Window View to the Sky as a Restorative Resource for Residents in Densely Populated Cities

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Abstract

We investigated the extent to which the amount of sky and other contents affect expectations that window views will support psychological restoration in an urban context. The study involved 102 digital view images across which the amount of sky and other contents were varied systematically through manipulation of variables relevant to urban densification. University students ($N = 212$) rated images on restorative quality (being away, fascination), restoration likelihood, or preference. We aggregated the ratings for each variable for each image and used the images as cases in analyses. Amount of sky and presence of a window box with greenery had direct positive effects on restoration likelihood judgments, as well as indirect effects mediated by being away and fascination. Ground-level views with people and street trees evoked ratings similar to those for some views with sky, but the views judged most restorative and most liked were those with the most sky.

Keywords

attention restoration theory, mediation analysis, preference–restoration relationship, restorative environments, urban greenery, window views

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Introduction

In growing cities around the world, densification of the built environment limits possibilities for contact with the natural world. This includes limitations on what residents can see from the window of their dwelling. Viewing the sky and other features of the natural world can support psychological restoration, thus sustaining health and well-being (R. Kaplan, 2001). Yet, increased building heights and other densification strategies may reduce the restorative quality of views by blocking out the sky and other natural contents.

The present study considers the amount of sky and other environmental features that can affect the restorative quality of residential window views in a context of high urban density. In the following, we first consider the role that window views can play in restoration within the residential context, and we frame restorative quality in terms of attention restoration theory (ART; S. Kaplan, 1995). We then explain the selection of the environmental attributes and view contents that we systematically manipulated in digital simulations of window views for use in our empirical work.

Restoration in the Residential Context and the Restorative Quality of Window Views

Restoration involves the renewal of physical, psychological, and/or social resources that have become depleted in efforts to meet the demands of everyday life (Hartig, 2017). Environments vary in the degree to which they support restoration, and the residence stands out as a setting that people rely on for restoration. Choices regarding location, surroundings, design, and furnishing of a residence commonly reflect expectations regarding its service in restoration (Hartig, 2012). This helps to explain, for example, why nearby parks and green spaces boost the prices paid for housing (e.g., Tyrväinen, 1997) and contribute substantially to residential satisfaction (e.g., Bonaiuto, Fornara, & Bonnes, 2003; Hur, Nasar, & Chun, 2010) as such relatively natural settings appear to support restorative processes better than other settings in cities (e.g., Staats, Jahncke, Herzog, & Hartig, 2016).

People do not need to be outdoors to realize restorative benefits while engaging with natural features near the residence. Field and laboratory experiments suggest that, compared with not having a view or viewing scenes with few natural features, viewing scenes dominated by natural features after some form of stressful or depleting situation can quickly engender greater reductions in heart rate (Chang & Chen, 2005), diastolic blood pressure (Hartig, Evans, Jamner, Davis, & Gärling, 2003), and facial muscle tension indicative of negative affect (Ulrich et al., 1991), as well as greater increase

in positive affect (van den Berg, Koole, & van der Wulp, 2003) and better performance on tests of directed attention (Lee, Williams, Sargent, Williams, & Johnson, 2015).

Urban residents commonly spend a large proportion of their time at home indoors (e.g., Brasche & Bischof, 2005). Over time, they may realize cumulative benefits from recurrent brief instances of restoration made more effective by natural view contents. For example, more natural views may engender a stronger sense of being focused and effective (R. Kaplan, 2001). Such benefits may help explain associations between what people can see from a dwelling and the amount they pay for residing there, over and above the cost of having close physical access to the features in view, such as green spaces (e.g., Benson, Hansen, Schwartz, & Smersh, 1998; Bourassa, Hoesli, & Sun, 2004; cf. Bishop, Lange, & Mahbubul, 2004).

To date, however, little research has considered what looking out to the sky by itself can do for restoration in an urban residential context. An exception is the study by R. Kaplan (2001), who asked residents in low-rise apartment buildings to rate how frequently they watched or checked on the sky, weather, and sunsets or sunrises from their home. Those who did so more often also reported more effective functioning, in line with the idea that looking out at the sky yields cumulative benefits. The association weakened, however, when the analysis was adjusted for having a view of a garden or landscaped area. Presumably, residents looked out the window more frequently not only to see the sky, but also to appreciate the greenery. These results exemplify the need to address the unavoidable confounding—or ecological covariation—of the sky and other view contents in research design and analysis.

The restorative quality that the sky, vegetation, and other contents impart to a window view can be framed in terms of ART (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). ART refers to restoration as a process in which attention goes without effort to interesting, pleasant aspects of the environment, allowing for rest of a neurocognitive inhibitory mechanism employed when a person willfully directs attention. Effortless engagement of attention by the environment, or *fascination*, is therefore a key component in restorative experience as described in ART, which also describes three other components thought to enable and sustain restoration of the ability to direct attention. *Being away* involves gaining psychological distance from routine mental contents and demands on directed attention. *Extent* refers to the scope and coherence of the environment engaged with, so that interest-driven exploration of the environment can continue without loss of orientation. *Compatibility* refers to the match between what a person can do, wants to do, and must do in the environment. According to ART, attention restoration can proceed to the extent these four components characterize an encounter with the environment.

The components of restorative experience described in ART can be treated as mediators of relationships between physical environmental attributes and psychological restoration. We focus here only on being away and fascination, following the examples of Nordh, Hartig, Hägerhäll, and Fry (2009) and Lindal and Hartig (2013, 2015), who also addressed problems of urban densification. We assume that being away and fascination are influenced by the amount of sky and other view contents, and that being away and fascination in turn affect judgments about the likelihood that restoration can occur while looking at that view.

Selection of Physical Attributes and View Contents

In creating the different view simulations, we manipulated the built environment in ways immediately relevant to urban densification. In the following sections, we elaborate on these manipulations and their expected effects. We base our expectations on theory and research concerned with environmental preferences as well as restorative environments, assuming that the likelihood of restoration often serves as a frame of reference for environmental preferences (Purcell, Peron, & Berto, 2001), particularly when a person has some need for restoration (Staats & Hartig, 2004; Staats et al., 2016; Staats, Kieviet, & Hartig, 2003; Staats, van Gernerden, & Hartig, 2010). That is, building on their experience with different settings, people in need of restoration will like a view more if they expect it to better serve restoration (see also Korpela & Hartig, 1996; Korpela et al., 2018).

Relative Floor Level and the Amount of Sky

Together with variation in the viewer's position relative to the buildings on the other side of the street, our floor-level manipulation introduces variation in the amount of sky seen to extend above rooftops across the street. We expect that more sky in the view will boost perceptions of restorative quality (being away, fascination) and in turn judgments of restoration likelihood. Several lines of theory and empirical research support these expectations; however, the previous work, reviewed below, is generally not concerned with the amount of sky per se, but rather with other aspects of the view that covary with the amount of sky. As the amount of sky seen over rooftops increases, the depth of the view and area of surroundings that can be surveyed from a window will also increase. Much of the research relevant here has concerned depth of view, area in view, and other physical attributes, together with their perceptual correlates, such as openness or spaciousness, enclosure, and visual complexity.

Various theoretical accounts have emphasized the adaptive value of different view attributes. Evolutionary perspectives on environmental preferences, notably prospect-refuge theory (Appleton, 1996), refer to the adaptive significance of open views that would have enabled early hominids to anticipate threats and locate survival requirements, such as places to hide from predators or otherwise find shelter. Natural selection therefore would have conserved preferences for places that afforded prospects while also providing refuge from threats (cf. Orians, 1980; Ulrich, 1983).

Reflecting their assumed significance, the perception and evaluation of spaciousness and enclosure in an urban context have drawn the attention of architects, planners, and environmental psychologists for decades (e.g., Gärling, 1969; Stamps, 2011). In a meta-analysis of studies involving responses to outdoor urban scenes viewed from ground level, Stamps (2005) found that the percentage of visually impermeable area (e.g., image area covered by walls) correlated strongly and positively with sense of enclosure, whereas depth of view had a strong, negative correlation with enclosure. In a meta-analysis that encompassed ratings of both indoor and outdoor settings, the amount of visible horizontal area extending through the scene had a strong correlation with spaciousness (Stamps, 2011).

People appear to prefer views from indoor and outdoor vantage points that engender stronger perceptions of spaciousness and depth of view, whereas views that evoke stronger perceptions of enclosure are not as well liked (e.g., Kaya & Erkip, 2001; Ozdemir, 2010; Stamps, 2005; Stamps & Smith, 2002). Some research has also considered the relations between these spatial perceptions and the restorative quality of outdoor urban environments. Galindo and Hidalgo (2005) asked longtime residents to provide ratings of the places in their city that held the greatest visual interest for them as well as the places that they found most unattractive. Their ratings of openness clearly distinguished between the most attractive and unattractive places, and those ratings correlated moderately with ratings for being away and fascination. Lindal and Hartig (2013) obtained ratings for views down simulated residential streetscapes under different density scenarios. With higher buildings along and at the far end of the street, enclosure was rated higher and preference lower. In addition, greater building height negatively affected judgments of the likelihood that restoration could proceed while walking along the street on the way home from work. This effect was mediated by a negative effect of greater building height on ratings of being away.

In views out from an urban residence, the amount of sky will covary not only with the amount of view area occluded by facing buildings and the amount of horizontal area the viewer sees below, but also with what can be seen on those vertical and horizontal surfaces. For this reason, constructs

such as visual complexity and visual diversity are relevant here. These constructs have also drawn the attention of architects, planners, and environmental psychologists for decades, in particular because of concern that the urban environment may appear either too monotonous or too complex (Stamps, 2000, 2002). This concern implies that environmental preferences may have a curvilinear relationship with visual complexity, with people preferring environments with moderate amounts of complexity. Evidence regarding such an inverted-U relationship is mixed, but this may reflect differences across studies in the ranges of complexity captured in the sets of photos or digital images used to obtain ratings (e.g., S. Kaplan, Kaplan, & Wendt, 1972; Stamps, 2002).

Lindal and Hartig (2013) represented a relatively low range of aggregate architectural variation through their manipulations of urban residential streetscape images, viewed from the street, for which they obtained low-to-moderate ratings of perceived complexity. In this range, the objective architectural variation correlated positively with perceived complexity, which in turn correlated positively with preference. Furthermore, Lindal and Hartig found that greater architectural variation evoked higher ratings of being away and of fascination, which in turn were positively related to restoration likelihood judgments. The finding of indirect effects of architectural variation on restoration likelihood through both being away and fascination contrasts with their findings for building height, which had an indirect effect on restoration likelihood only through being away. These contrasting findings highlight the need to consider how different view contents might affect evaluations of the view through multiple experiential pathways.

Street Width

We expect that greater street width will boost perceptions of restorative quality and in turn judgments of restoration likelihood. Our reasoning in this regard is similar to that for relative floor level. Greater street width should allow the viewer a greater sense of openness and spaciousness (or reduced enclosure), which relate positively to environmental preference (e.g., Kaya & Erkip, 2001; Ozdemir, 2010; Stamps, 2005; Stamps & Smith, 2002) and ratings of fascination and/or being away (Galindo & Hidalgo, 2005; Lindal & Hartig, 2013). Greater street width also allows a viewer to see more of the facade of facing buildings and/or their rooftops, thus boosting visual complexity and providing more to hold attention (cf. Lindal & Hartig, 2013, 2015). Arguably, street width means little when the viewer is far above the rooftops of adjacent buildings. Our manipulations of relative floor level have excluded this possibility; we focus here on effects of street width when the facades and/or rooftops of facing buildings are in the immediate foreground.

Different View Contents Specific to Different Relative Floor Levels

Amounts and kinds of other view contents covary ecologically with floor level. For example, people residing near street level may see little sky from the window, but they may see people passing by outside, while residents on the highest floor levels may see little street life, but they may be able to look across rooftops and see the landscape beyond. We systematically varied such contents for two reasons: to assess their own relevance for judged restoration likelihood and to estimate what the amount of sky per se would contribute to restoration likelihood, looking across variation in those other contents.

For views near street level, we varied the number of people and cars passing by. Our concern here is for people in need of psychological restoration, ordinarily due to demands faced outside as well as inside the home. Some of their need for restoration may stem from noise, crowding, and hassles experienced while moving around on busy city streets (Masoudinejad, 2013; Milgram, 1970), and viewing conditions otherwise experienced as stressful may not promote restoration. In the present study, we therefore manipulated the numbers of cars and people passing by only in the low ranges, from none to a few of each. How these manipulations will affect ratings of restoration likelihood is an open question.

For views near street level, we also varied the presence versus absence of street trees. Theory and empirical studies in residential and other contexts lead us to expect that including trees in the view will boost expectations regarding restoration (e.g., R. Kaplan, 2001; Lin, Tsai, Sullivan, Chang, & Chang, 2014; Lindal & Hartig, 2015; Shin, 2007).

For the views from the highest floor levels, we varied the presence versus absence of a backdrop of cityscape and mountains beyond the rooftops of the facing buildings. How this manipulation will affect ratings of restoration likelihood is an open question; increased visual complexity and the distant natural features may enhance restorative quality, but the reduction in amount of sky may reduce restorative quality.

For views from the higher floor levels, we also varied weather conditions, contrasting overcast skies with clear, sunny conditions. Sunny weather is commonly assumed to boost mood and overcast weather to darken it; however, in desert countries like Iran, overcast weather is relatively cool and unusual, so it is not necessarily regarded as negative (cf. Connolly, 2013). It is an open question how this manipulation will affect ratings.

Window Box With Green Plants

Residents can often affect what they see at the window, for example, by placing plants on the interior window sill. We considered the effect of another

such option, the addition of an exterior window box with greenery. Given indications that plants and other natural features in the near view can support restoration (cf. Bringslimark, Hartig, & Patil, 2009), we expect that a window box with greenery will increase the restorative quality and likelihood of restoration attributed to window views. This effect may be particularly pronounced when the view otherwise lacks features that raise restorative quality, that is, when the addition of a window box could compensate for a poor view (Bringslimark, Hartig, & Patil, 2011; Heerwagen & Orians, 1986).

Overview of the Present Study

This study assesses the likelihood of restoration with different views from apartments in urban high-density housing, as mediated by perceptions of restorative quality. We study these aspects of restorative experience here in relation to several physical attributes, including relative floor level (amount of sky), street width, and the presence of a window box, systematically varied in digital images meant to simulate window views. Independent groups of participants rated the views on being away, fascination, or the likelihood of restoration when looking out the window. We calculated mean ratings for the respective groups for the given variable for each view, and we then treated the views as the units of analysis. Our main statistical analyses addressed the following hypotheses:

Hypothesis 1 (H1): With successively higher floor levels relative to the top of the buildings on the other side of the street, and so with an increasing amount of sky in view above and beyond the facing buildings, ratings of restoration likelihood will increase (H1a). This effect will be mediated by positive effects of an increasing amount of sky on experiences of being away (H1b) and fascination (H1c).

Hypothesis 2 (H2): Increase in street width will cause increase in ratings of restoration likelihood (H2a). This effect will be mediated by positive effects of increasing street width on experiences of being away (H2b) and fascination (H2c).

Hypothesis 3 (H3): The presence of a window box with plants will evoke higher ratings of restoration likelihood (H3a). This effect will be mediated by positive effects of a window box with plants on experiences of being away (H3b) and fascination (H3c).

Hypothesis 4 (H4): The presence of street trees will evoke higher ratings of restoration likelihood for views at street level (H4a). This effect will be mediated by experiences of being away (H4b) and fascination (H4c).

How the presence of people and cars, distant background conditions, and weather variations affect judgments of restoration likelihood are open questions. Another open question is whether any views without sky are considered as restorative as some views with sky.

Building on the main mediation analyses, we also conducted analyses concerning the assumption that restoration likelihood often serves as a frame of reference for environmental preferences, particularly for people in need of restoration (e.g., Purcell et al., 2001; Staats et al., 2003). Backed by this assumption, we had consulted the literature on environmental preferences for help in identifying view attributes likely to affect restoration. In empirically addressing this assumption here, it was not only of interest whether restoration likelihood and preference would correlate strongly, as shown previously (e.g., $r = .72$ in Lindal & Hartig, 2013; $r = .88$ in Nordh et al., 2009), but it was also of interest, for example, how well preference would substitute for restoration likelihood as the dependent variable in the mediation analyses described above. Among other values, findings in this regard could provide stronger backing for using preference ratings as proxies for restoration likelihood judgments when there is inadequate information about the relevant physical setting attributes.

Method

Creation of the Visual Stimuli

We created a set of digital simulations of window views from apartments in densely built residential areas by systematically manipulating physical variables relevant to urban planning, the design of multifamily housing, and opportunities for residents to change their view. The images capture plausible variation in views available in Tehran, Iran, the study location. They simulate three residential areas with arrangements that are common in Tehran, given the city's master plan regulations (Municipality of Tehran, 2012) and building norms. All of the images show views from apartments that look south across a yard and then over a street with an east-west orientation (see Figure S2 in the Online Supplemental Material). The three simulated residential areas are similar with the exception that the width of the street and the overall height of buildings along the street differ. See the Online Supplemental Material for further details of image creation.

Physical Variables in the Analyses

Relative floor level and amount of sky. Together with variation in the height of the viewer's position relative to the buildings across the street, the floor

level variable introduces variation in the amount of sky in the view beyond those buildings. The five levels of this variable represent different ratios between the amount of building facade and the amount of sky in the window view: (a) three thirds of the view taken up by built elements, including street and building facade, and no sky view; (b) three thirds of the view taken up by built elements, though only building facade; (c) two-thirds building facade and one-third sky view; (d) one-third building facade and two-thirds sky view, grounded by rooftops; (e) no building facade and a full sky view grounded by the rooftops on the other side of the street. For some analyses, we combined Levels 1 and 2 to form a linear progression in the amount of sky.

In using these five levels, we do not mean to imply that our concern here is only with five-story buildings. Views at Level 1 could be obtained from one to two stories above street level. The other floor levels refer to relative positions involving buildings on opposite sides of the street. For example, Level 2 views could obtain from multiple floors of a 12-story building if the buildings on the other side of the street also had 12 or more stories. In the following, when we refer to the level numbers, the reader must keep in mind that they are not limited to specific floors within a five-story building.

Street width. The three residential areas we simulated differed in the width of the street: 8 m, 19 m, or 30 m. Across the residential areas, increase in street width is accompanied by increase in the outdoor area encompassed by the window view and the number of different elements in the area encompassed. Accordingly, the manipulation of street width entailed increase in amounts of other view contents.

Other view contents. Different floor levels involve different view contents. The kind and amount of these covary ecologically with the amount of sky and width of the street. We sought to represent realistic variation in these additional view contents and to balance that variation within the set of views so that we could examine the effects of the amount of sky per se, looking across the variation in other contents. More detail on each variable is given in the Online Supplemental Material, as is the overall scheme for variable manipulation (see Figure S1).

Street life. The images from Level 1 have “street life” in the view. For this study, the street life variable has four values, obtained by crossing absence versus presence of passersby and cars with absence versus presence of street trees. The images for wider streets include larger amounts of sidewalk, street, and building facade, together with more people and cars.

Weather. For those images with sky view, half of the relevant images had clear/blue sky and the other half had completely cloudy sky.

Background conditions. For half of the images with some amount of sky visible, we included background beyond the rooftops in the near distance that included both a distant cityscape and a mountain backdrop beyond it. For the other half of the images, only rooftops are visible in the distance. The cityscape with mountain backdrop grows in prominence with higher floor levels from hardly visible at Level 3 to prominence at Level 5. Also, the apparent area of background encompassed by the view is larger with the wider streets.

Window box. In half of the images, we included a small window box holding small green plants without flowers.

Psychological Variables in the Analyses

We had each of several different groups of participants rate half of the images on one of four psychological variables: being away, fascination, restoration likelihood, and preference. To avoid imposing a too-heavy workload on participants, we measured each of the variables with only one item. Methodological research has challenged the view that single-item measures necessarily have poorer psychometric properties than multi-item scales (Gardner, Cummings, Dunham, & Pierce, 1998); similar single-item measures have previously demonstrated their sensitivity to subtle environmental variations (e.g., Lindal & Hartig, 2013, 2015).

To make the restoration context explicit for the ratings of the variables concerned with restoration, the participants first read a scenario about a need for restoration and the possibility of satisfying it with the given view. They then rated the given images on either likelihood of restoration (“I would be able to rest and recover my ability to focus if I sat and looked at this view”), fascination (“This view is fascinating; my attention is drawn to many interesting things”), or being away (“Looking at this view gives me a break from my day-to-day routine; looking at this view helps me to relax my focus on getting things done”). Ratings were made with an 11-point scale (0 = *not at all*, 10 = *completely*). The being away and fascination items were composites of two items from the respective subscales of the Perceived Restorativeness Scale (PRS; Hartig, Kaiser, & Bowler, 1997; Hartig, Korpela, Evans, & Gärling, 1997). Both subscales typically show high internal consistencies (e.g., Cronbach’s $\alpha = .89$ for being away and $.92$ for fascination; Dahlkvist et al., 2016). Nordh et al. (2009) and Lindal and Hartig

(2013, 2015) found that PRS-based single-item measures differentially mediated effects of different physical attributes in images of small urban parks and urban residential streetscapes, respectively, on judgments of restoration likelihood. All items were adapted to the window view context and translated into Persian.

The preference item ("I like this view out the window") was also rated with an 11-point scale (0 = *not at all*, 10 = *completely*). The rating task was introduced with a scenario that did not clearly impose a restoration context. This scenario and measures taken to avoid imposing an implicit restoration context in the images themselves ensured that any restoration frame applied when rating the images on preference would have been implicitly applied by the participant. These details of the methods bear on the possibility that restoration provides a frame of reference for environmental preferences.

Participants

The participants were undergraduate students at Shahid Beheshti University, Tehran, enrolled in a variety of majors unrelated to environmental design (chemistry, mathematics, statistics, psychology, educational sciences, and curriculum planning). All participants were recruited at the start of select classes. Only students who grew up in Tehran and still currently resided there were admitted into the study. Data were collected from 212 persons (43 male, 168 female, one unknown gender) ranging in age from 18 to 24 years.

Procedure

We ran the procedure with 16 groups of participants, with four groups for each of the four psychological variables. The groups came from 16 different classes, which we selected from the course schedules of two faculties at the university. Our recruiting strategy sought to ensure that all images would be rated on all of the psychological variables by participants from each faculty. With the permission of the teacher, one of the authors (S.M.) entered the class, explained the general aim of the research (i.e., to investigate how the experience of the home depends on design features), described the test procedure, and invited students who were residents of Tehran to stay in the classroom after the lecture to participate in the study.

We had the participants in each group rate the images on only one variable to disallow same-source bias that would otherwise inflate correlations between the variables. Across the four groups assigned to the given variable, the number of participants who provided usable data totaled 58 for restoration likelihood, 46 for being away, 48 for fascination, and 60 for preference.

The numbers varied because different numbers of participants were recruited from the classes scheduled for the different variables. The variables had been assigned to classes in alternating order prior to recruitment of the group to ensure similar representation of the different faculties.

To guard against systematic effects of the order of image presentation, we used a unique image order for each of the 16 groups. To minimize the work load of the participants, we did not ask each participant to rate all of the images on the given psychological variable. Instead, we produced eight different image sets, each with the 102 images ordered at random using sets of numbers produced with a random number generator. We then divided each of the eight sets into two subsets (the first 51 images, and the second 51 images). With these 16 image subsets, we had a unique subset of 51 images for use in collecting ratings from each of the four separate groups assigned to each of the four psychological variables.

Each subset of 51 images was set in the given random order into a Microsoft PowerPoint file. The program displayed each image for 15 s. We allowed a 1-min break after the 17th image and again after the 34th image to minimize rater fatigue.

Testing was performed in the classroom following the lectures. As in previous studies of this kind (e.g., Herzog, Black, Fountaine, & Knotts, 1997; Staats et al., 2003), participants who were to rate the images on being away, fascination, or restoration likelihood received a suitable scenario before beginning the rating task:

Imagine that you are at home, you are mentally tired and feeling a need to rest and clear your thoughts a bit before going on to do some tasks that require concentration. You have some time to sit down, and during that time you look out the window.

Note that scheduling the procedure for just after a lecture was intended to make the fatigue scenario more immediately relevant and readily imaginable for the participants (cf. Hartig & Staats, 2006). Those participants who were to rate images on preference received a scenario that did not explicitly impose a restoration context: "*Imagine that you are at home, and you have some time to look out the window.*"

Each group of participants viewed the assigned set of 51 images on a large screen (ca. 1.80×1.80 m). After rating the images, the participants answered background questions (age, gender, where they had grown up, where they lived now) and an open-ended question about whether or not the images were similar to what is usually seen in residential areas in Tehran. In general, the test took around 20 min to complete.

Statistical Analysis

The question about the similarity of the images to what is usually seen in Tehran elicited 195 affirmative responses and 12 negative responses. Five participants did not answer. Thus, 94.2% of the valid responses were affirmative. Remaining participants indicated that they did not understand the question (e.g., stated they did not like the given images). Only one to three participants who rated a given variable gave a negative response on the similarity item, and their scores were in general much like those of the remainder of the given group of raters. We therefore used the ratings from all 212 participants in the further analytic work.

The ratings from the given groups of participants were used to calculate a mean value for each psychological variable for each image. These means were used as the data in analyses that treated the images as cases.

The statistical analysis proceeded through three steps. In the first step, we took a regression-based approach to address our expectations that increasing amounts of sky in the window view would contribute to greater judged restoration likelihood via enhanced experiences of being away and fascination. The sky view variable was created by recoding the five relative floor levels into four levels of sky view: no sky view, one-third sky view, two-thirds sky view, and full sky view. The only other physical variables included in these analyses were those that were balanced across all levels of sky view, namely, street width and the presence versus absence of a window box with plants. The analyses were done using the *MEDIATE* macro for SPSS published by Hayes (<http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html>), which generates bias-corrected 95% confidence intervals (CIs) with bootstrapping procedures (5,000 samples) to aid inference about (a) indirect effects of the physical variables (i.e., sky view, street width, and window box) on judged restoration likelihood as mediated by being away and fascination, (b) direct effects of the physical variables on restoration likelihood not mediated by being away and fascination, and (c) the total effect of the physical variables on restoration likelihood (i.e., the combined direct and indirect effects). As in the studies by Nordh et al. (2009) and Lindal and Hartig (2015), the mean ratings of being away (provided by one set of raters) correlated strongly with the mean ratings of fascination (provided by another set of raters). We therefore conducted three separate tests, one with being away and fascination together and the other two with either being away or fascination as the sole mediator. For a discussion of the inferential problems entailed by collinear mediators, see Hayes (2013).

In the second step of the analysis, we addressed the fact that the amount of sky in the view is confounded with view contents uniquely available at

different relative floor levels. We tested the effects of different view contents for different sets of floor levels in a series of ANOVA and an additional mediation analysis concerned with the indirect effects of street trees as mediated by being away and fascination.

In the third step of the analysis, we addressed the assumption that restoration likelihood provides a frame of reference for environmental preferences. We performed single-mediator analyses like the two described above, but with preference as the dependent variable instead of restoration likelihood. We also tested competing models with an extended causal sequence that included the two dependent variables in serial, one with restoration likelihood mediating between the restorative quality variable and preference (i.e., restoration likelihood as the frame of reference for preference) and the other with preference between the restorative quality variable and restoration likelihood (i.e., preference as the frame of reference for restoration likelihood; see Figure S3 in the Online Supplemental Material).

The various tests satisfactorily complied with their statistical assumptions. For details, see the Online Supplemental Material.

Results

Effects of Physical Variables as Mediated by the Restorative Quality Variables

Across the set of window view images, mean scores for restoration likelihood ranged from low to moderate (see Table 1). To illustrate how evaluations varied across the manipulated view attributes, Figure 1 shows those window view images that received the lowest, closest to average, and highest ratings on restoration likelihood.

The bivariate correlations provided in Table 1 for the variables represented in the main mediation analyses show that being away, fascination, and restoration likelihood tended to be rated higher for window views that had more sky, in line with Hypotheses 1a to 1c. The presence of a window box with plants also engendered higher scores on all three psychological variables as expected, in line with Hypotheses 3a to 3c. In contrast, street width appears to have had little effect on those variables, at odds with Hypotheses 2a to 2c. Also worth noting, the ratings concerned with restoration correlated strongly and positively with preference.

The pattern of relationships differs in the multivariate regression analyses, depending on the model tested. With both restorative quality variables included as mediators, more sky in the view and the presence of a window box independently engendered judgments of greater restoration likelihood by

Table 1. Descriptive Statistics and Matrix of Bivariate Correlations for the Variables in the Mediation Analyses, Based on 102 Window View Images.

	<i>M</i>	<i>SD</i>	Min	Max						
1. Being away ^a	3.36	1.02	1.08	5.64	(1)					
2. Fascination ^a	3.95	0.97	1.52	6.09	.74**	(2)				
3. Restoration likelihood ^a	3.62	0.94	1.43	5.87	.68**	.88**	(3)			
4. Preference ^a	3.43	1.18	0.69	6.07	.66**	.88**	.84**	(4)		
5. Amount of sky ^b	—	—	—	—	.47**	.70**	.76**	.70**	(5)	
6. Street width ^c	—	—	—	—	-.01	.06	.15	.08	.00	(6)
7. Window box ^d	—	—	—	—	.55**	.43**	.34**	.41**	.00	.00

Note. Nonparametric Spearman correlations differed only slightly from the values for the Pearson correlations reported here. Descriptive statistics are not reported for the physical variables because they were manipulated in the creation of the images. The levels of each physical variable were balanced over the levels of the other two physical variables, so the physical variables are by design not correlated.

^aAll psychological variables were rated on an 11-point scale, with higher values indicating a higher level (e.g., a stronger sense of being away).

^b0 = no sky in the window view, 1 = one-third sky above rooftops, 2 = two-thirds sky, 3 = three-thirds sky.

^c1 = 8 m, 2 = 19 m, 3 = 30 m.

^d1 = no window box with plants, 2 = window box with plants present.

***p* < .01.

Figure 1. Window view images with the lowest, closest to average, and highest likelihood of restoration ratings.

boosting fascination (see Table 2, top panel). Street width did not have a statistically significant indirect effect via fascination, and none of the physical variables had a significant indirect effect mediated by being away.

Inclusion of strongly correlated mediators in an analysis can obscure their respective contributions to explanation (Hayes, 2013). With only being away included as a mediator, both more sky in the view and the presence of a

Table 2. Specific Indirect Effects of the Physical Variables on the Judged Likelihood of Psychological Restoration as Mediated by the Restorative Quality Variables Being Away and Fascination, Included as Mediators in the Model Together (Top Panel) or Separately (Bottom Panel).

Variables	Multiple mediator model					
	Being away			Fascination		
	Effect	LLCI	ULCI	Effect	LLCI	ULCI
Amount of sky	0.035	−0.014	0.091	0.314	0.212	0.441
Street width	−0.002	−0.024	0.013	0.037	−0.042	0.120
Window box	0.094	−0.040	0.226	0.446	0.280	0.662

Variables	Single mediator models					
	Being away alone			Fascination alone		
	Effect	LLCI	ULCI	Effect	LLCI	ULCI
Amount of sky	0.114	0.061	0.197	0.343	0.247	0.462
Street width	−0.005	−0.053	0.046	0.040	−0.045	0.129
Window box	0.306	0.181	0.466	0.487	0.324	0.699

Note. An effect is statistically significant at $p < .05$ if the confidence interval (CI) does not include zero. $N = 102$ window view images used in each analysis. LLCI = Lower limit of the bias-corrected bootstrap 95% CI; ULCI = upper limit of the bias-corrected bootstrap 95% CI.

window box engendered greater restoration likelihood by enhancing a sense of being away, in line with Hypotheses 1b and 3b, respectively. With only fascination included as a mediator, more sky in the view and the presence of a window box again indirectly affected restoration likelihood, in line with Hypotheses 1c and 3c. These indirect effects appear stronger than the corresponding indirect effects in the model with being away as the sole mediator. In particular, the CIs for the indirect effect of amount of sky do not overlap (see Table 2, bottom panel).

The three physical variables together explained 71% of the variation in the aggregate restoration likelihood judgments ($R^2_{adj} = .705$). They also explained 52% of the variation in being away ($R^2_{adj} = .505$) and 67% of the variation in fascination ($R^2_{adj} = .664$). With both being away and fascination included as mediators, the model explained 83.4% of the variation in the restoration likelihood judgments ($R^2_{adj} = .826$). The model that included only fascination as a mediator performed almost as well, accounting for 83.1% of the variance in restoration likelihood ($R^2_{adj} = .824$), whereas the model with

being away as the sole mediator explained 75.6% of the variance in restoration likelihood ($R^2_{adj} = .746$). These latter results reinforce the impression that, while the two restorative quality variables overlapped to a great extent, fascination had the more decisive role in mediating the effects of the amount of sky in the view and the presence of a window box on the restoration likelihood judgments.

Street width did not have a significant indirect effect on restoration likelihood in any of the models (contrary to Hypotheses 2b and 2c), but it did have a significant *direct* effect in all three of the models (in line with Hypothesis 2a). The direct effect seen after adjustment for the other physical variables and their indirect effects contrasts with the modest and nonsignificant bivariate correlation between street width and restoration likelihood given in Table 1. Follow-up regression analyses indicated that adjustment for the amount of sky in particular uncovered the direct effect of street width.

The coefficients for the effects of the physical variables are given in Figures 2 and 3 for the respective single mediator models, both before and after adjustment for the given mediator. Most of the direct effects remain statistically significant after adjustment for the mediator, an indication that they may influence judgments of restoration likelihood via mediators other than those measured in this study. At the same time, fascination did not only transmit part of the effect of physical variables included in the analysis; when added to the model with only the physical variables, it also explained an additional 12% of the variation in restoration likelihood judgments. This additional contribution presumably reflects, at least in part, the influence on fascination of the window view manipulations made in addition to the manipulations of amount of sky in the view, street width, and the presence of a window box. We turn now to consider the effects of those other manipulations.

Effects of Different View Contents Available on Different Floor Levels

Recognizing that the amount of sky is confounded with other contents in views from different floors of high-density buildings, we performed a second set of analyses focused on the effects of different view contents on the different floor levels.

We first considered how different street view contents affected restoration likelihood ratings. The image set included 24 images from Level 1, and we used those to estimate the main and interactive effects of those view contents unique to that level, namely, people, cars, and street trees. In

Figure 2. Mediation model with being away as a mediator of the effects of different window view variables on judgments of restoration likelihood ($N = 102$). Note. Unstandardized coefficients are shown (with standard errors in parentheses). The “a” paths represent the effects of the view variables on being away. The “b” path represents the effect of being away on restoration likelihood. The “c” paths represent the total effects of the view variables on restoration likelihood before adjustment for being away, though with adjustment for the other view variables. The “c’” (c prime) paths represent the direct effects of the view variables on restoration likelihood after adjustment for being away. The differences between the c and c’ values reflect on the indirect effect transmitted through being away. For the complete model, explained variance in the aggregate restoration likelihood ratings is $R^2 = .756$ ($R^2_{adj} = .746$).

* $p < .05$. ** $p < .01$.

line with Hypothesis 4a, the ANOVA affirmed that the presence of street trees boosted ratings of restoration likelihood, $F(1, 20) = 11.15, p = .003, \eta_p^2 = .36$. Neither the main effect of people and cars nor the interaction of street trees with people and cars reached statistical significance ($ps > .60$; see Table 3 for descriptive statistics). Despite the small number of images, we conducted a follow-up mediation analysis to test the indirect effect of street trees on restoration likelihood through being away. In contrast to Hypothesis 4b, it was not significant (coefficient = 0.196, 95% CI = $[-0.0531, 0.611]$). In line with Hypothesis 4c, however, a separate mediation analysis found a significant indirect effect through fascination (coefficient = 0.227, 95% CI = $[0.008, 0.572]$).

Given the small number of images from Level 1, we did not include the presence of a window box as a third factor in the foregoing ANOVA. It was,

Figure 3. Mediation model with fascination as a mediator of the effects of different window view variables on judgments of restoration likelihood ($N = 102$). Note. Unstandardized coefficients are shown (with standard errors in parentheses). The “a” paths represent the effects of the view variables on fascination. The “b” path represents the effect of fascination on restoration likelihood. The “c” paths represent the total effects of the view variables on restoration likelihood before adjustment for fascination, though with adjustment for the other view variables. The “c’” (c prime) paths represent the direct effects of the view variables on restoration likelihood after adjustment for fascination. The differences between the c and c’ values reflect on the indirect effect transmitted through fascination. For the complete model, explained variance in the aggregate restoration likelihood ratings is $R^2 = .831$ ($R^2_{adj} = .824$).

* $p < .05$. ** $p < .01$.

Table 3. Means (Standard Deviations) for Judged Restoration Likelihood as a Function of View Contents Available Near the Street Level.

	Presence of car and pedestrian traffic	
	No	Yes
Presence of street trees		
No	2.66 (0.60)	2.69 (0.25)
Yes	3.48 (0.35)	3.28 (0.72)

Note. The statistics for each combination of view contents are based on aggregate (mean) ratings for each of six images. Thus, aggregate ratings for 24 images are summarized here. Higher scores indicate greater expectations of restoration (on a scale from 0 to 10).

Table 4. Means (Standard Deviations) for Judged Restoration Likelihood as a Function of the Amount of Sky in the View and Weather Conditions.

Amount of sky (floor level)	Weather	
	Cloudy	Clear
1/3 sky (floor level 3)	3.19 (0.47)	3.03 (0.46)
2/3 sky (floor level 4)	4.12 (0.44)	4.06 (0.74)
3/3 sky (floor level 5)	4.73 (0.56)	4.51 (0.69)

Note. The statistics for each combination of floor level and weather are based on aggregate ratings for each of 12 images. Thus, aggregate ratings for 72 images are summarized here. Higher scores indicate greater expectations of restoration (on a scale from 0 to 10).

however, of interest whether the presence versus absence of a window box moderated the effects of the other Level 1 view contents. We therefore completed two additional ANOVA in which we included one of those first-level content variables with the window box variable. The presence versus absence of a window box did not moderate the effect on restoration likelihood ratings of either street trees or people and cars (both $ps > .78$).

It was of further interest whether having a window box can compensate for not having a sky view. We ran an ANOVA in which we combined the images from Levels 1 and 2 and compared the effect of the window box for those floors with the effect of a window box for views with some sky view. The results affirm the results from the regression analyses regarding the positive main effects of window box and view to the sky ($ps < .001$), but the two variables did not interact; a window box did not increase restoration likelihood judgments to a greater degree for views without some sky ($p > .30$).

Two further ANOVAs considered the effects of the variation in only those views with some amount of sky. One of these analyses concerned the visible weather conditions (cloudy vs. clear). For this analysis, we included only those images with views from Level 3 and above. Even with this restricted range of variation, the amount of sky in the view had a strong effect, $F(2, 66) = 43.16, p < .001, \eta_p^2 = .57$. The difference between clear and cloudy weather conditions played a relatively minor role, however, with restoration likelihood ratings slightly but not significantly higher for the cloudy conditions on average, $F(1, 66) = 1.20, p = .28, \eta_p^2 = .02$ (see Table 4 for descriptive statistics). The amount of sky did not interact with weather conditions ($p > .89$).

The second ANOVA concerned only with views with some amount of sky considered the effects of what could be seen above and beyond the facing

Table 5. Means (Standard Deviations) for Judged Restoration Likelihood as a Function of the Amount of Sky and Distant View Contents.

Amount of sky (floor level)	Distant view contents	
	No distant background	Distant city and mountains
2/3 sky (floor level 4)	3.75 (0.54)	4.43 (0.45)
3/3 sky (floor level 5)	4.44 (0.73)	4.81 (0.45)

Note. The statistics for each combination of floor level and distant view contents are based on aggregate ratings for each of 12 images. Thus, aggregate ratings for 48 images are summarized here. Higher scores indicate greater expectations of restoration (on a scale from 0 to 10).

buildings (either a cityscape and more distant mountains or just rooftops in the near distance). For this analysis, we included only the images with views from Levels 4 and 5. Despite the further restriction of variation in the amount of sky, it again proved to be a potent factor, $F(1, 44) = 10.97, p = .002, \eta_p^2 = .20$. The presence of the distant background features also substantially increased ratings of restoration likelihood over a simple view of sky over rooftops, $F(1, 44) = 10.57, p = .002, \eta_p^2 = .19$. The amount of sky and the distant background did not interact ($p > .33$; see Table 5 for descriptive statistics).

We considered whether any views without sky had restoration likelihood ratings like those for views with some sky. The box plots in Figure 4 show the range of group mean values obtained for the views at each floor level. Some individual views with street contents (Level 1) received restoration likelihood ratings similar to those given for some views with the greatest amount of sky (Level 5). The views with neither sky nor contents such as people and street trees (Level 2) were consistently the least liked. These impressions are affirmed by a set of Dunnett C post hoc tests associated with a one-way ANOVA with floor level as a fixed factor. These tests indicate that, on average, the Level 2 views had lower restoration likelihood values than all other floor levels ($p < .05$), while the images on Levels 1 and 3 did not significantly differ on average.

Restoration Likelihood as a Frame of Reference for Environmental Preferences

In the third step of analysis, we addressed the assumption that restoration likelihood provides a frame of reference for environmental preferences. Here we only summarize the results; additional details are given in the Online Supplemental Material.

Figure 4. Box and whisker plots of restoration likelihood scores for the five floor levels, indicating the median value and range of group mean scores for those images used to represent the given floor level.

Note. The floor levels are relative to the street and to the cross street buildings; they are not meant to only represent successive floors in a five-story building. Higher scores indicate greater expectations of restoration (on a scale from 0 to 10).

We first performed mediation analyses like those presented above, but with preference substituted for restoration likelihood as the dependent variable. Of interest was whether these analyses would yield results like those obtained with restoration likelihood. The coefficients for the total, direct, and indirect effects are given in the Online Supplemental Material (Tables S1-S4, Figures S4-S5), together with the corresponding coefficients from the analyses with restoration likelihood as the dependent variable, taken from Figures 2 and 3. By and large, the coefficients for the various effects did not differ significantly across the analyses, though there are some exceptions. The presence of a window box had a stronger total effect on preference than on restoration likelihood, a difference also seen in the respective direct effects after adjustment for being away as a mediator. That difference was no longer significant after adjustment for fascination, which also left smaller direct effects

from the window box variable to the dependent variables than those seen with adjustment for being away. Fascination of itself had a stronger effect on preference than on restoration likelihood, and stronger associations with both dependent variables than did being away. Yet, the coefficients for the indirect effects of the physical variables on preference as mediated by fascination apparently did not differ statistically from those for the corresponding indirect effects on restoration likelihood (see Table S4). The coefficients for the indirect effects mediated by being away are much the same for preference and restoration likelihood. In brief, when we substituted preference for restoration likelihood, we obtained largely similar results, though with some differences indicating a need for caution when approaching preference as a proxy for restoration likelihood.

As for whether preference might serve as a frame of reference for restoration likelihood judgments, rather than vice versa as we have assumed, our tests of the competing models that included both of those variables gave little empirical reason to prefer one perspective over the other. All of the indirect effects in which preference mediated the effects of earlier variables on restoration likelihood had CIs that overlapped substantially with those of the corresponding effects from the model in which restoration likelihood transmitted effects to preference. See the Online Supplemental Material (including Table S5) for further details.

Discussion

We found that having more sky in view lifted expectations that attention restoration could proceed while looking out the window from an apartment in an area of high residential density. So, too, did greater street width and a window box with greenery. The effects of the amount of sky and the window box were mediated by their impacts on perceptions of being away and fascination. In general, the indirect effects through being away were weaker than those through fascination, and when both of these restorative quality variables were included as mediators in an analysis, the only reliable indirect effects went through fascination. The different view contents would thus seem to support restoration more by providing something to engage attention than by enabling psychological distance; however, the close correlation between being away and fascination suggests that these components of restorative experience work together. Having more to engage attention may help a viewer gain psychological distance from mundane tasks and routine mental contents, and gaining psychological distance may help a viewer open up to the variation that can be seen outside.

Additional analyses considered view contents specific to particular floor levels. In line with expectations, we found that street views that included trees evoked higher ratings of restoration likelihood, as mediated by fascination. We also found that distant cityscape and mountain features seen from the uppermost floors substantially increased restoration likelihood over a simple view of sky over rooftops. On the whole, window views without either sky or street trees were judged least restorative. Furthermore, the presence of a window box did not compensate for a lack of a view to the sky.

To our knowledge, this is the first study to systematically address how perceived restorative quality and expectations regarding restoration vary with the amount of sky and other view contents affected by physical design measures that are instrumental in urban densification. As such, our study is timely, if not long overdue; the practical issues of interest here are of growing importance. Among other values of engaging with the natural world, viewing the sky and other natural features can support restoration of depleted psychological resources in an urban context (Hartig et al., 2003; R. Kaplan, 2001; Lee et al., 2015). Yet just as population growth, urbanization, and densification are producing more stressful living environments, more people in more places have little contact with the natural world in their everyday lives (Soga & Gaston, 2016), including restorative contacts afforded by views out a dwelling window.

The number of floors in buildings and the width of streets are common referents for urban design, policy, and planning measures that weigh the interests of different parties, such as those in need of affordable housing in a growing city, those who need to travel on streets, those who would have their views blocked by new buildings, and those who would enjoy expansive views from new, higher buildings. These competing interests mean that actual or threatened loss of views is a knotty problem, one that in some societies provokes legal conflicts (see, for example, the list of court cases posted at the website of the Pacific View Rights Resource center: <https://pacificviewcenter.com>). We assume that efforts to resolve such problems will benefit from scientific knowledge about just what is at stake.

As a resource for addressing such problems, the present study has notable strengths. Our systematic manipulation of attributes in view images, together with our study design, procedures, and analyses, have helped us to counter or directly address a variety of potential confounders in estimating effects of interest. Our findings are largely in line with expectations based on theory and previous research, and key effects, notably the positive effect of the amount of sky, are strong. Also, importantly, the measurement instruments we used enable us to say something about longer term implications of view loss. We have noted that repeated brief episodes of restorative viewing may

over time generate cumulative benefits (R. Kaplan, 2001; Lee et al., 2015). Our measure of restoration likelihood reflects on experience in the use of places for restoration. As such, it also reflects on the deliberate efforts that people can make to manage cognitive and other resources they need to meet the demands of everyday life (cf. Korpela & Hartig, 1996; Korpela et al., 2018; Staats et al., 2003). Such self-regulatory activity has been related to diverse outcomes relevant to effective functioning, well-being, and health (e.g., S. Kaplan & Berman, 2010). The measures of the restorative quality mediators also deserve mention in this regard. Several previous studies have demonstrated the utility of the PRS being away and fascination subscales in representing the psychological process mediating longer term effects on self-perceived health of diverse environmental features and interventions. These include the availability of garden greenery in residential care facilities for older people (Dahlkvist et al., 2016), the amount of urban green space near an urban residence (Dzhambov, Hartig, Markevych, Tilov, & Dimitrova, 2018), traffic-related noise and air pollution near the home (von Lindern, Hartig, & Lercher, 2016), and a therapeutic horticulture program for clinical depression (Gonzalez, Hartig, Patil, Martinsen, & Kirkevold, 2010). Those aspects of the environment that the present study has shown can boost or reduce experiences of being away and fascination during time available for restoration can therefore also be considered with regard to longer term effects.

Given the evidence of longer term effects just cited, it is inappropriate to assume that residents will simply adapt to a relatively impoverished skyline view without realizing any negative consequences. A reasonable question, then, concerns the measures that can be taken to ameliorate a lack of desirable view contents. Aside from choosing among different residential alternatives, people ordinarily cannot do much about the width of the street outside or the degree to which an existing or planned building obscures the view. They can, however, often affect what they see at the window itself. Our results indicate that a simple window box with greenery did boost ratings of the views on restorative quality and restoration likelihood. However, the effect of the window box on restoration likelihood judgments was not stronger for views that lacked sky than for views that had sky. The addition of a window box exemplifies compensatory behavior described in other literature on window view constraints (Bringslimark et al., 2011; Heerwagen & Orians, 1986), but the effectiveness of the strategy must be questioned. That aside, if a window box with greenery can enhance the restorative quality of the residence (and possibly serve meaningful ecological functions as well; Hartig & Kahn, 2016), then building design would do well to allow for this option.

On Restoration Likelihood as a Frame of Reference for Environmental Preferences

As in previous studies of the restorative quality of dense urban environments (Lindal & Hartig, 2013, 2015; Nordh et al., 2009), restoration likelihood had a strong bivariate correlation with preference across the view images. Such findings encourage the practice we applied here, namely, taking guidance from the preference literature when the literature on restorative environments lacks information about environmental supports for restoration in a given context. This practice does, however, require caution. For example, preference and restoration likelihood are not necessarily affected to the same degree by a particular physical variable, and that effect may not get mediated to the same degree by a restorative quality mediator. Such possibilities are illustrated by results from our mediation analyses with preference substituted for restoration likelihood. The total, direct, and indirect effects were largely similar across the two models, but the presence of a window box had a stronger total effect on preference than on restoration likelihood, perhaps because people can like window boxes for reasons that have little bearing on attention restoration. Moreover, the difference persisted in the respective direct effects left after adjustment for being away, but it was no longer significant after adjustment for fascination, which also left smaller direct effects than seen with adjustment for being away. Being away may have narrower bandwidth as a mediator than fascination, and more selectively transmit effects of specific relevance to attention restoration, whereas fascination may also transmit effects of relevance even outside of a restorative process. Fascination of itself had a stronger association with preference than with restoration likelihood, which may simply reflect the fact that people can like or dislike settings for reasons other than restoration. This last point bears emphasizing: We do not mean to imply here that restoration is the only frame of reference for preferences. People can like places for multiple reasons, some of which may have nothing to do with restoration.

Taking a bivariate correlation as evidence that restoration serves as a frame of reference for preferences also opens for an implicitly theoretical critique: Preference could as well serve as the frame of reference for restoration likelihood judgments. Our choice of perspective follows that of previous researchers (Lindal & Hartig, 2013, 2015; Nordh et al., 2009) in assuming that an expression of preference reflects on a person's experience with the use of different places for restoration and other purposes. This assumption is explicit in other research as well. For example, research on environmental self-regulation (Korpela & Hartig, 1996; Korpela, Hartig, Kaiser, & Fuhrer, 2001) assumes that one reason a person can develop an attachment to place is

that it has repeatedly served emotion- and self-regulation. Such a place may eventually become identified as a favorite one (i.e., one that is most liked or preferred within a given set) when it serves particularly well in this regard. Importantly, restoration can be considered one among other integral aspects of normal emotion- and self-regulation (Korpela et al., 2018). Other research has approached preference as an attitude toward a behavior (e.g., going for a walk) and explained it with regard to expectations about the likelihood of certain outcomes (e.g., attention restoration) when the behavior is performed in a given environment (Staats et al., 2003). This line of research has also illustrated how preferences are sensitive to a variety of immediate contextual and personal determinants relevant to the realization of restorative outcomes, including the level of attentional fatigue (see also Hartig & Staats, 2006; Staats & Hartig, 2004; Staats et al., 2016; Staats et al., 2010). In brief, we have good theoretical and empirical grounds for preferring a perspective in which expectations about achieving restoration (as reflected in ratings of restoration likelihood) guide expressions of preference, particularly when a person is in need of restoration. The alternative perspective assumes lasting environmental preferences that are stable across situations. This might seem to allow room for the claim that evolutionary inheritance still plays a significant role in determining expressed preferences (e.g., as described in Appleton's [1996] prospect-refuge theory); however, it cannot exclude the possibility that those lasting, stable preferences were acquired early in the individual's development. Moreover, an evolutionary account that would treat preference as a frame of reference for current restoration likelihood judgments does not exclude the possibility that in establishing biological bases for habitat preferences natural selection had worked on an ability to find settings that supported restoration.

This is not an issue that we can resolve empirically here; our data do not allow a test that would establish that one of the perspectives is to be preferred. Among other limitations of the data, we cannot say that any one of the rated variables is temporally antecedent to any other for any one individual in a strictly operational sense. Also, our measures were collected at one point in time from adults—they do not reflect on the development of preferences from an early age. Yet the present study also has particular strengths as a test of the assumption that restoration likelihood serves as a frame of reference for environmental preferences, particularly when a person is in need of restoration. The ratings of being away, fascination, restoration likelihood, and preference were obtained from independent groups of raters for each image. The preference rating task was introduced with a scenario that did not specify a restoration goal. The visual stimuli themselves did not impose an implicit restoration frame; they assumed a standing viewer in the middle of the room

rather than one seated beside the window. Furthermore, we collected the data after a lecture, making the need-for-restoration scenario more readily imaginable for those participants who rated one of the variables related to restorative experience and increasing the likelihood that those participants who rated the view images on preference could approach the task with some need for restoration. Given these advantages and the possibility that our data could offer useful insights on this issue, we tested additional models that represented the different perspectives, extending the models already tested by including an additional mediation component after the given restorative quality mediator. One set of these serial mediation models reflects our assumption regarding the causal sequence: The restorative quality mediator (being away or fascination) transmits the effect of a given physical variable to restoration likelihood, which in turn affects preference. The second set of serial mediation models reflects the alternative: The restorative quality mediator transmits the effect of a given physical variable to preference which in turn affects restoration likelihood. Our tests of these competing models gave no clear empirical reason to prefer one perspective over the other. Given the theoretical arguments and empirical research precedents we have worked from here, as discussed above, as well as our specification of a context involving some need for restoration, we think it appropriate to focus on restoration likelihood as the mediator of (or frame of reference for) environmental preferences in circumstances like those in focus here. Looking beyond the kind of circumstances created in this experiment, it should be fruitful to approach the relationship between preference and restoration likelihood as a reciprocal or nonrecursive one that sees occasional updating.

Limitations and Future Research Directions

Our study has significant strengths, but we recognize that it also has limitations beyond those mentioned above. First, we used a convenience sample of university students rather than a random sample from the general population, and we focused on the experiences of people in one large city in a specific geographical and cultural context. The generalizability of our findings is an open question. This said, Stamps' (1999) meta-analysis described strong correspondence ($r = .83$) between environmental evaluations from student and nonstudent groups. Also, cross-cultural studies indicate that loss of contact with the sky and other natural view contents with urban densification are likely to be negatively evaluated in many cultural contexts (Stamps, 1999).

Second, the validity of view evaluations obtained with digital images instead of on-site can be questioned. In his meta-analysis, however, Stamps (1990) found a strong correlation between environmental evaluations obtained

on-site and with photographs (cf. Stamps, 2010). Moreover, we asked the participants about whether the images we showed were similar to what they are used to seeing in residential areas in Tehran. Almost all answered affirmatively, and the remainder apparently did not understand the question.

Third, our representation of content variables involved significant simplifications. We strictly constrained or held constant numerous variables, such as building facade detail, traffic levels, number of street trees, daylighting, the activity context of the rater, the viewing position of the rater in the virtual room, and, not least, the weather, for which we represented only two relatively homogeneous conditions (blue sky vs. overcast), leaving unattended the enormous potential variation in colors and clouds. We imposed these restrictions to secure reliable estimates of the effects of primary interest without having to work with the huge number of images that would be required to balance the levels of different variables across the levels of the other variables as appropriate to the given relative floor levels. Nonetheless, we recognize that we have not represented the full complexity of possible viewing situations. This may have made some of our effect estimates conservative.

Despite its limitations, the present study provides valuable findings and useful points of departure for further research. Some of the work still needed would address limitations of the present study, for example, with more attention to weather and daylight variations, more detailed modeling of architectural variation in facades, the potentially counteractive effects of different levels of pedestrian versus vehicular traffic, and the experiences of residents who have undergone or are facing change in their views. As in the present study, the selection of attributes could be guided by practical considerations related to urban densification.

Future studies could also address implications of the present results. For example, it seems that street width affected ratings of restoration likelihood through one or more experiential mediators other than being away or fascination. One might refer to extent as described in ART, thereby raising questions about the degree to which extent can contribute to restoration independently of being away and fascination. Another experiential mediator that could be at work involves privacy regulation; with windows of cross street apartments farther away, one is allowed more privacy. Our images did not show people in the facing apartments, but the possibility of the presence of other people could have implicitly operated.

One more direction for further research, out of the many, would involve tests of actual restoration under different view conditions. How much, for example, can different window views with and without any visible sky aid recovery from attentional fatigue and stress?

Concluding Comments

Densification strategies may help to reduce the ecological footprints of large and growing cities, but the implementation of such strategies can undermine environmental supports for the fulfillment of basic human needs. Biophilic, green urbanist and restorative environmental design approaches can help to reconcile the competing demands (e.g., Beatley, 1999; R. Kaplan, Kaplan, & Ryan, 1998; Kellert, Heerwagen, & Mador, 2008; Lindal, 2013; Masoudinejad, 2013; Thwaites, Helleur, & Simkins, 2005). In further theoretical, empirical, and practical work on these issues, we encourage researchers and practitioners to look to the sky as “blue space” relevant to the fulfillment of recurrent needs for psychological restoration and therefore to the design of psychologically sustainable urban environments.

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Supplemental material

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