 15).

44 National Aeronautics and Space Administration, “Anthropometry and Biomechanics,” in *Man-Systems Integration Standards* (July 1995), <http://msis.jsc.nasa.gov/sections/section03.htm> (accessed July 22, 2012).

45 For examples of dysfunctional physical proxemics, see www.aetv.com/hoarders/ (accessed July 8, 2012).

Comments on Methodology

The overall approach of this apple pie study breaks with accepted research practice in a number of ways. The experimenter herself participated in the tests, which studied only one subject—who was a family member—in a study restricted to a highly specific circumstance. These points merit comment.

Prior relationships between test subjects and researchers are normally considered to be a drawback. However, the domestic kitchen is a setting that admits only intimate users, so reproducing that condition in a study is arguably appropriate. Furthermore, only the prior relationship permitted development of the new “push distance” testing method. This method would not be appropriate for strangers, who might be distracted by other connotations for physical contact.

An additional advantage was that the study design permitted the researcher, me, to gain access to “emic” experiential insight, as well as “etic” outside observations. Emic experience vividly reminded me that the stop-distances requested by “H” were not his decision alone, but rather a collaboration between us. As trials started, I strode forward confidently with the hot pie, expecting to hear a rapid call of “stop.” However, subject “H” seemed sure that I would, in fact, not go ahead and burn him with the pie. When he said nothing, I began to walk more and more slowly, grinding almost to a halt before he took pity on me and announced, “stop.”

The collaborative nature of proxemic decisions highlights another distortion of Hall’s research, created when diagrams illustrate his zones in relationship to a single body. Such depictions propose proxemics as a personal opinion held by one active agent toward some unnamed, non-represented “other.” That assumption is embedded in the standard “stop distance” test procedure, where only one person gets a say. In contrast, Hall’s illustrations showed distances between two people. Participating in the apple pie tests reminded me that proxemic decisions are negotiated between multiple agents, all of whom are active.

This research approach also permitted preservation of rich contextual detail. Most studies abstract or simplify problems at an early stage, forcing prior assumptions to be made about which details will prove significant. The extremely narrow scope of this study allowed full retention of detail. Focusing on depth rather than breadth of understanding, it deferred decisions about the relative importance of different variables.

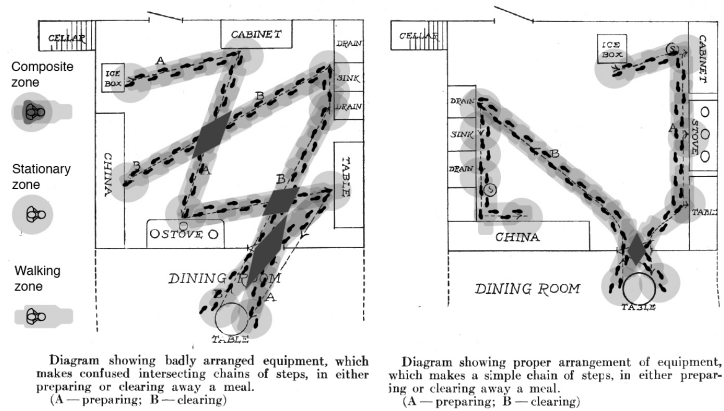
Finally, note that this methodology offered the advantage of cost-efficiency. The roll of black masking tape cost less than \$10, avoiding any need to write a grant application. Frugality in conducting research might be an effective strategy for avoiding the

contemporary “tyranny of managerialism,” in which workers might be asked to spend more time on proposals, planning, and reporting than they do on the real job.⁴⁶

Proxemics in the Frederick Kitchens

The working definitions of static and moving proxemic zones obtained in the apple pie study permitted an analysis of the Frederick kitchen redesign in terms of social conflict. This analysis initially showed an apparent improvement, but upon closer examination, problems were found with Frederick’s basic conceptualizations of kitchen work.

Figure 16
Proxemics for the Frederick’s kitchen redesign;
conflict shown in dark gray.



The above diagrammatic review of the Frederick kitchens assumes that the “A” and “B” lines represent two people working at the same time, which is a reasonable assumption for a household with multiple helpers or staggered mealtimes. Figure 16 shows the plans with scaled footprints superimposed at a stride length of about 70 centimeters (2.3 feet). Moving (narrow) proxemic bubbles are positioned over each stride to define body space requirements for walking. Static (round) proxemic bubbles indicate standing work positions. While Frederick does not claim that her “improved arrangement” reduces footsteps, a count shows that the improved plan does require fewer. Table 2 shows the estimated footstep count for the before and after arrangements. In addition, proxemics conflict is reduced, occurring only in the doorway in the improved layout.

Table 2 | Count of Footsteps Before and After Frederick’s “Proper Arrangement”

Path	Footsteps “before”	Footsteps “after”	% Change
“A”	50	29	42% reduction
“B”	44	36	18% reduction

46 David Graeber, “Of Flying Cars and the Declining Rate of Profit,” *The Baffler* 19 (2012), www.thebaffler.com/past/of_flying_cars/print (accessed July 8, 2012).

Figure 17

More realistic chain of steps for food preparation in the Frederick kitchens.

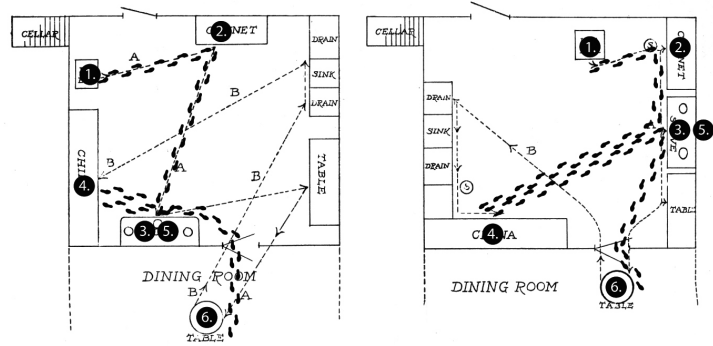


Diagram showing badly arranged equipment, which makes confused intersecting chains of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

Diagram showing proper arrangement of equipment, which makes a simple chain of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

However, a closer review of the design reveals problems. Figure 17 introduces a more detailed scenario by specifying that the cooking task is to fry an egg and requires the following steps:

- 1) Get egg from cabinet.
- 2) Get pan and spatula from cupboard.
- 3) Put pan on stove, heat, and crack egg into pan (assume butter is on counter).
- 4) Get plate and fork from china cabinet.
- 5) Put egg on plate.
- 6) Carry egg to table.

The more detailed task analysis reveals that Frederick’s cooking description omits the need to get a plate for the food. With this step added, the “after” kitchen in fact requires 16% more walking than does the “before” kitchen (see Table 3).

Table 3 | Count of Footsteps in Frederick Kitchens for Egg Frying

Path	Footsteps “before”	Footsteps “after”	% Change
“A”	51	59	16% increase
“B”	57	61	7% increase

Just as Frederick’s preparation omits the plate, her cleanup omits handling of the pan. As Figure 18 shows, when this step is included, cleanup in the improved plan requires 7% more footsteps, following this procedure:

- 1) Carry plate and fork from table.
- 2) Pick up pan at stove.
- 3) Take plate, fork, and pan to sink; wash and dry.
- 4) Put away plate and fork.
- 5) Put away pan.

Figure 18
More realistic chain of steps for cleanup in the Frederick kitchens.

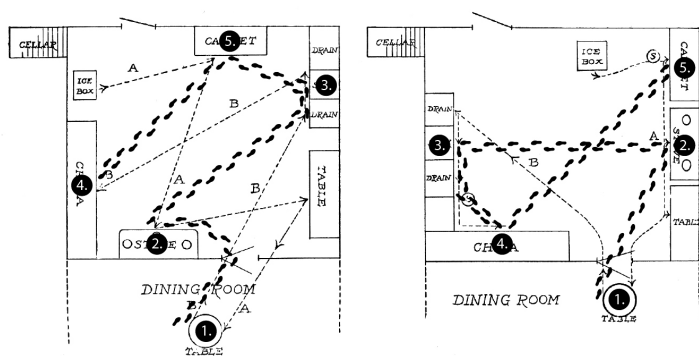


Diagram showing badly arranged equipment, which makes confused intersecting chains of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

Diagram showing proper arrangement of equipment, which makes a simple chain of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

Figure 19
More realistic proxemics clash in the Frederick kitchens.

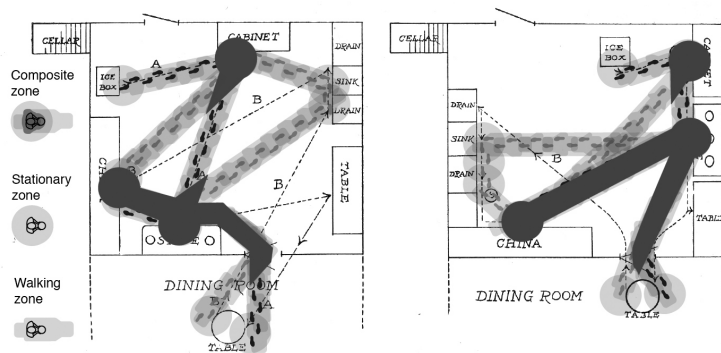


Diagram showing badly arranged equipment, which makes confused intersecting chains of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

Diagram showing proper arrangement of equipment, which makes a simple chain of steps, in either preparing or clearing away a meal. (A—preparing; B—clearing)

When the two proxemic maps are superimposed (see Figure 19), considerable proxemic clash emerges.

Clearly, Frederick's diagrams do not properly represent the cooking and cleanup tasks she claims to describe. Rather, she appears to have categorized chores on the basis of technology, separating hot stove-centered jobs from wet sink-centered ones. Frederick was a devotee of the scientific management theories of engineering consultant Frederick Winslow Taylor. His trademark reorganization of factory work employed time-and-motion studies to analyze, classify, and regroup tasks for greater efficiency.⁴⁷ Frederick sought to apply Taylor's process to the domestic kitchen. Sorting chores by technology, she was able to suggest plausible "improvements." But kitchen chores are less readily separable than those in a factory. Kitchen work is periodic—not continuous—and suffers from frequent interruptions, including the delays needed for set-up. Before the egg is cracked into it, the pan must heat up; and while that happens, the kitchen worker will rinse out a few glasses, feed the cat, or start the crossword. Kitchen tasks are difficult to isolate either spatially or temporally. In other words, Frederick's approach suffers from excessive abstraction. In removing too much detail, she lost sight of how a kitchen really operates.

47 Kenneth Thompson, "Introduction," in *The Early Sociology of Management and Organizations*, ed. Kenneth Thompson (London: Routledge, 2003), i-xv. See also Frederick Taylor, *Scientific Management* (1911; repr. New York: Harper and Row, 1947).

Frederick did perceive one thing correctly. She understood that the people who work in kitchens often perceive the room to be poorly planned. Kitchen workers believe that there must be a better solution, and this belief creates a market for promises to help. Frederick's own message of hope enjoyed considerable success, enabling her to become a highly paid consultant, lecturer, and author. She contributed to the development of the new style of fitted cabinetry that now dominates Western kitchen design. There seems to be little evidence, however, that new kitchens have improved kitchen work. At least one author argues that none of the technological changes of the past hundred years have done anything to make housework more efficient.⁴⁸

Conclusion

When the common kitchen work triangle depicts human motion as a dotted line, it neglects the significance of body volume. Proper kitchen planning must accommodate the body, as well as "proxemics," or body spacing between multiple bodies. However, locating proxemic information suitable for use in kitchen planning is difficult. The classic measurements developed by Hall appear to be incomplete and have been distorted in later citations. More recent proxemic and anthropometric research fails to consider issues significant to kitchens, including body posture, motion, and the influence of objects.

This apple pie study addresses that research gap by examining a single proxemic encounter between a husband and a wife. Analysis of the study offers general conclusions about bodily presence in the kitchen, suggesting that architectural planning should define the "size" of a moving body as a flexible zone of probability rather than as a finite, hard shape. The study also suggests that the desirable perimeter of personal space around the body might relate to physical dimensions of arms and legs. Such a description would permit proxemics to be understood as a type of affordance—a description of the relationship between person and environment, as well as between person and person. Both physical and social proxemics are important in the kitchen, where zones of potential social conflict are generated whenever two workers wish to use the same space at the same time.

Finally, note that the quantitative autobiographical research method adopted for this study offers promise as a general technique. Focusing on a narrow but richly detailed personal problem might help to reveal general principles concealed within the commonplaces of everyday complexity.

Culture hides more than it reveals, and strangely enough what it hides, it hides most effectively from its own participants. Years of study have convinced me that the real job is not to understand foreign culture but to understand our own. — Edward T. Hall, 1959.⁴⁹

48 Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983).

49 Edward T. Hall, *The Silent Language* (New York: Fawcett, 1959), 39.