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The impact of plants offering cover on female students' perception of danger in urban green spaces in crime hot spots

Abstract

Urban parks and forests are important for wellbeing, but feelings of insecurity limit their usage. Removal of vegetation from hotspots of fear is sometimes recommended as a means of boosting safety. However, such actions should be approached with caution. One explanation, based on prospect-refuge theory, is that plants increase perceptions of danger because of their contribution to a setting's effectiveness in concealing criminals. It is also believed that people do not like urban parks containing trees and shrubs that can act as hiding places because of the sense of danger that this vegetation evokes. To test this explanation, participants (female students) rated 57 photos of urban parks settings in terms of perceived danger, effectiveness of concealment, and landscape preference. In addition, the effectiveness of concealment in the photos was measured, assuming that the value of this variable is expressed by the percentage of the pixels occupied by trees and shrubs offering concealment in a photograph. Results confirmed that concealment and danger are strongly correlated. Mediation analysis confirmed that the impact of concealment on preferences can be explained by perceived danger. When danger was controlled, the efficiency of concealment had no influence on preferences.

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1 Introduction

The importance of urban green spaces for health and well-being have been well established (Chang et al. 2021; Ayala-Azcárrag et al. 2019; Gramkow et al. 2021; Stier-Jarmer et al. 2021). Moreover, research has demonstrated that people generally prefer and benefit from trees and other types of greenery in various situations (e.g. Ayala-Azcárrag et al. 2019; Bringslimark et al. 2009; Hedblom et al. 2019; Kaplan and Kaplan 1989; Kuo and Sullivan, 2001; Scopelliti et al. 2018; Ulrich 1984; 1986; White and Gatersleben 2011). A number of studies based on the Biophilia hypothesis (Wilson 1984), Attention Restoration Theory (ART) (Kaplan and Kaplan 1989) and the Stress Reduction Theory (Ulrich 1983) provided empirical evidence that wildlife has multiple benefits for human health and well-being (Berto 2005; Hartig et al. 2014; Jarvis et al. 2020; Laumann et al. 2001; Qiu et al. 2021). The importance of nature for people is also taken into account by programs and strategies related to urban policy (Hoyle et al. 2017; Evensen et al. 2021). Significant research has been devoted to ecosystem services (ES), which refer to the benefits people derive from nature (Constanza et al. 2017). Much less research on negative emotions related to the influence of nature, or more broadly, research on ecosystem disservices (EDS), has been conducted and has received far less discussion (Taylor 2019). EDS is defined as the negative impact of nature on human well-being – functions or properties of ecosystems that produce effects that are perceived as harmful, unpleasant or unwanted (Wu et al. 2020; Blanco et al. 2019).

One example of EDS is the sensation of fear that city parks can evoke (Lyytimäki 2019). Researchers point out that perceived danger in urban parks acts to the detriment of wellbeing (Fisher et al. 2021) and limits the use of such parks (Magde 1997). In situations of increased threat, safe-related environmental characteristics are of particular importance – hence, many other studies on the impact of hiding places also looked at hotspots of fear and crime (Fisher and Nasar 1992; Nasar et al. 1993; (Nasar and Jones 1997) or night-time periods when the sense of danger increases (Blöbaum and Hunecke 2005; van Rijswijk et al. 2016; (van Rijswijk and Haans 2018). Women are found to experience higher levels of insecurity than men (Blöbaum and Hunecke 2005; Fisher and Nasar 1992; Jansson et al. 2013; Jorgensen et al. 2002; Loewen et al. 1993; Rišová and Madajová 2020; Jorgensen et al. 2007; van Rijswijk et al. 2016). That is why our research, like a range of others that focus on the issue of fear and danger (e.g. Evensen et al. 2021; Haans and de Kort 2012; Koskela and Pain 2000; Nasar and Jones 1997), was conducted on this particular group of respondents.

Perceived danger is often associated with the presence of plants, which may constitute a prospect blocker or a hiding place for potential offenders (Lis et al. 2016a; 2016b). It was also found that dense vegetation can create places that criminals are keen to use (Michael and Hull 1994) and provides opportunities facilitating criminal acts (Michael et al. 2001). Kuo and Sullivan (2001) recall a number of studies describing active programs for removing greenery that was considered to facilitate crime. This was in spite of the fact that the researchers point out that the impact of vegetation on the fear of crime or perceived danger depends on the characteristics and location (Fisher and Nasar, 1992; Nasar et al. 1993; Herzog and Chernick 2000; Lis et al. 2016b; Evensen et al. 2021). Although there have been many studies in this area, the exact relation between vegetation, crime, and the fear of crime remains ambiguous (see e.g. Bogar and Beyer 2016; Kuo and Sullivan, 2001; Maas et al. 2009; Wolfe and Mennis 2012). Therefore, the removal of trees and other vegetation should not be taken lightly. Instead, it should be a justified decision taking into account the cause and conditions behind. The present study aims to contribute to a better understanding of the mechanisms behind the influence of trees and shrubs on perceived danger and landscape preferences.

Research on the effect of physical characteristics on danger is often based on Appleton's (Appleton 1975; 1984) prospect-refuge theory concerning landscape preferences. According to Appleton, the ability to see (i.e., prospect) without being seen (i.e., refuge) was an intermediate step in satisfying biological needs. This is why we prefer landscapes that afforded such opportunities. This theory was adapted for studying fear of crime and safety perceptions. Fish-

er and Nasar (1992) argued that vantage points that offer both prospect and refuge are beneficial also to criminals since they offer a good place for them to hide. Expanding considerations on how environmental features influence perceived danger. Some researchers (Fisher and Nasar 1992; Nasar, Fisher and Grannis 1993) select three key factors. The first two are prospect and refuge, based on Aplleton's theory. The third is escape – features of the environment that facilitate escape in the event of an assault and/or access to help.

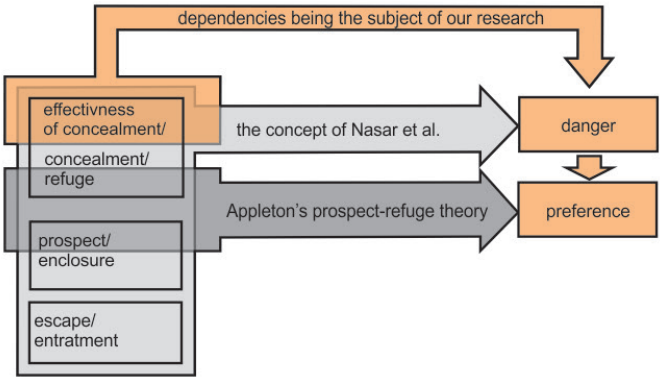


Figure 1. The influence of environmental features on danger and preference – the concept presented by our research against the background of the theories discussed.

The role of prospect, concealment, and escape (and derivatives such as enclosure, entrapment, etc.) in the formation of safety perceptions has received much empirical support (Blöbaum and Hunecke 2005; Haans and de Kort 2012; Herzog and Chernick 2000; Lis and Iwankowski 2021a; 2021b; Lis et al. 2019a; 2019b; 2019c; Nasar and Jones 1997; van Rijswijk et al. 2016) – Figure 1. Van Rijswijk and Haans (2018) recently demonstrated that prospect, concealment, and entrapment can robustly explain 70% of variation in perceived safety within a large and representative set of nocturnal urban environments.

The possible negative effects of trees and shrubs in urban parks (Baran et al. 2018; Jorgensen et al. 2002) may thus be explained from prospect-refuge theory: Greenery can block prospect and offer concealment to potential criminals (e.g. Fisher and Nasar 1992; Herzog and Chernick 2000; Lis et al. 2016a; 2016b; 2019a; 2019c; Nasar et al. 1993). Thus, we argue that the negative effect of trees and other vegetation on perceptions of safety is not due to their mere presence, but to their contribution in making the setting effective as a hiding place for criminals. Since studies have reported on a negative correlation between perceptions of danger and landscape preference (e.g. Herzog and Flynn-Smith 2001; Herzog and Kutzli 2002; Herzog and Kutzli 2002) dense vegetation is expected to affect negatively landscape preferences, also because of their concealing properties. However, at the same time, the results of research on the impact of safety-related plant characteristics (e.g. vegetation density) on preferences are not conclusive. Most often, researchers assume or conclude from studies that parks allowing unobstructed views are preferred, featuring no dense shrubbery or other visual obstructions (Campagnaro et al. 2020; Jorgensen et al. 2002). It was also found that such parks are safe, as opposed to parks containing a dense understorey that may, inter alia, offer a potential place of concealment (Michael et al. 2001; Jorgensen 2004). In contrast, other studies have shown that dense vegetation is strongly preferred (Harris et al. 2018). This may be because the areas that contain it have enhanced ecological values (Fuller et al. 2007), and as such are valued, especially by those who are ecologically inclined (Kurz and Baudains 2012). Cultural differences between the areas researched may also be the reason. Another possible reason for the positive assessment of dense vegetation may be found in Appleton's aforementioned shelter-view theory. Considering the double role of hiding places postulated by Fisher and Nasar (1992), we can suppose that places associated with concealment can also be perceived positively since they provide desired privacy (Altman 1975). Recent studies by Lis and colleagues (Lis et al. 2019) have shown that hidden, intimate places are sometimes liked despite the danger they evoke. Unfortunately, studies applying prospect-refuge theory to natural environments, including urban parks, remain rare (but see Andrews and Gatersleben 2010; Herzog and Kutzli 2002; Lis and Iwankowski 2021a; 2021b; Lis et al. 2019a; 2019b; 2019c; Maruthaveeran and Konijnendijk van den Bosch 2014).

To sum up, the influence of plant characteristics that may make them good for concealment is not, in the light of research, cut and dried. Researchers

assume that the features of trees and shrubs associated with their potential role as places of concealment (e.g. plant density) are disliked because they evoke a sense of danger (Rouquette and Holt 2017). However, there is a lack of research that tests such a mechanism – e.g. by mediation analysis. Our research makes an attempt to do so (Figure 1).

1.1 Research aims

In this study, we examined the role of perceived threat as a mediator in relation to two variables: (1) features of vegetation that facilitate human concealment (effectiveness in masking) and (2) landscape preferences. The study involved public municipal parks. In particular, we were interested in empirically investigating such mediation effects in areas perceived to be hotspots of fear and crime. Considering three basic variables influencing an increased perception of danger (entrapment, prospect and concealment), we focused solely on concealment as a possible mediator, which we expected to be most important in explaining the relationship between vegetation and safety perceptions. Research covering all three variables was most often conducted in urban settings (like a street or an academic campus). There are a lot of architectural obstacles in such areas, which create screens and cut off escape routes. These obstacles increase the role of prospect and entrapment in shaping perceived danger. Parks contain fewer forms that create long visual obstructions, but more plants are planted alone or in groups that can offer a hiding place for a potential assailant. Therefore, a place of concealment may influence sense of danger in parks more significantly than in an urban environment.

We formulated the following hypotheses:

H1: For urban parks, the perceived danger of a specific setting depends heavily on the extent in which the physical features of the environment allow for the effective concealment of criminals. In other words, we expected a strong correlation between ratings of a settings' effectiveness of concealment and its perceived danger.

H2: Perceived danger mediates or explains the impact of effectiveness of concealment on landscape preference. In particular, we expected that after accounting for their contribution to perceived danger, the characteristics of plants that affect their ability to conceal someone will not be related to landscape preference.

2 Methods

2.1 Experiment design

We conducted a survey study in which photos of landscapes were evaluated according to perceived danger, preference, and the effectiveness of concealment. Each of these variables was assessed separately by a different group of respondents to reduce spurious correlations between the various evaluations (e.g. van Rijswijk and Haans 2018). The photos were evaluated in the same random order, but this order was modified by interchanging the halves of the original order for sessions 12 to 22.

A total of 177 people, all female, participated in the study. All were students of Landscape Architecture at Wrocław University of Environmental and Life Sciences; 146 were undergraduates and 31 were graduate students. Their mean age was 20.56 (SD = 1.68; range 19–25 years). Of the 177 participants, 67 (i.e., 37.9%) rated the photos according to perceived danger, 37 (20.9%) for preference, and 73 (41.2%) for effectiveness of concealment.

The stimulus material consisted of 57 colour photos taken in various urban parks presented on a projector screen (BenQ 800 x 600 SVGA, 4:3 format, 121 inch diagonal). All photos were taken in the summer or late spring. No photos contained people. The sample was selected to include photos of trees and shrubs that could serve as a place of concealment to varying degrees. Among others, the height and width of the shrubs, their density or transparency as well as the shape of the crown, the thickness of trunks, and the height of their crowns were differentiated (Lis et al. 2016a; 2016b). We took a random sample from a large number of the photos that we took, which we divided beforehand into three groups according to the level of the concealment offered: landscapes with vegetation featuring high, medium and low possibilities of concealment.

2.2 Data collection

Perceived danger and preference were evaluated with a single item using a 5-point scale, ranging from "a great deal" (coded with a 5) to "not at all" (coded with a 1). Both items were taken from Herzog and colleagues (e.g. Herzog and Chernick 2000; Herzog and Flynn-Smith 2001; Herzog and Kutzli 2002). For perceived danger, the item read: "How dangerous is this setting? Please imagine you are walking along such a path. How likely is it that you could be harmed in this setting?" For preference, the item read: "How much do you like the setting? This is your own personal degree of liking for the setting, and you don't have to worry about whether you're right or wrong or whether you agree with anybody else."

Previous research has not established one consistent definition of an operating place of concealment or methods of measuring it. Most often, the place of concealment was measured using the respondents' assessments (e.g. Blöbaum and Hunecke 2005; Haans and de Kort 2012) or categorised by researchers according to perceptual-cognitive judgement (Fisher and Nasar 1992; Andrews and Gatersleben 2010). Exceptions include measurements based on physical data. This measurement was carried out by Nasar et al. (1993) by recording the space occupied by each tree, shrub and mass of shrubs in the study area. Taking into account the limitations of each method, we decided to use two measurements based on different methods. The first measurement method – the traditional one – was analogous to the measurement perceived danger and preference. The variable was assessed by respondents on a 5-point scale. The item read: 'Please imagine that a person might be lurking behind the shrubs or trees that you see. How do you rate such a hiding place in terms of effectiveness?' We asked the respondents, while issuing the assessment, to try to determine how easily they could hide themselves behind the trees or shrubs visible in the picture if they were looking to conceal themselves effectively (for whatever purpose). We explained that the effectiveness of a hiding place is determined by the ease with which a person or a group of people can hide and remain unseen, irrespective of their body position (standing, bent or crouched).

Because the question about the variable could, despite our best efforts, suggest to the respondents an association with danger and cause spurious correlations between the various evaluations, we adopted an additional measurement method independent of the respondents' assessments. We used the photographs to make the measurement. With the use of Coreldraw X6 we outlined all the trees and shrubs on the photos that may be a place of concealment in an area not exceeding the height of a person. Since the pictures were taken from a standing position, this area was located, approximately, below the line of the horizon. Next we used the Image Histogram function in Adobe Photoshop CS 6 to measure areas previously indicated (trees and shrubs as the places in the photo offering concealment). Next, we identified the number of pixels contained in the entire photo in the area below the line of the horizon. The effectiveness of concealment is the percentage of the pixels occupied by trees and shrubs constituting a place of concealment in a photograph (see Figure 2).

The method of measurement we used to calculate the percentage of vegetation in the photo frame has already been used by other researchers, for example to measure vegetation density (Jiang et al. 2015; 2017; Lis and Iwankowski 2021a; 2021b). We first selected areas of trees and shrubs constituting effective concealment in the photo and identified the number of pixels in those areas. It is worth underlining that the operationalisation and measurement method we adopted in this way indirectly takes into account the distance of trees and shrubs from the observer (potential victim) – as the distance increases, it decreases in the photo due to the principles of perspective. As a result, this variable measurement takes into account not only the characteristics of the plant itself, but also its location, which plays a significant role in the impact of concealment on danger (Fisher and Nasar 1992; Lis et al. 2016b; Lis and Iwankowski 2021a; 2021b).

The study was conducted in a reading room in which the landscape photos were depicted on a projector screen. Participants arrived in groups of 8 to 18 participants. After taking a seat, the task was explained to the participant. Depending on the session they were in, they were instructed to evaluate each scene

Figure 2. Representation of the method of measuring the effectiveness of concealment for a sample site: the effectiveness of concealment. The trees and shrubs constituting potential concealment (highlighted in yellow) divided by the total number of pixels in the photo.

on one of three criteria (perceived danger, preference, or effectiveness of concealment). Respondents evaluating scenes on target variables (perceived danger and preference) were asked to imagine, with each photo, that the depicted environment was located in a dangerous district of a city, and that they were walking along a path in it. Next, the participants were presented with twelve practice photos, followed by the 57 photos comprising our stimulus set. Each photo was shown on the screen for 15 seconds, during which the participant would evaluate the photo. After 29 photos, there was a five-minute break.

The study lasted approximately 20 minutes.

To sum up: we measured the dependent variables (danger and preference) via the respondents' evaluations using the survey tool. We measured the variable effectiveness of concealment using two methods: (1) by assessing the respondents' assessments of the landscapes presented in the photos, and (2) by measuring the share of trees and shrubs constituting the place of concealment in the same photos.

2.3 Data analysis

All analyses were performed with a setting (landscape on the photo) as the unit of analysis. For this purpose, we calculated, for each setting, a single score for each variable by averaging the respondents' responses. As a measure of the absolute agreement among respondents, we calculated intraclass correlations (ICCs) using a two-way random model (randomly selected raters from larger population of assessors, (Koo and Li 2016). These ICCs ranged from 0.912 and 0.987, indicating satisfactory agreement among the respondents. Thus, it was appropriate to use aggregated scores in our analyses.

The statistical analysis was carried out using IBM SPSS Statistics version 23. For mediation analyses, we used PROCESS version 2.16.2 (Hayes 2013). Mediation analysis tests the existence of an intermediary relationship by performing a series of regression analyses – between the independent variable and the mediator (path a), between the mediator and the dependent variable (path b), between the independent variable and the dependent variable (path c), and between the independent variable and the dependent variable, but while taking into account the mediator in the model, i.e. the intermediary variable (path c') (Baron and Kenny 1986). In this approach, when path c' ceases to be statistically significant next to the current statistically significant path c, the mediator can be considered as an intermediary variable explaining why there is a relationship between the independent variable and the dependent variable. This method is complemented by the Sobel test and the superior bootstrap method (Hayes 2009). We used the bootstrap method with a random sampling of n = 5000 samples. The 95% confidence interval constructed on its basis does not contain the value 0.

3 Results

First, we checked the distributions of measured variables. Table 1 provides descriptive statistics. The value of skewness and kurtosis shows slight deviations from the normal distribution.

Next, we examined the correlations between the effectiveness of concealment rated and measured in the photos, perception of danger, and landscape preference (see Table 2 for an overview). We found the effectiveness of concealment to correlate very strongly with the perception of danger – both when it was assessed by the respondents and when it was measured in the photos (respectively: r = 0.90 and r = 0.85, p <0.001). The more effective a landscape is in providing a hiding place, the bigger the perception of danger was. This finding supports our H1. With respect to landscape preferences, we found moderate correlations with effectiveness of concealment and perception of danger. The more effective a landscape is in providing a hiding place or the bigger its perceived danger, the less the landscape is preferred.

It is worth noting that the effectiveness of concealment measured by participants' evaluation is correlated more strongly with danger than the effectiveness of concealment measured based on photographs. This is important from the point of view of a further analysis (mediation analysis) aimed at testing the H2 hypothesis. In the case of path b (mediator influence on dependent variable with simultaneous control of independent variable), the collinearity manifested by the effectiveness of concealment measured in the photographs with danger is below the relatively conservative threshold set by Sheather (Sheather 2009) of 5 (VIF = 3.51), while the collinearity for the assessed effectiveness exceeds this threshold (VIF = 5.19). Hence, the decision was made to use only the assessment of effectiveness measured in the photographs for mediation analysis.

During the next stage, a mediation analysis was performed (see Table 3, Figure 3). The analysis showed a statistically significant mediation effect. According to the classic approach of Baron and Kenny (Baron and Kenny 1986), the assumptions regarding relationships between variables in the model were met.

Table 1. Basic descriptive statistics of the variables measured.

	Mean	Median	Min.	Max.	Standard Deviation	Skewness	Kurtosis
danger	2.77	2.54	2	5	0.800	0.675	-0.285
preference	3.12	3.11	1	4	0.583	-0.184	0.528
effectiveness of concealment (photo)	13.28	10	0	43	11.101	0.866	0.140
effectiveness of concealment (rated)	2.57	2.52	1	5	0.941	0.510	-0.699

Note: Units of measure: for danger, preference, effectiveness of concealment (rated) - averaged responses on Likert scale; for effectiveness of concealment (photo) – the percentage of the pixels occupied by trees and shrubs constituting a place of concealment in a photograph.

Table 2. Correlations between the rated effectiveness of concealment, the effectiveness of concealment measured on the photos, perceived danger and landscape preference.

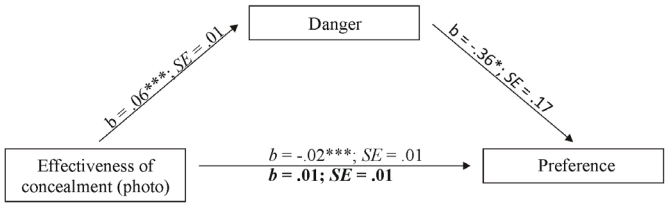
		danger	preference	effectiveness of concealment (photo)	effectiveness of concealment (rated)
danger	Pearson's r	-			
	Significance				
preference	Pearson's r	-0.42	-		
	Significance	0.001			
effectiveness of concealment (photo)	Pearson's r	0.85	-0.32	-	
	Significance	<0.001	0.014		
effectiveness of concealment (rated)	Pearson's r	0.90	-0.40	0.85	-
	Significance	<0.001	0.002	<0.001	

The independent variable (effectiveness of concealment) statistically and significantly influences the mediator (danger) (β = 0.85, p <0.001) (path a), the mediator coincides statistically and significantly with the dependent variable (preference) (β = -0.50; p = 0.037) (path b) while the statistically significant relationship between the independent variable and the dependent variable without the presence of a mediator in the model (β = -0.32; p = 0.014) (path c) became statistically insignificant after the introduction of an intermediate variable in the form of danger (β = 0.10, p = 0.108) (path c'). Therefore, it represents a total mediation. Supplementing this approach with the Sobel test indicates a statistically significant intermediary effect.

Table 3. The mediation effect of danger in the relation between the effectiveness of concealment and preference.

				Bootstrap 95% CI (n = 5000)	
	indirect effect	*SE*	*Z*	*LL*	*UL*
mediation effect of danger	-.02	.01	-2.10*	-.042	-.003

SE – standard error; *Z* – Sobel test; 95%*CI* – confidence interval; *LL* – lower limit; *UL* – upper limit * p < .05



* - $p < .05$. *** - $p < .001$.

Figure 3. Non-standardized regression analysis coefficients that reveal danger as a mediator of the effectiveness of concealment and preference (direct effect in boldface).

4 Discussion

4.1 Operationalization of the effectiveness of concealment variable

The concealment measurements obtained from the respondents' assessments proved to be strongly correlated with danger in terms of influence on preferences. This correlation is lower in the case of the effectiveness of concealment measured in the photos. Probably the reason is that our question about concealment could have suggested to the respondents that a place of concealment is dangerous. This result indicates that research methods should be treated carefully, whereby the operationalisation of a place of concealment is based on perceptual-cognitive judgement (Lis et al. 2019a; 2019c). The factors influencing spurious correlations between the various evaluations should be reduced. In our study, each of these variables was assessed separately by a different group of respondents, although this precaution proved insufficient. Another operational question or other measurement methods should be found. It seems both appropriate and relevant to look for methods to quantify the physical characteristics of a space such as a potential hiding place that may yield more objective results. Our method of measuring a variable from photos constitutes an alternative suggestion, albeit one that requires further testing.

4.2 The correlation of concealment and danger, the mediating role of danger in the influence of concealment on preferences

In the present study, we examined the role of perceived danger in explaining the relation between effectiveness of concealment and landscape preference in urban park settings. The study showed a strong correlation between how the respondents evaluated a setting's effectiveness of concealment and the perception of danger, despite both evaluations being made by a different group of participants. A strong correlation between the two variables also occurs in the case of the measurements taken from photos. It suggests that the effectiveness of concealment, as hypothesised in H1, is a particularly significant predictor of the perception of danger in urban parks. The correlation is stronger than that obtained in earlier studies, but several aspects should be pointed out.

First, the stronger relationship confirmed in our study compared with others may be explained, in part, by differences in the nature of the dependent variables. Whereas as Blöbaum and Hunecke (2005) used a similar concept of 'perceived danger', other studies focused on related but perhaps different concepts, such as fear of crime (e.g. Fisher and

Nasar 1992) or perceived safety (Haans and de Kort 2012; van Rijswijk et al. 2016; van Rijswijk and Haans 2018).

Second, differences in study outcomes may result from differences in the type of settings considered. Most studies to date were concerned with urban settings (e.g. streets or university campuses); settings consisting predominantly of architectural forms (e.g. Blöbaum and Hunecke 2005; Fisher and Nasar 1992; Haans and de Kort 2012; van Rijswijk et al. 2016; van Rijswijk and Haans 2018). Perhaps, the effect of concealment on danger is bigger in parks than in urban settings, perhaps because park settings and its inherent abundance of natural elements provide a wider variation in hiding places across settings. More research is needed to confirm such an explanation. Since effect sizes are influenced by often arbitrary choices with respect to the range of a variable in the stimulus materials, future research ideally should use random samples of urban park environments. This would ensure that stimulus materials reflect the naturally occurring variation in concealment between such environments, and thus more ecologically valid effect size estimates (van Rijswijk and Haans 2018).

The correlation between the effectiveness of concealment and preference turned out to be negative, which is in line with the majority of research (Michael et al. 2001; Jorgensen, 2004). Most important, however, was the confirmation of the assumptions and estimations of the researchers (Rouquette and Holt 2017) that the weaker preferences for plants that offer concealment result from the sense of danger that these plants evoke.

Our research was limited to one predictor, but the results allow us to assume that a similar role may be played by danger in how it influences the preferences of the other two safety-related environmental characteristics proposed by Nasar et al. (Fisher and Nasar 1992; Nasar et al. 1993) – prospect and escape. Additionally, for a more complete picture of the mechanisms related to the interaction of these traits, it is worth conducting future research by checking a range of variables such as specific plant characteristics, their composition patterns, the degree of naturalness, etc.

5 Limitations

There were several limitations to the present study. First, we included in our regression models no other predictors apart from the effectiveness of concealment. We thus excluded not only prospect and entrapment (escape), but also how well-kept a particular place looked (Herzog 1989; Herzog and Chernick 2000; Nasar et al. 1993; Talbot and Kaplan 1984). Therefore, future research needs to examine the predicting role of these and perhaps other variables. Secondly, the research was carried out on students. Some researchers believe that there are indeed grounds to generalise the results of research conducted on students across the population as a whole (Stamps 1999). Many, however, think differently (e.g. Balling and Falk 1982; Herzog i et al. 2000). Additionally, the questionnaires were completed by students of areas related to landscape architecture. Some researchers found differences between the responses of students of landscape architecture and other fields of study (Kaplan 1973); (Herzog et al. 2000). It can be assumed that this may have influenced the answers to some questions, especially those regarding preferences.

6 Conclusions

Despite these limitations, practical conclusions can be drawn based on the results of our study. Studies demonstrating a negative impact of vegetation on the sense of safety have frequently advised to avoid using plants that limit visibility (Hami et al. 2014; Kuo et al. 1998). Similarly, researchers have argued that the optimal types of plant forms to use are trees with high crowns, and plain grass areas with no dense shrubs (Donovan and Prestemon 2012; Kuo and Sullivan 2001). In the light of our research, such recommendations seem justified, although they call for some complementation and fine-tuning. First, the observed very strong influence of the effectiveness of concealment on the perception of danger indicates that one should avoid plant forms that may offer concealment for a potential attacker. Our analyses did not determine the relationship be-

tween specific plant features, such as height, width, crown formation, etc. However, some such features can be associated with the effectiveness of a place of concealment, referring to their impact on the result of measuring the degree of plant coverage of an area that might conceal someone (up to human height). Therefore, in our opinion, it can be considered that in parks it is acceptable to introduce low shrubs, shrubs with a low density (i.e., a lattice-like structure), as well as plants with a very narrow crown (e.g. column-like shrubs), even in hotspots of fear and crime. This is because the perception of danger is exacerbated not by the very presence of shrubs, but by their concealing properties. Secondly, plants that offer concealment are disliked because they create a sense of danger. This means that in places where users have no reason to be worried about their safety (e.g. in fenced, guarded, very quiet areas), the presence of dense bushes and other covering plants is acceptable and will not, in all probability, have a detrimental effect on landscape assessment. This gives designers greater opportunities to shape attractive and diverse spatial compositions.

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