Walkable route perceptions and physical features:

Converging evidence for en-route walking experiences

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Abstract

Guided walks near a light rail stop in downtown Salt Lake City, UT, were examined using a 2 (gender) x 3 (route walkability: low, mixed, or high walkability features) design. Trained raters confirmed that more walkable segments had more traffic, environmental and social safety; pleasing aesthetics; natural features; pedestrian amenities; and land use diversity (using the Irvine-Minnesota physical environment audit) and a superior social milieu rating. According to tape recorded open-ended descriptions, university student participants experienced walkable route segments as noticeably safer, with a more positive social environment, fewer social and physical incivilities, and more attractive natural and built environment features. According to closed-ended scales, walkable route segments had more pleasant social and/or environmental atmosphere and better traffic safety. Few gender differences were found. Results highlight the importance of understanding subjective experiences of walkability and suggest that these experiences should be an additional focus of urban design.

KEY WORDS: Walkability, environmental aethetics, urban environment, incivilities

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Perceptions and physical features of walkable routes:

Converging evidence for en-route walking experiences

Understanding how walking routes encourage or discourage pedestrians has become an important priority for researchers, planners and developers, health and governmental officials, and a variety of citizen advocacy groups. Walking confers multiple personal and societal benefits, but many people walk too little to realize these benefits. Past research on physical fitness often emphasized creating motivational or social factors to support adherence to formal exercise programs, such as exercise classes. More recent research focused on lifestyle activities, such as walking, and noted how deficits in the environment make walking unpleasant, inconvenient, or scary. If these environmental deficits could be corrected, regular brisk walks could enable millions of people to meet the Center for Disease Control goal of accumulating 30 minutes of moderate activity on most days of the week (Simpson et al., 2003). The benefits of walking are also appreciated by a growing coalition of other actors: city officials want to encourage people to walk to make downtowns safe and popular destinations for residents, workers, and shoppers; social equity advocates want to make walking possible and pleasant for elders, women, children, transit riders, poor people, and people with disabilities; environmentalists want alternatives to more parking, roads, car emissions, and automobile-dependency; and New Urbanists want to design diverse pedestrian friendly places that support resource efficiency and a sense of community.

By focusing on the multiple forces that create pleasant or unpleasant walks, rather than focusing exclusively on flaws of sedentary individuals, research on walking can be informed by a transactional approach (Altman & Rogoff, 1987; Werner, Brown, & Altman, 2002). A transactional approach assumes that behavior is multiply determined, with physical,

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psychological, social, and cultural aspects all playing a role. For example, walking can be supported by recent federal funding for pedestrian paths, local zoning requirements for sidewalks and street trees, and growing societal interests in health and energy efficiency. However, a long legacy of cultural values and environmental infrastructure supports car use and ownership, so that drivers' needs overrule pedestrians' needs. By understanding how these countervailing forces come together to influence walking, we can develop a better understanding of how to encourage walking. In this study, we focus on how particular small scale street segments are designed and perceived to support or discourage walking.

Walking is a healthy but infrequently used way to get around. Less than half of U.S. adults achieve healthy levels of physical activity (MMWR, 2003). Nevertheless, walking is one of the most popular forms of physical activity (Eyler, Brownson, Bacak, & Housemann, 2003) and can be done regularly (Perri et al., 2002). Even short 10-minute bouts of brisk walking provide health benefits when they total 30-minutes a day (Andersen et al., 1999). Walking 15 extra minutes a day would burn 100 calories and prevent the typical adult yearly gain of 1-2 pounds that can lead to obesity (Hill, Wyatt, Reed, & Peters, 2003). A U.S. public health goal for adults is to increase the number of short (less than a mile) trips that are walked from 17% in 1995 to 25% in 2010 (U.S. Department of Health and Human Services, 2000); fully 27% of the 90% of trips made by car are short and might be accomplished by walking (U.S. Department of Transportation, 2001). If places were designed to allow convenient, pleasant, safe, and useful walks, more people might opt to walk.

To understand how people are attracted to or repelled by certain walks, research has taken two major approaches, reviewed below. One approach is to identify environmental correlates of walking in general; another is to compare walking in settings sampled to have

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contrasting walkability configurations.

Environmental correlates of walking. A growing number of studies ask residents their perceptions of neighborhood environmental features and correlate those perceptions with residents' reports of walking. These studies involve fairly large samples, selected from a variety of neighborhoods, and provide intriguing (albeit correlational) evidence that environmental features encourage or support walking. Findings often indicate that residents report more walking when they perceive accessible or high quality sidewalks or paths (Addy et al., 2004; Ball, Bauman, Leslie, & Owen, 2001; Brownson et al., 2000; Chad et al., 2005; De Bourdeaudhuij, Sallis, & Saelens, 2003; Duncan & Mummery, 2005; Giles-Corti & Donovan, 2002; King et al., 2003; Troped, Saunders, Pate, Reininger, & Addy, 2003). Walking is more likely when the area provides good access to desired destinations (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Humpel et al., 2004). Desirable destinations that inspire walking include shopping areas or malls (Addy et al., 2004; De Bourdeaudhuij, Sallis, & Saelens, 2003; Duncan & Mummery, 2005; Foster, Hillsdon, & Thorogood, 2004; King et al., 2003; van Lenthe, Brug, & Mackenbach, 2005), recreation facilities (Chad et al., 2005), parks/open space (Foster, Hillsdon, & Thorogood, 2004; Giles-Corti & Donovan, 2002; King et al., 2003; Li, Fisher, & Brownson, 2005; Timperio, Crawford, Telford, & Salmon, 2004), or public transportation stops (Besser & Dannenberg, 2005; De Bourdeaudhuij, Sallis, & Saelens, 2003). In addition, walking is associated with pleasant pathways, such as those with appealing scenery (Ball, Bauman, Leslie, & Owen, 2001; Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Giles-Corti & Donovan, 2002; Humpel et al., 2004; Troped, Saunders, Pate, Reininger, & Addy, 2003).

Safety fears have frequently emerged as barriers to walking (Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Foster, Hillsdon, & Thorogood, 2004; Li, Fisher, & Brownson, 2005;

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Sharpe, Granner, Hutto, & Ainsworth, 2004; Wilson, Kirtland, Ainsworth, & Addy, 2004). Recent reviews (Loukaitou-Sideris, 2006; Loukaitou-Sideris, Liggett, & Iseki, 2002) addressed how environmental and social cues may trigger fear of crime. Fear cues include social incivilities, such as disreputable-looking individuals or street confrontations; the absence of people; physical (or non-human) incivilities such as unattended dogs, vacant lots, litter, and graffiti; and limited visual surveillance of an area, as well as potential hiding places and blocked escapes. Safety concerns also extend to traffic safety, with less walking reported in areas of greater traffic or traffic noise (Carver et al., 2005; van Lenthe, Brug, & Mackenbach, 2005). These results underscore how a range of environmental and social conditions are offered by participants as reasons for walking or not walking.

Correlational studies of environmental perceptions are useful but limited because they do not focus on particular objectively-rated environmental features and because research participants select themselves into walking environments. Thus, the methodology cannot explain puzzling findings, such as when more walking is reported in the presence of barriers to walking, including heavy traffic (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Troped, Saunders, Pate, Reininger, & Addy, 2003) and hills (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Chad et al., 2005). Similarly, the studies do not explain why men and women report different associations between walking and perceived environmental features such as access to walking paths and destinations, pleasant scenery, traffic and perceived safety (Humpel, Marshall, Leslie, Bauman, & Owen, 2004; Humpel, Owen, Iverson, Leslie, & Bauman, 2004; Suminski, Poston, Petosa, Stevens, & Katzenmoyer, 2005). Such results may be due to differential exposure to environments, differential perceptions of the same environments, or complex interactions between participant characteristics and environmental exposures and

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perceptions. More definitive results regarding the roles of objective and perceived aspects of the environment require data on both the actual environment and participants' perceptions of the exact same environment.

Walkable and non-walkable places. A second line of research focuses more on actual physical environments and typically samples areas hypothesized to represent good and poor walkability. This research is published in a variety of discliplinary outlets, including transportation, planning, and health journals. The research involves a wide variety of sample sizes, from small contrasts of two particular subdivisions, to larger scale studies of areas characterized by Geographic Information Systems assessments of walkability. This strategy provides more information about ecologically valid configurations of environmental features and is consistent with the transactional assumption that multiple aspects of the environment support, encourage, and shape behavior. For example, compared with lower density suburban designs, more walking has been reported in neighborhoods designed with New Urbanist features: small residential lot sizes, gridded narrow streets, and relatively dense mixtures of houses and apartments, (Brown & Cropper, 2001; Handy, 1996; Saelens, Sallis, Black, & Chen, 2003). Generally, reviews show that a combination of density, diverse land uses and destinations, and pedestrian friendly designs such as good street or sidewalk connectivity enhance walking (Cervero & Kockelman, 1997; Li, Fisher, Brownson, & Bosworth, 2005; Saelens, Sallis, & Frank, 2003). Walking is less likely in sprawling areas without these design supports (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003; Frank, Andresen, & Schmid, 2004). These studies provide additional information on the physical environment, although often at a large scale, such as for street grid networks. These studies are also still subject to the possibility that participants select into particular types of neighborhoods.

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The present experiment. Both the environmental correlates studies and walkable place studies show that environments perceived to be walkable and environments designed to combine many walkable features support more walking. However, both lines of research often rely on recalls of large areas such as neighborhoods and over a number of days, such as the last week or month. Thus these studies cannot answer the question of whether participants exposed to the same walking environment would perceive the environment in the same way. In this study, we combined exposures to the same walking environment with both subjective and objective ratings of the environment.

The task of studying walkability is eased by recent efforts to construct audit tools to measure the environmental features believed to support walkability. Day and Boarnet (Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006; Day, Boarnet, Alfonzo, & Forsyth, 2006) have developed a fairly comprehensive audit to assess environments for their potential to support walking and other physical activities. The Irvine-Minnesota audit measures accessibility, pleasurability, and perceived safety from traffic and crime.

Walkability audits provide a rigorous tool to apply to topics of long standing interest to environment and behavior researchers. In 1959 Kevin Lynch had participants walk about five blocks while describing what they noticed (Lynch, 1980). His participants confirmed the importance of very small scale environmental features, such as sidewalks. Moreover, participants noticed small scale qualities of the sidewalks, such as their width and upkeep. Other small scale details of the environment, which are often not assessed in the recent environmental correlates and walkable place studies, were also important. The design of striking and pleasing buildings, the focal point of a bookstall on a sidewalk, and commercial or street signs along the way were also salient features of good walks. Relatively few studies have subsequently addressed whether

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these immediate "micro features" of the physical environment for walking might yield more positive walking experiences. A transactional approach assumes that both the physical environment and psychological experiences are both integral parts of a pedestrian event. Past research does show that walking in green rather than urban settings relates to more positive moods and lower blood pressure (Hartig, Evans, Jamner, Davis, & Garling, 2003). Another study shows that pedestrians rate pathways according to immediate environmental cues such as "weather, sound, water, light and edge of space" (Naderi & Raman, 2005). Our study extends the assessment of pedestrian experience by having volunteers describe their experiences on downtown walking routes selected to vary in walkability features, according to the Irvine-Minnesota audit tool.

We address several research questions. When environments are rated as more walkable via objective environmental audits by trained and reliable auditors, will participants experience those walks more positively, according to both open-ended and closed-ended assessments? Conversely, when environments are characterized by low walkability, according to objective audits, will participants experience those walks more negatively? When environments have mixed walkability features, will participants experience them with as mixed positive and negative places? We then examine what salient and potentially modifiable features supported or detracted from walkability.

Comment [HE1]: You use the phrase "we expect" three times. Might vary language. Or, say "we expect" once with a colon, and then use bullet points.

Method

Participants

Participants for our two studies of slightly different walks were University of Utah male and female undergraduates, recruited during the 2004-2005 academic year from social science classes for class credit or extra credit. Study 1 included 7 male and 19 female participants (mean

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age = 23.96, Range = 19 to 39, SD = 5.29) and Study 2 included 18 males and 29 females (mean age = 24.17, Range = 18 to 51, SD = 7.45).

Experimental Design, Procedures, and Setting

Experimental design and procedures. A 2 (gender) x 3 (walkability of route) between and within participants design allowed us to examine how students experienced a contiguous route with distinct segments selected to include low, mixed, and high walkabilty design features. As explained below, slightly different routes were chosen in Study 1 and Study 2. In both studies, each participant met an experimenter-guide at a campus light rail station, signed the informed consent form and completed a demographic questionnaire while taking the 20-minute ride to the common starting point in downtown Salt Lake City, UT. The guide explained that the study took about two hours and was about "how people experience different aspects of their environments." For the outbound half of each walking route, participants were asked to describe "your experiences during the walk… what is most salient to you as you walk. Feel free to mention anything that you like/dislike, enjoy/don't enjoy." Comments were tape recorded (using a Sony M-450). The guide was nearby to define the beginnings of walk segments 1, 2, and 3 and to provide directions, but otherwise maintained neutrality during the walk. For the return trip, the route was retraced, and at the end of each segment, the participant was asked to rate the just-traversed section on an 18-item questionnaire. The route was also rated by trained raters using an environmental audit.

Environmental setting. The route chosen was typical for areas undergoing downtown redevelopment, especially around rail transit stops. The high walkable segment included a new outdoor mixed use mall, with apartments and condos over the shops, as shown in Figure 1. Mall attractions included restaurants, movies, and shops. Pedestrian amenities were plentiful and

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included narrow roads, benches, a fountain, and posted maps and signs. The mixed walkable segment was on the non-commercial (back) side of the mall, with the new 2-3 story rental apartments on one side of the street and a large rail yard, empty lots, and seemingly abandoned buildings on the other side (see Figure 1). The low walkable segment included a homeless shelter dominating one block, a power substation, empty warehouse, and vacant lots (see Figure 1). Although some studies focus on differences between walking for pleasure and walking for instrumental reasons, such as shopping or to get to transit, the walkable area in this study combines both—it is known to be a leisure destination where people enjoy features such as a fountain and plaza, but it also has stores where individuals can shop.

Route differences across studies. During Study 1 we found that, at certain times of the day, a somewhat rowdy group of individuals was waiting outside the shelter and our participants were sometimes panhandled or verbally abused. To prevent any further problems, we altered the low walkable route slightly and considered all participants from that point on to be in Study 2 (the high and mixed walkable segments of the route remained the same). Specifically, we slightly shortened the low walkable route to allow pedestrians to see into the block with the homeless shelter but to avoid walking directly in front of the shelter. The objective ratings of physical features for the two low walkable routes were the same because the views, presence of the homeless shelter, and existing physical structures did not change. However, the objective ratings of social milieu by the trained raters were more positive for the shorter low walkable route used in Study 2. Participant experiences of the low walkable area were also different across the two studies. Whereas participants in both Studies 1 and 2 referred to homeless individuals, only in Study 1 did participants remark on how aggressive the homeless individuals had been around the homeless shelter. We also instructed research assistants to provide more prompting for en-route

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comments from participants, given that some participants had been reticent in Study 1. Although differences across the studies were slight, they require separate analysis of Study 1 and Study 2.

Measures and Reliability Tests

Environmental audit of routes. To confirm that segments differed in walkability and to characterize those differences, four trained raters used a pre-publication version of the Irvine-Minnesota Inventory, an audit of environmental features supportive of walking and other physical activities (Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006; Day, Boarnet, Alfonzo, & Forsyth, 2006). The rating system identifies four classes of environmental walkability features, most of them dichotomous items, which were averaged. *Traffic safety (n = 38)* includes crosswalks, safety features around crosswalks (such as visibility flags for pedestrians to carry, striping to highlight the cross walk), bicycle lanes, and so on. *Crime safety (n = 11)* includes the absence of environmental incivilities such as litter, weeds, vacant lots, broken windows, and so on. Pedestrian accessibility involves ease of access to desired destinations. Pedestrian accessibility features include four specific composites: *density—building height* (i.e., number of stories in buildings along the street; $n = 1$), *diverse land uses* (e.g., number of land use categories; $n = 58$), *pedestrian amenities* (nonsafety features for comfort such as benches or restrooms; $n = 6$), and *pedestrian access* (e.g, steepness, broken sidewalks, or barriers to access; $n = 28$). The fourth general category—pleasurability--includes two specific composites: *natural features* (parks, trees, flowers, etc. $n = 25$), and pleasant *aesthetics*, such as festive urban design elements (awnings, fountains, artwork, $n = 28$).

Based on preliminary site visits, we supplemented the Irvine-Minnesota audit with two new sets of items: a) two items indicating whether pedestrians were buffered from automobile traffic (parking strip, street islands), which were combined with the Irvine Minnesota traffic

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safety composite (resulting n = 40 total items); and b) *social milieu*, items describing the social feeling of the area (friendly, exciting, dull, etc.), the frequency of people on the segment (none, one, some, many) who looked reputable, neutral, or disreputable, as well as whether there were adults, teens, and children present (yes/no; n =23). Although social features of a place might vary over time, subsequent inter-rater reliabilities demonstrated sufficient consistency to retain these ratings. We felt that impressions made by the social milieu were sufficiently strong that it was important to include these, even though this required developing new measures.

Four trained observers used the Irvine-Minnesota audit and the social milieu audit to rate all three walk segments, with the third author serving as the standard for reliability tests. During daylight hours, three raters assessed the area at the same time and without conferring; because of schedule conflicts, the fourth rater assessed the area at a different time. Instructions for the audit recommend using percent agreement instead of Cohen's κ for interrater reliabilities to avoid underestimating agreement for measures with low base rates and small samples (Boarnet, Day, Alfonzo, Forsyth, & Oakes, 2006); as a conservative assessment of reliability, we used both tests. For our segments, there were at most 220 judgments (but fewer when elements were absent, such as no park to rate for attractiveness) and 175 of these required dichotomous judgments. Across the 3 walk segments and different rater pairs, percent agreement for all 203 judgments ranged from 92% to 100% (r's ranged from .84 to 1.00). For the subset of 175 dichotomous judgments, Cohen's κ ranged from .83 to 1.0 and percentage agreement ranged from 92% to 100%. The social milieu ratings are included in these numbers. Separate examination indicated that the 3 raters who were in the area at the same time agreed 98% of the time (agreement for ratings at a different time was 81%, which we believe indicated the fluidity of the social environment); r 's(21) ranged from .99 to 1.0 Thus, for all three segments, inter-

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rater agreement was quite high.

Participants' open-ended comments. The open-ended recordings of participant experiences during the walk were transcribed and coded for themes related to walkability (because of equipment malfunction, Study 1 $n = 21$; Study 2 $n = 39$). Participants' comments were first divided by the fourth author into meaningful codeable segments. After extensive discussions and refinement of category definitions based on difficult and ambiguous comments, a trained coder categorized all comments for substantive content and valence of affective tone--positive, neutral, or negative evaluations of the feature. Negative comments were subtracted from positive to compute a single index for each category for each study. Seven categories resulted, with definitions and examples in Table 1. An eighth category, general atmosphere, contained statements so general that it was not clear whether they referred to attractiveness, amenities, social milieu, or environmental safety; these are summarized along with other mean statements per category by segment in the Appendix. A second independent coder rated a random sample of 52% of the participants' transcripts. For the 21 reliability estimates on the difference scores (7 categories X 3 walk segments), the median correlation coefficient was .90 (range = .67 to .97).

Closed-ended questionnaires. The 18-item questionnaire for each route segment addressed traffic concerns and other pleasant or unpleasant features of the walk; these were rated on 5-point Likert-type scales ("strongly agree" to "strongly disagree"), with 7 items reversed to reduce response biases. After dropping two items, principal components analyses (PCA) indicated a simple 2-factor structure for all three segments (using varimax rotations) that was similar in both studies. The two factors are traffic safety and pleasant atmosphere. Sample traffic safety items include: "I felt safe from traffic walking in this area," "drivers yielded to

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pedestrians," "there is too much traffic along this segment of the route" and "traffic moves too fast along this segment." Examples of pleasant atmosphere items include: "the walk was unpleasant," "this area is well maintained," "there were attractive views," "the area was vibrant," and "I would come back to this area again." As appropriate, items were reversed for analyses so that high scores always indicate a positive or safe atmosphere. Coefficient alphas for these scales were acceptable, ranging from .74 to .93 (see Table 2).

Results

Walk Segments: Environmental/Social Audit

According to the audit, the most walkable segment had superior traffic and environmental safety; a pleasant social milieu; more positive aesthetics; more natural features; more pedestrian amenities; and a greater diversity of destinations. Table 3 shows the mean subscale scores for the Irvine-Minnesota environmental audit and our additional subscale relating to social milieu. Subscales are summed scores with different possible ranges of scores, depending on the number of items and response metric (dichotomous or 3-point ratings). As needed, ratings were reversed so that all scores indicate more walkability and safety. Ratings shown are of the route used in Study 2, which provides a conservative test of the differences, given that the social milieu for the nonwalkable Study 1 segment was clearly more negative.

In the analysis of these objective ratings, the overall multivariate was significant, Wilks' Lambda criterion Multivariate F (14, 6) = 64.04, $p < .001$, partial $\eta^2 = .99$. All but two of the subscales (density and pedestrian access) yielded significant main effects, with $p < .05$. The patterns were similar for all of the significant effects, with the least walkable segment rated significantly less walkable than the most walkable segment. For the subscales traffic safety, social milieu, and land use diversity, the mixed segment was intermediate (i.e., significantly

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different from the other two segments); pedestrian amenities only occurred in the mixed and walkable segments, and differed significantly, $t(6) = 16.97$, $p < .001$. For the most part (i.e., for 7 of 9 composites), we were successful in demonstrating construct validity for our selection of three walk segments that differed significantly in their environmental supports for walkability and that should create different experiences for our participants.

Participant Experiences

No significant main or interactive effects emerged for the order in which segments were walked (High, mixed, then low walkable or Low, mixed, then high walkable), so we collapsed across that factor. We tested for main and interactive effects for participant sex, but collapsed results because only one significant effect emerged, as noted below. Because Studies 1 and 2 yielded similar results, they are discussed together. Although open-ended responses were recorded first in order to avoid alerting participants to our specific questions, we discuss the results of the closed ended questionnaires first, followed by open-ended comments.

Closed-ended judgments. As shown in Table 2, results supported the hypotheses that participants would perceive the walkable segment to be more pleasant and to have greater traffic safety. The low and high walkable segments were clearly different, with the low walkable segment means ranging from 2.26 to 3.50 and the high walkable segment means ranging from 3.95 to 4.53. The mixed walkable segment was perceived as more mixed, resembling the low walkable segment once, the high walkable segment twice, and significantly different from and in between the low and high walkable segments once. All tests use Hunyh-Feldt adjustments for lack of sphericity and two-tailed protected *t*-tests for comparisons between means.

Participants judged Traffic safety to increase with walkability, Study 1 $F(1.61, 38.62) = 6.84$, $MSE = .320$, $p < .005$, $\eta^2 = .222$; Study 2 $F(1.84, 82.88) = 12.61$, $MSE = .271$, $p < .000$,

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η^2 = .219; Sex main effect, F (1, 45) = 5.74, MSE = .790, p < .02, η^2 = .110. The sex main effect in Study 2 occurred because male participants were more positive than females (3.93 vs. 3.56) regarding Traffic safety. In both studies, participants judged the Pleasant atmosphere scores to increase with increases in walkability of the segment; Study 1 F (1.84, 44.19) = 82.92, p < .000, η^2 = .776, MSE = .348; Study 2 F (1.81, 81.58) = 30.06, p < .000, η^2 = .400, MSE = .580.

Open-ended comments. Although most of the themes derived from the content analysis of open-ended comments paralleled those in the environmental audit, there were some differences. Because of low frequencies in the natural features category during winter, we combined environmental aesthetics and natural features into a single category of "attractiveness." Density did not emerge as a category, perhaps because building height was typically uniform at 2-3 stories (and only 4 participants mentioned building height).

As shown in Table 4, participants reported more net positive comments (i.e., positive minus negative comments) on the high walkable segments. Bonferroni adjusted critical values of F for the seven measures were used (Maxwell & Delaney, 2004). In Study 1, participants commented more positively on environmental safety, attractiveness, and social milieu in the high walkable segments. In Study 2, participants commented more positively on those three categories plus pedestrian amenities. For example, in the high walkable segments, participants commented on artistry and attractiveness of the shops and store windows (attractiveness). They liked wading pools, benches and shade (pedestrian amenities), the pleasure of watching people enjoying themselves (social milieu), and cleanliness and upkeep (physical environmental safety).

Positive, neutral and negative comments. To this point, we have emphasized comparisons among the three walk segments, using a net score (positive comments minus negative comments) for the open ended comments. In order to illustrate how salient various features were, the

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Appendix provides, for each walk segment, the original mean number per person of positive, neutral, and negative comments. Neutral comments were simply descriptive and did not convey identifiable positive or negative affect. The Appendix includes separate means for comments in Studies 1 and 2 (left and right halves of the table, respectively) by evaluative tone of the comments (see negative, neutral, and positive columns) and segment walkability (see low, mixed, and high walkability in top, middle, and bottom rows, respectively). For example, examination of the far right column shows that the category "attractiveness" was mentioned positively 2.92 times per person in the low walkable segment, 3.62 times in the mixed walkable segment, and 5.62 times in the high walkable segment.

In addition to allowing the interested reader to peruse the original scores, this table is useful for exploring what aspects about these environments were most salient, and to consider whether future objective audit tools should expand to include new categories. For simplicity and because of the larger sample, the present discussion considers only scores for Study 2.

Participants commented most frequently on the relative attractiveness of built and natural environmental features, with an approximate average of 5 mentions (negative + neutral + positive) in the low walkable and more than 7 each in the mixed and high walkable segments. In the high walkable segment, over 5 of the 7 remarks were positive and less than 1 was negative. In contrast, in the low walkable segment, a mean of 2.9 of the 5 remarks were positive while 1.7 were negative. Thus for these frequently noticed features, positive comments dominated in the high walkable segment while positive and negative comments were more evenly distributed in the low walkable segment.

Many comments concern crime safety, whether safety was inferred from the absence or presence of environmental incivilities (environmental safety), or from the kinds of people present

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and their activities (social milieu). These comments far exceeded traffic safety in frequency and -- presumably -- in salience. Crime safety comments were frequently negative in the low and mixed walkable segments and almost uniformly positive in the high walkable segment. Note that other types of features noticed along the walks evoked more neutral comments. For example, participants frequently pointed out particular buildings (land uses) but without clear affective evaluation ("there is a street vendor" or "lots of clothing stores"). Perhaps with prompting, participants might have been able to clarify that neutral comments were really negative or positive, but no prompting was needed for eliciting affect about environmental safety.

Note also that many comments about social milieu were "neutral" because they could not be labeled as negative or positive, but their total number underscores the salience of people in the urban scene. Pedestrian amenities also distinguish the segments, but in a different way from that uncovered by the environmental audit. The audit demonstrated that more amenities were present on the high walkable than mixed walkable segments (1.29 vs. .29; no amenities were observed by auditors on the low walkable segment). However, the Appendix shows how the amenities were especially salient in the high walkable segment, evoking numerous positive comments (2.72). Providing pedestrian amenities appears to be a relatively low cost way to enhance the perception of walkability.

Discussion

This study revealed that a downtown area can vary substantially in walkability across a few adjacent blocks and that pedestrians are quite sensitive to these different levels of walkability. Trained raters, using the Irvine-Minnesota environmental audit tool and our own social audit tool, found that segments chosen to vary on walkability indeed differed significantly on most (i.e., 7 of 9) physical and social features. The lack of difference on building height and

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pedestrian access is not surprising, as the area is small and has fairly consistent building heights and pedestrian infrastructure. However, substantial differences were due to the types of facilities, their architectural and decorative styles, and the social scene they attracted. The objective ratings showed that the more walkable segment had multiple safety indicators in terms of traffic, fewer environmental incivilities, and a more pleasant social milieu. In addition, the provision of more pleasing built environment aesthetics, natural features, and pedestrian amenities created an environment that pedestrians could enjoy.

Participants' ratings also distinguished between walkable and less walkable segments. Spontaneous comments were made before they saw the rating scales and therefore should reflect the social and environmental information most salient to them. In fact, naïve participants reported noticing most of the features that walkability advocates have identified. The more walkable segments garnered more positive mentions of the social milieu, environmental safety cues, attractive built and natural features, and (in Study 2) pedestrian amenities. Consistent with the trained observer audit ratings, pedestrian access comments did not differ substantially (and there were few comments about density). Furthermore, the questionnaire ratings confirmed that participants judged the more walkable segments to be more pleasant, including perceptions that it was attractive, vibrant, interesting, and well-maintained. Thus, there was substantial agreement that environments designed with walkability features were noticeably more pleasant and walkable, based on both open-ended comments and the more directed closed-ended judgments.

Note that the results of this microlevel in-depth examination of walkability can be contrasted with typical results from macro-scale correlational studies. Many of the larger scale correlational studies measure walkability by focusing exclusively on density and pedestrian accessibility (e.g., sidewalk network completeness, intersection density, average block size)

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because those are the only walkability indicators that are available from existing Census or GIS data bases. Such data bases may provide good measures of density and land use diversity, but pedestrian friendly design also plays an important role in walkability (Cervero & Kockelman, 1997). Significant differences arose in this study even across blocks that would have been rated equally walkable via larger scale density and sidewalk access measures. Understanding these micro level design features that support walking has been deemed the "newest frontier in travel research" (Ewing & Cervero, 2001, p. 10). Future research is needed to establish generalizability using more varied participants and places.

The open-ended comments give a sense of the differences between macro GIS measures and micro en route measures. The environmental characteristics that evoked the most clearly evaluative comments involved those related to safety from crime. The high walkable segment had almost uniformly positive comments while the mixed and low walkable segments evoked comments that were clearly negative a majority of the time. Given how basic a feeling of safety is for pedestrians, future research is needed to determine if safety is always perceived in such an extreme and uniform fashion. Although correlational studies have noted several sex differences in perceived walkability research, this study yielded only one sex difference, with males more satisfied with traffic safety. In correlational studies it may be that sex differences emerge because males and females have different exposure to places in the neighborhood or they may notice different aspects of the same environment, or both. The more experimental methodology in the present study allowed us to have both males and females experience the same environment, and the results suggest similar perceptions. Several studies find that females perceive more crime problems on walks than males, but this study did not. Our participants were accompanied by a research assistant, in daytime conditions in Salt Lake City, a city not known for crime. Although

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participants in Study 1 had some unpleasant encounters with homeless individuals, the conditions did not evoke any gender differences in ratings of crime safety. Gender differences have been found in other research on walkability and fear of crime. A recent review suggests that older women, non-white women, or lower income women may be more fearful; similarly, certain places, such as parking garages and transit stops, may evoke greater fear (Loukaitou-Sideris, 2006). Females may be especially sensitive to fear cues when they are alone (Warr, 1990) and are less likely to walk alone or at night (Clifton & Livi, 2005). Several participants -- both male and female -- explicitly said they would not be in the mixed or low walkable segments alone or at night.

Participant comments also suggested a new role for the social milieu. Past research on social factors in walking has related to social support for exercise, social modeling of exercise, or having company for exercise (Addy et al., 2004; Ball, Bauman, Leslie, & Owen, 2001; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Chad et al., 2005; De Bourdeaudhuij, Teixeira, Cardon, & Deforche, 2005). Although these features may be important for planned bouts of exercise, in our study the presence of people played a different role. Our pedestrians enjoyed people watching on segments they considered to be good walks. Many commented on how much they enjoyed seeing other people enjoying themselves, or how they often visited certain features in part because they knew others would be drawn there as well (e.g., a symbol of The Salt Lake City 2002 Olympics, a fountain where children played). In contrast, our participants were made uncomfortable by or disliked seeing panhandlers, transients, and people sleeping on the sidewalk. Although many expressed fear of these people, many others expressed empathy and described feeling guilty they had so much while these people had so little. Some people thought it was good for middle class people to be exposed to the urban poor, and others thought it was

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too uncomfortable and unsafe. Thus, in addition to physical features, the social climate of an area emerged as one of the most important features people noticed and commented on. It is possible that social milieu may not be as salient in more familiar areas near home. However, in this public setting with a wide variety of users of the area, social milieu is a key evaluative factor and had little to do with social models of exercise or partners for exercise. Consistent with our transactional approach, which seeks to identify multiple positive supports for behavior, the entertainment value of the social scene should not be overlooked as a positive support for walking.

Future users of environmental audit instruments may want to supplement them with social audits as well. The Irvine-Minnesota scale was not intended to measure social factors and its developers note that the field's efforts at social audits have so far proved only modest in reliability (Boarnet et al., 2006). Although the instrument used in the present study was a simple one, it was both useful and reliable (as long as the raters were in the area at approximately the same time and could observe similar social scenes). Future research is needed to clarify whether social audits are feasible in other situations that might require extensive time sampling to adequately characterize rapidly changing social scenes.

Given downtown economic development interests in getting people to frequent downtown areas, it may be useful to appreciate the holistic experience of downtown trips. It is not just a particular store but also the social and environmental sights along the way that can foster a pleasant downtown experience. In our own research we have found that good light rail transit can create more interest and excitement in visiting downtown (Brown, Werner, & Kim, 2003). Whyte's analysis of good plaza designs (Whyte, 1980) suggests that downtown uses are enhanced by good seating, urban design features, and the ability to choose pleasing parts of the

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setting to visit. In urban areas, good designs for sitting may also be good designs for walking. Thus, it is important to focus on the range of social and environmental qualities that support walking. The key to walking in urban areas may be the ability to achieve multiple goals, such as running errands, enjoying scenery and social milieu, avoiding the hassle and cost of driving, and enjoying the health benefits of walking.

These results are especially important to keep in mind for downtown redevelopment and transit-oriented development areas. One way in which downtowns compete with suburbs is by offering diverse and varied destinations well connected by sidewalks and transit. However, many transit oriented developments are better described as transit-adjacent instead of transit oriented. Indeed all of the walks included in the present study were within a half-mile of a rail transit stop. Although some segments of the walk were quite pleasant, others were not. These pedestrian unfriendly areas could serve as priority targets for pedestrian improvements. However, this seemingly simple recommendation can also prove to be controversial. For example, although the homeless shelter itself received positive comments for its appearance and maintenance, the larger area around the homeless shelter was distinctly pedestrian unfriendly. Urban areas are known for diverse land uses, including homeless shelters. These results should not be used as an argument for removing homeless shelters, but rather used as grounds for improving the physical conditions surrounding those areas to benefit homeless clients as well as other downtown pedestrians. In fact, there were 14 comments that participants thought it strange ($n = 8$) or guilt-inducing ($n = 6$) to site a new shopping area right next to the low income service area. Given that most urban areas have both, downtown advocates have additional reasons to promote good quality services for homeless individuals. The encounters with homeless individuals that disturbed our participants might not have happened if homeless individuals had places to go at all times,

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instead of having to wait for the shelter to open for the evening.

Recalling the diverse audiences interested in walkable places—health researchers, social equity proponents, downtown advocates, and environmentalists—all can benefit from knowing how to create downtown walkability. Health researchers can benefit from a focus on urban walkability, given that the world is rapidly urbanizing. In addition, this study suggests more attention is merited for the role of urban design in walking. Several large scale health studies associated walking with density and diverse destinations; this study highlights the importance of small scale social and environmental features to support walking. Social equity proponents may find that walking studies can provide additional support for economic development and housing initiatives. In this study, although the homeless shelter was unpopular with our participants, the high walkable area included a number of affordable housing apartments above the stores. Thus, mixed income areas can be both attractive and functional, serving individuals of all economic backgrounds. Downtown advocates might be able to promote health and safety by publicizing the presence and availability of safe walking paths and their health consequences. Good directories at major transit stops and other central locations might allow pedestrians to take advantage of more destinations and promote local businesses and services at the same time. Directories could even be supplemented with pedestrian mileage signs to allow pedestrians to gauge distances and perhaps be more aware of the benefits of healthy downtown walks. Finally, environmentalists might be interested to see whether downtown walks can substitute for car trips, thereby reducing air pollution levels. We believe that research aimed at urban design that incorporates the benefits of walkable environments might help catalyze a coalition of diverse interests around improving downtown environments and other urban areas. All of these interest groups may focus on particular positive aspects of walkability; consistent with a transactional

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approach, we believe walking is fostered when all of these positive aspects of walkability can be combined into meaningful pedestrian-friendly settings.

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Appendix

Mean Number of Comments per Participant by Walkability Segment and Affective tone

	Study 1 (n = 21)				Study 2 (n = 39)			
	Negative	Neutral	Positive	Sum	Negative	Neutral	Positive	Sum
				Low walkability segment				
Traffic safety	.29	.43	.10	.82	.64	.39	. 33	1.36
Environmental	1.29	.10	.05	1.44	1.13	.36	.54	2.03
Social milieu	1.43	.33	.24	2.00	.90	1.15	.54	2.59
Attractiveness	1.19	.76	1.10	3.05	1.64	.85	2.92	5.41
Pedestrian amenities	.00	.00	.05	.05	.05	.23	.49	.77
Pedestrian access	.29	.05	.05	.39	.23	.54	.23	1.00
Land use	.00	.29	.05	.34	.31	1.97	.97	3.25
General atmosphere	.24	.05	.00	.29	.23	.13	.28	.64
				Mixed walkability segment				
Traffic safety	.29	.29	.33	.91	.03	.21	.28	.52
Environmental	.76	.24	.29	1.29	3.51	.26	.41	4.18
Social milieu	.33	.57	.14	1.04	.67	.67	.36	1.70
Attractiveness	1.43	.91	1.81	4.15	2.69	1.03	3.62	7.34
Pedestrian amenities	.05	.05	.43	.53	.00	.05	.31	.36
Pedestrian access	.10	.00	.43	.53	.13	.26	.26	.65
Land use	.10	.38	.10	.58	.41	1.56	.39	2.36
General atmosphere	.38	.14	.10	.62	.49	.18	.28	.95
				High walkability segment				
Traffic safety	.52	.48	.43	1.43	.33	.21	.28	.82
Environmental	.10	.00	.71	.81	.00	.00	1.13	1.13
Social milieu	.48	.57	.76	1.81	.46	1.59	1.87	3.92
Attractiveness	.62	1.10	3.48	5.20	.90	1.23	5.62	7.75
Pedestrian amenities	.14	.19	.71	1.04	.18	.46	2.72	3.36
Pedestrian access	.24	.10	.62	.96	.23	.28	.39	.90
Land use	.05	.14	.05	.24	.31	2.23	1.18	3.72
General atmosphere	.05	.00	.24	.29	.15	.13	1.10	1.38

Note: Data are the mean number of comments per person in this category and affective tone. "Sum" provides a rough gauge of how frequently each category was used per person (i.e., what people noticed); it is the sum across affective tone.

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Table 1

Coding system category definitions and positive (+) and negative (-) examples for participant en-route comments
Traffic safety: perceived safety in relation to moving cars, such as comments about how safe it would be to cross the street.
+ "I do like the fact that the sidewalks are separated from the street itself. It gives you kind of a boundary and a little bit of protection from the streets" - "There are a lot of cars; hopefully I don't get run over."
Physical environmental safety: environmental incivilities or their opposite. Incivilities suggest that an area is not cared for or protected (trash, weeds, abandoned buildings), or is overprotected because of chronic criminal activity (barbed wire, barred windows, warning signs).
+ It's a well-lit walkway …I can see that it would be a well-lit walkway if it were night, which is good… it makes me feel like it would be safe to come here at night. - "Passing some kind of a parking lot that says `park at your own risk.' That's comforting." - "But what I didn't like is … there was a lot of litter on the ground which made it kind of uncomfortable and kind of apprehensive walking, especially if I was by myself. "
Social milieu: feelings evoked by the number, type, appearance, or activities of people around.
+ "There are kids here jumping around, playing, which is fun. I'd like to see more kids … come here and have a good time," - "… a lot of homeless people which kind of makes it scary."
Aesthetics, natural features: aesthetic or natural features sensed in any way (sight, smell, sound).
+ "…this is really nice because there are trees, the trees kind of have like flower gardens around and everything. It makes it seem very inviting". - "[this area] is not very attractive, it's ugly." - "The one thing that I did not like about it was the big train whistle in the background. I felt that detracted from the area."
Pedestrian amenities: pedestrian comforts, conveniences, or orientation aids, such as sitting areas, heated areas, public transportation stations, clocks, maps, instructional signs, and directories.
+ "It just looks inviting because there are benches to sit on." + "Good map for the whole entire [shopping area]". - "There is no where to sit." - "Probably what I didn't like about it is I didn't see too many signs - wayfinding signs, so that you can locate where you are in the area, and if you are looking for a specific place… I didn't see too many of those."
Pedestrian access: the perceived ease or difficulty of walking in an area. This included parked cars, coded negative if they were characterized as impeding pedestrian movement, neutral if their relevance to access was unclear, and positive if someone commented on the absence of cars in a positive way.
+ "The footpaths are wide, so that's good." + "The sidewalks is paved well so it doesn't make it at all bad to walk on." - "I just hit a loose brick and if I were a smaller person I probably would have tripped on that." - "They have way too many [metal] bars there, and I'm thinking maybe that's so the delivery trucks will know where to stop, but it just kind of gets in the way of your walking."
Land use: comments about diversity of stores and services or, more commonly, about particular stores or services (including parking lots), and whether they thought it was a good use of the land.
+ "I like the restaurant. It looked like some place I would like to eat." "…good choice of stores… I noticed a type of a media store, bookstore…" + "There are many shopping stores around here with lots of clothes and a lot of window shopping to do." - "There are too many parking lots in this area." - "I don't think I'd ever want to shop at any of these stores, too classy for me, prefer thrift stores."

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Table 2

Questionnaire closed-ended judgments of pleasant atmosphere and traffic safety by guided walk participants: Coefficient alpha reliability tests and means by route segment

		Route walkability		
		Low	Mixed	High
		Pleasant atmosphere		
Alpha	Study 1	.80	.91	.93
	Study 2	.85	.90	.92
Mean	Study 1	2.26_a	3.48_b	4.53_c
	Study 2	3.17_a	3.02_a	4.12_b
		Traffic safety		
Alpha	Study 1	.80	.84	.74
	Study 2	.78	.75	.77
Mean	Study 1	3.50_a	4.03_b	3.98_b
	Study 2	3.45_a	3.84_b	3.95_b

Note. Ratings use 5-point scales, where 5 is most positive. Within rows, means with different subscripts differ at $p < .05$ by a priori *t*-tests.

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Table 3

Means for the environmental/social audit by 4 trained raters

	Low	Mixed	High	F (2,9)	Partial η^2
Traffic safety	0.61 [a]	0.68[b]	0.74[c]	19.02**	0.81
Environmental safety	0.89 $_a$	0.82 $_a$	1.23 $_b$	119.57**	0.96
Social milieu	1.08 $_a$	2.46 $_b$	5.10 $_c$	192.61**	0.98
Aesthetics	0.45 $_a$	0.40 $_a$	0.75 $_b$	27.38**	0.86
Natural features	0.37 $_a$	0.49 $_b$	0.50 $_b$	11.92**	0.73
Pedestrian amenities	0.00	0.29 $_a$	1.29 $_b$	--	
Pedestrian access	1.00	1.06	1.00	--	
Diverse land use	0.43$_a$	0.38 $_b$	0.53 $_c$	54.92**	0.92
Density- building height	2.50	1.75	2.00	0.33	0.07

Note: Higher scores indicate more walkability. Zero variance cells for Access and Amenities preclude *F* tests. Amenities mixed vs. friendly $t(6) = 16.97$, $p < .01$. Within rows different subscripts indicate where means differ, with Tukey's post hoc tests at $p < .01$ level, except "Traffic Safety" where $p < .05$.

* $p < .05$; ** $p < .01$, N = 4

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Table 4
Open-ended Remarks: Net Positivity about Each Segment of the Walk

	Study 1					Study 2				
	Walkability of Segment					Walkability of Segment				
	Low	Mixed	High	F(2,38)	Partial η^2	Low	Mixed	High	F(2,74)	Partial η^2
Traffic safety	-.19	.05	-.10	0.57	.03	-.31	.26	-.05	4.39	.11
Environmental safety	-1.24_a	$-.48_a$	$.62_b$	8.26*	.30	$-.59_a$	-3.10_b	1.13_c	40.57*	.52
Attractiveness	$-.10_a$	$.38_a$	2.86_b	17.16*	.48	1.28_a	$.92_a$	4.72_b	19.34*	.34
Social environment[1]	-1.19_a	-.19	$.29_b$	8.15*	.30	$-.36_a$	$-.31_a$	1.41_b	13.52*	.29
Ped. amenities	.05	.38	.57	1.86	.09	$.44_a$	$.31_a$	2.54_b	34.67*	.48
Pedestrian access	-.24	.33	.38	2.93	.13	.00	.13	.15	0.85	.02
Land use	.05	.00	.00	0.12	.01	.67	-.03	.87	6.84	.16

*$p < .05$ with Bonferroni adjustment

Note. Scores are number of positive comments minus number of negative comments. All F values represent the main effect for segment except for Study 1, social milieu, which shows the Linear trend, $F(1, 19) = 8.15$. With alpha set at .05, Bonferroni adjustments for the seven variables yield a critical value for Study 1 of $F_{crit} = 8.09$, and for Study 2, $F_{crit} = 7.68$ (Maxwell & Delaney, 2004). Within each row and separately for each study, means with different subscripts differ at $p < .05$ by two-tailed a priori t-tests. Hunyh-Feldt adjusted degrees of freedom: Study 1, Environmental safety (1.51, 28.73); Amenities (1.67, 33.30); Access (1.70, 32.21): Study 2, Environmental safety (1.86, 68.77), Amenities (1.39, 51.23); Land use (1.82, 67.38). In Study 1, for both Pedestrian amenities and Land use, Segment is the only factor, and error degrees of freedom are 40; sex could not be included as a factor because males did not use the category in at least one segment.

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Figure 1. Examples of high, mixed, and low walkability segments.

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