

Predicting experiential qualities of architecture by its spatial properties

Abstract for the IAPS '04 conference

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Introduction. Everyday experience, as well as several theories from environmental psychology (e.g., Kaplan, 1988; Newman, 1996), suggest that the form and configuration of architectural spaces are important factors for their experiential qualities. While architects are generally well aware of this, there is almost no practically applicable empirical knowledge on likely effects of particular design decisions. One reason for that may be that many classical studies did not relate their findings to directly measured properties, but relied on introspectively assessed intermediate predictor variables. Meanwhile several analysis techniques have been developed that allow to describe characteristics of spaces by simple measurands (e.g., Space Syntax, cf. Turner et al., 2001) and correlate with human spatial behavior.

Objective. We present an approach that aims to close the gap between measurable physical properties and experiential qualities of architectural spaces. As demonstrated by Franz, von der Heyde, & Bühlhoff (2003), already few parameters characterizing basic spatial properties are widely sufficient to explain the variance in affective appraisals of rectangular indoor spaces. To overcome this limitation, the aim of the presented study is to explore perceptual parameters generically describing the spatial form that appear to be most suitable for predicting experiential qualities.

Method. For this purpose a psychophysical experimental method based on virtual reality (VR) simulations is combined with spatial analysis techniques derived from Space Syntax and empirical aesthetics. VR offers flexibility and controlled laboratory conditions at a high degree of perceptual realism. In a factor-analytic approach single properties of spaces can be individually varied,

allowing to ascribe observed variances in the measured experience to particular differences of stimuli.

The experimental task was a semantic differential rating of 34 spaces from a fictive art gallery. All scenes were evaluated by eight participants in three principal affective (pleasure, interestingness, beauty) and descriptive (spaciousness, complexity, clarity) experiential categories. The empirical study included a pilot stage comprising 18 virtual exhibition rooms. For the second stage a refined set of 16 stimuli was designed where the variance of visible room area was restricted. Surface properties and illumination level were constant over all scenes. The stimuli were presented as radiosity-rendered spherical panorama images on a 130x90 degree wide-angle projection system. The virtual standpoints were fixed, but subjects could freely choose their gaze direction. In the explorative analysis averaged ratings were compared with 28 characteristic values describing the viewsheds (isovists) from the particular standpoints in the virtual scenes.

Results. The first experimental stage revealed the area of the viewsheds as dominant main factor. It was highly correlated with all rating categories except of clarity which showed a high negative correlation with the density of wall edges (correlation coefficient $r=-0.81^{**}$). In the second scene set rated spaciousness ($r=0.83^{**}$) and beauty ($r=0.73^{**}$) still were highest correlated with isovist area, but the constraint of its variance allowed further differentiated observations: A multivariate linear regression analysis found pleasure to be best explained by the additional factor enclosure ratio (total explained variance $r^2=0.69^{**}$), and interestingness by the number and density of wall edges and the jaggedness of the isovists ($r^2=0.62^{**}$). The correlations to complexity were similar, since both rating categories were strongly interrelated ($r=0.83^{**}$).

Discussion. Generally, the results turned out to be well interpretable: The revealed factors qualitatively corresponded to the study by Franz et al. (2003) and appear to be suitable generalizations of their measurands like room area and wall-opening ratio. Regarding the theories, the correlation between pleasantness and physical enclosure is particularly in accordance with Newman's (1996) concept of defensible space, while the apparently positive effect of a diverse spatial profile on interestingness fit well to information load theories (e.g., Mehrabian & Russell, 1974). Furthermore, it is worthwhile mentioning that similar measurands that allowed predictions on the experience of facades and house silhouettes (cf. Stamps, 2000) appear to be transferable to the form of indoor space.

Conclusion. Virtual reality proved to be an effective medium for basic architectural research. Our experimental method allowed us to empirically demon-

strate significant correlations between spatial properties and affective appraisals of architecture. The analysis of isovists proved to be suitable for generically describing important perceptual properties of spaces: Already few and simple measurands explained a large fraction of the observed variances. The revealed main factors viewshed area, enclosure, and complexity of the spatial profile fit well to theoretical assumptions. While due to the exploratory character of this study the measured numerical factors do not claim quantitative validity, we expect the observed main effects to indicate relevant general relations. We assume this approach to be a feasible way towards quantifying and predicting the effects of design decisions.

References

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