The Semantic Differential in Landscape Research[1]

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Abstract: On-site reactions of groups of viewers to six timber harvesting procedures were measured by direct and indirect measuring techniques. Using the direct technique, groups recorded their overall impressions of harvested tracts on five-point scales ranging from very favorable to very unfavorable. For the indirect technique, semantic differential procedures were used. Factor scores developed from the evaluative factor of the semantic differential reactions were highly correlated with overall impression scores for the harvested tracts. In addition to validating the direct reactions, semantic differential data contributed to a partial explanation of why some tracts were rated more favorably than others.

INTRODUCTION

Knowledge of the public's landscape preferences is an important element in resource planning and management. Planners, managers and researchers should be cognizant of landscape preferences because many people are concerned about the long-term effects of resource manipulation, or object to the short-term appearance of certain activities such as timber harvesting.

These concerns and objections are understandable. Professional resource planners and managers have such a long-term view of resource management that their perception of timber harvest sites is considerably different from that of most casual observers. Complete recovery from timber harvests is often so slow that many people perceive the visual site degradation as permanent. Therefore planners, managers and researchers should refine the tools at their disposal or develop new tools to determine public landscape preferences.

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The questions surrounding forest aesthetics research have always been troublesome, For instance, are viewer reactions based on photographs or slides as reliable as those based on actual site visitations? Should one be more concerned with the on-site results of a timber harvest? or the distant view? How valid are viewer reactions to the results of timber harvests? What assessment methods are most useful; most reliable; most efficient? Some of these questions have been answered by experts such as Craik (1972), Kaplan (1975) and Dunn (1976). But the questions of the validity of viewer reactions have not been resolved satisfactorily.

One method that has been used in the field to determine viewer responses to forest management activities is scenic beauty estimation or SBE(Daniel and Boster 1976). Using this technique, groups of viewers rated the beauty of landscapes from photos taken in random directions and at random points within the landscapes. Standardized scores were used to measure differences in perceived scenic beauty among landscapes. The scenic beauty estimation method shows promise as a direct measure of aesthetic preferences. Schweitzer et al. (1976) used SBE, claiming it is "a well-tested technique." Another technique, the semantic differential, has also been used successfully by researchers in evaluating physical environments (Winkel et al. 1969; Calvin et al. 1972; Zube et al. 1974), but their studies did not validate viewer reactions.

The objectives of this paper are to describe how semantic differential procedures were used to corroborate viewer reactions to recently harvested northern hardwood forest stands, to suggest input variables toward a model for predicting viewer reactions to these sites and to help enrich the quality of information obtained in landscape preference studies.

In the semantic differential technique, developed and tested by Osgood et al. (1957), respondents use a series of bipolar adjective pairs to judge a concept. Respondents decide whether a concept, for example, mother, is associated more with warm or cold, hard or soft, etc., and to what degree:

______	______	______	______	_______
warm				cold
______	______	______	______	_______
hard				soft
______	______	______	______	_______
small				big
______	______	______	______	_______
rough				smooth

Osgood found that when semantic differential data are factor-analyzed, one factor that emerges is "an index of attitudes," or an evaluation of the concept. This index is labeled the evaluative factor. Brinton (1961) noted: "An attitude score, because of its close relationship with the evaluative factor in the semantic differential, is almost always present in the data."

Although most studies in which the semantic differential is used deal with concepts, this study explores the notion that the "concept" to be evaluated could be a forest scene.

THE STUDY

Three study sites were chosen in upstate New York. Each site was a mature northern hardwood sawtimber stand that contained over 100 square feet of basal area per acre. At each site, timber was harvested by three cutting methods: individual-tree selection (partial cutting), patch clearcutting and strip clearcutting. Each cutting method was contained within a 7-10 acre tract. Sixteen one-fifth acre patches, laid out in a series of zigzag patterns and three 70-foot wide by 300–foot long zigzag strips were harvested at each location. This meant that instead of 10-acre patch or strip clearcuts, the actual area cut was about 3.5 acres. In the partially cut tracts, each 10-acre stand was reduced from about 100 square feet of basal area per acre to approximately 70 square feet of basal area according to guidelines by Arbogast (1957) and Leak et al. (1969).

Within each of the three cutting methods, the visual impact of top-lopping was also studied. For this study, top-lopping was defined as cutting limbs and branches from the unused portion of a harvested tree so that no branch larger than 2 inches in diameter extended more than 4 feet above the ground. This cutting arrangement resulted in six tracts at each study location: partial cut--lopped and unlopped; patch clearcut--lopped and unlopped; strip clearcut--lopped and unlopped.

This study was part of a larger project (Nyland et al. 1976) that investigated the effects of logging on soils, wildlife, woody vegetation, logging efficiency and forest aesthetics--how groups of viewers reacted to different logging procedures. The logging operations were all completed by the fall of 1973; by the fall of 1974, eight groups of viewers had evaluated the tracts. Representing seven organizations, the groups ranged from 6 to 38 people. Each group visited one location and evaluated all six tracts in that area.

The number of respondents and their interests varied at each location. Tracts near Camden, N. Y., were visited by 22 people in two groups--members of the Camden Rotary Club and members of the Onondaga County Audubon Society. Tracts near Cuyler, N.Y., were visited by 35 people in three groups--members of a hiking organization, members of a student forestry club and a nature interpretation class. Tracts near Northville, N. Y., were visited by 86 respondents, two groups of students from a forestry summer camp and members of the Fulton County Conservation Education Advisory Committee.

Upon arriving at a study location, each respondent was given a Timber Removal Evaluation Packet that contained a two-page questionnaire for each tract. Instructions for evaluating the tracts were read. Questions about research design or whose answers might have biased study results were postponed until all six tracts had been evaluated. Each group spent about 7 minutes in a tract before completing the appropriate tract's questionnaire (fig. 1). To avoid sequential bias, groups were guided through the tracts in differing sequences.

Figure 1--A group reacts to the on-site results of a strip clearcut.

The first question about each tract consisted of 16 bipolar adjective pairs. This semantic differential measured a viewer's indirect evaluation of a tract. In the second question, respondents were asked to indicate their overall impression (direct evaluation) of the appearance of each tract by rating it on a five-point scale from very favorable to very unfavorable.

Respondents also were asked to describe why they felt the way they did about each tract, and to what extent each of 10 site characteristics influenced their overall impression of a tract.

RESULTS AND DISCUSSION

The semantic differentials for each tract were factor-analyzed. Communalities of variables used in the analysis were generally .4 or greater, and sometimes exceeded .9. Identification of an evaluative factor was based on variables in the Factor I varimax rotated factor matrix that had loadings of .4 or greater. The adjective pairs that made up the evaluative factor are: fragrant-foul, good-bad, beautiful-ugly, clean-dirty, pleasant-unpleasant, sacred-profane, and valuable-worthless.

Evaluative factor scores (indirect reactions) were computed for each respondent by summing the raw scores for the seven word pairs for each tract. Means and standard deviations were then determined for each tract (table 1). Scores ranged from 16.81 to 26.69.

The overall impression scores represent direct reactions to each tract. They were derived by summarizing individuals' scores from the questionnaire's 5-point overall impression scale and computing means and standard deviations (table 1). Scores ranged from 2.31 to 3.96. The overall impression scores (OVIMP) for each tract were then compared to the evaluative factor scores; correlation coefficients ranged from .505 to .882. The relationships between the direct and indirect evaluations were highly significant (table 1). This means that the OVIMP and semantic differential scores are reliable proxies for one another. The fact that they agree to such an extent means that they are probably accurate indicators of the reactions of these viewers to these harvesting procedures.

Table 1--Correlations between indirect and direct responses to harvested tracts

Location	Mean Overall Evaluative Factor Score 1/	Standard Deviation	Mean Overall Impression Score 1/	Standard Deviation	Correlation Coefficient
Camden (N = 22)					
1. Top-lopped partial	17.14	6.06	2.41	1.26	.791*
2. Unlopped partial	19.27	5.63	2.77	1.23	.799*
3. Top-lopped strip	22.68	9.22	3.70	1.17	.700*
4. Unlopped strip	19.27	8.02	3.29	1.15	.640*
5. Top-lopped patch	2.68	4.35	3.00	.98	.505*
6. Unlopped patch	22.95	4.97	3.41	1.05	.722*
Cuyler (N=35)					
1. Top-lopped partial	18.77	5.96	2.60	1.15	.813*
2. Unlopped partial	20.41	5.50	2.97	1.04	.817*
3. Top-lopped strip	20.69	6.99	2.82	1.26	.838*
4. Unlopped strip	24.11	6.22	3.38	1.23	.859*
5. Top-lopped patch	19.83	6.64	2.77	1.26	.882*
6. Unlopped patch	24.79	5.85	3.50	1.26	.761*
Northville (N=86)					
1. Top-lopped partial	16.81	4.78	2.31	1.05	.749*
2. Unlopped partial	17.88	6.41	2.52	1.17	.861*
3. Top-lopped strip	26.11	5.62	3.69	1.11	.773*
4. Unlopped strip	26.69	5.45	3.96	1.07	.683*
5. Top-lopped patch	23.75	6.14	3.42	1.16	.832*
6. Unlopped patch	25.85	5.41	3.65	1.09	.698*

* Highly significant (P < .01)   1/ Lower scores reflect more favorable reactions

After satisfying the requirement that the direct and indirect measurements agreed, the next step was to examine the data to determine viewer reactions and preferences. Table 1 indicates that there is a general preference for partial cuts over clearcuts and that patch clearcuts are probably preferred over strip clearcuts. The data also imply that top-lopped tracts are preferred over tracts that had not been top-lopped.

These observations were investigated at each location using three-way analysis of variance. The overall impression scores at each location were tested for differences due to top-lopping, for differences due to cutting methods and for differences due to groups. In addition, the three-way analysis of variance provides an opportunity to test for interactions between these three sources of variance.

After the analysis of variance was completed (Nyland et al. 1976), it was concluded that a partial cut selection system was perceived more favorably than a patch cut system, and that a patch cut system was perceived more favorably than a strip clearcut system. A second conclusion drawn from the analysis was that there is some question about viewers' perception of top-lopping. It was concluded that top-lopping may not have been an aesthetically effective post-logging practice, except in one strictly sawlog operation that had been clearcut. At this location, there was a considerable amount of large-sized slash left lying on the ground. At the other two locations, many of the larger pieces not taken as sawlogs were subsequently taken for pulpwood.

The analysis of variance did confirm the notion that groups with different affiliations tend to be more critical or less critical of harvested tracts, depending on their group's affiliation. In spite of this, there is a tendency for some agreement about the order in which the tracts were rated, regardless of group affiliation. Partially cut tracts tend to be viewed more favorably than clearcuts, and most groups rated the patch clearcuts more favorably than the strip clearcuts.

With this information at hand, it was possible to delve deeper into the semantic differential to see if any light could be shed on reasons for viewer reactions to the harvesting procedures. In addition to the evaluative factor that emerges as an index of attitudes, semantic differential data invariably produce other factors. Two of the factors that frequently emerge from factor analysis of semantic differential data are, a potency factor and an activity factor. The potency factor is usually related to "power and the things associated with it, size, weight, toughness, and the like;" the activity factor is "concerned with quickness, excitement, warmth, agitation and the like" (Osgood et al. 1957:73). The potency factor (Factor II) was represented in this study by the adjective pairs: unique-commonplace, delicate-rugged, smooth-rough, humorous-serious, and gentle-violent; the activity factor (Factor III) was represented by the adjective pairs: varied-repetitive, active-passive, hot-cold, and vibrant-still.

Of the five word pairs that represented Factor II, three were loaded in excess of .4 often enough to make up a potency factor. They are: delicate-rugged, smooth-rough and gentle-violent. For Factor III, two word pairs emerged to represent the activity factor. They are active-passive and vibrant-still.

Mean potency and activity factor scores were computed for each tract in the same manner as mean evaluative scores (table 2). At Camden and Northville, the partially cut tracts with top-lopping had the lowest mean potency factor scores. At Cuyler, the strip clearcut tract that had been lopped produced the lowest mean potency factor score. The highest mean potency factor scores occurred for the unlopped partial cutting at Camden, the unlopped patch clearcutting at Cuyler and the unlopped strip clearcutting at Northville. The latter two tracts at Cuyler and Northville also elicited the most unfavorable overall impression scores from respondents. This suggests that unfavorable reactions to harvested tracts may be related to a perception of roughness, ruggedness, or violence. The correlations between overall impression scores and mean potency factor scores (Factor II) were highly significant for 17 out of 18 tracts.

Table 2--Mean potency (Factor II) and activity (Factor III) scores with standard deviations

Location	Factor II (SD)	Factor III (SD)
Camden (N = 22)		
1. Top-lopped partial	9.95(2.55)	5.77(2.14)
2. Unlopped partial	11.64(1.76)	4.77(1.57)
3. Top-lopped strip	11.36(2.98)	5.82(2.54)
4. Unlopped strip	10.14(2.73)	4.86(2.14)
5. Top-lopped patch	10.95(2.44)	5.86(1.98)
6. Unlopped patch	11.09(1.90)	6.36(1.79)
Cuyler (N = 35)		
1. Top-lopped partial	10.26(2.70)	5.95(1.82)
2. Unlopped partial	10.77(2.02)	5.85(1.41)
3. Top-lopped strip	9.00(3.04)	6.66(1.99)
4. Unlopped strip	11.31(2.17)	6.23(1.54)
5. Top-lopped patch	9.91(2.37)	6.11(2.15)
6. Unlopped patch	11.60(2.17)	5.69(2.21)
Northville (N = 86)		
1. Top-lopped partial	9.19(2.44)	5.64(1.71)
2. Unlopped partial	5.39(1.II9)	10.51(2.87)
3. Top-lopped strip	11.19(2.64)	6.28(2.52)
4. Unlopped strip	12.27(2.05)	6.87(2.52)
5. Top-lopped patch	10.44(2.92)	5.31(2.92)
6. Unlopped patch	11.09(2.85)	5.14(2.70)

The mean activity factor scores were not similarly related to the overall impression scores; only 4 of the 18 correlations were highly significant. This probably means that people do not find landscapes favorable or unfavorable based on perceptions of activeness or passiveness or of vibrancy or stillness.

Although the three adjective pairs (delicate-rugged, smooth-rough, and gentle-violent) helped describe potency factors in other studies, they more nearly identify what might be described as a "perceived orderliness factor" for the recently harvested forest tracts in this study. The data suggest a relationship between perceived orderliness and overall impression scores; that is, if a harvested tract is perceived as having a degree of order about its appearance--regardless of the harvesting procedure, the tract may produce a more favorable reaction than if it is perceived to be chaotic in appearance.

This notion is given some credence in previous work. In studying the reactions of suburban forest owners to photos of common forest practices, Hamilton et al. (1973) concluded: "The orderly piling of cordwood as well as slash gave an impression of neatness and industrious endeavor despite the intensive logging that was being done at the time." In commenting on results of a study of judgments of representational paintings by nonartists, Osgood et al. (1957:70) stated: "It is evident that 'goodness' in representational paintings is identified with 'orderliness' and 'clarity' rather than with the more abstractly moral attributes with which we are familiar from our previous more general analyses." Calvin et al. (1972) described research by Sanoff in 1969 that identified an "orderliness" factor, and research by Vielham in 1966 that identified a "physical organization" factor emerging from semantic differential data. These studies, like the present study, used landscape scenes rather than concepts as the basis for their analyses.

In this study, the high correlations between overall impression scores and Factor I scores helped validate which landscapes were preferred. The high correlations between overall impression scores and Factor II (perceived orderliness) scores shed some light on why some of the tracts were rated more favorably than others. Viewers tended to be more favorably impressed with tracts that were perceived as delicate, smooth, or gentle. They tended to be more unfavorably impressed with tracts that were perceived as rugged, rough, or violent.

A second opportunity to examine why some tracts are rated more favorably than others is provided by data obtained from another question in the Timber Removal Evaluation Packet. This question permitted a respondent to identify how much influence each feature had on his overall impression of a tract. Analysis of data from this question showed that four features were perceived as most important: high slash, low slash, obstructions to walking on trails and distance you can see into a forest from a trail. All four of these features can be logically associated with a viewer's perception of orderliness in a forest scene.

Finally, field measurements of two features were significantly correlated to overall impression scores. The features were the distance one could see into a forest from a trail and areas of bare soil at the center of the logging site. These two features plus the cutting method, plus the presence or absence of top-lopping at a site were submitted to stepwise multiple regression analysis as independent variables along with each tract's overall impression score as the dependent variable. The equations developed from the analysis that explained 81 percent of the variation in overall impression scores among the 18 tracts are as follows:

TRACT	PREDICTION EQUATION*
Partial cut	
-- lopped	Impression score=2.695-0.092D+0.01S
--unlopped	Impression score=2.909-0.092D+0.01S
Clearcut strips	
-- lopped	Impression score+3.369-0.092D+0.010S
--unlopped	Impression score=3.583-0.092D+0.010S
Clearcut patches	
-- lopped	Impression score=3.242-0.092D+0.010S
--unlopped	Impression score=3.456-0.092D+0.010S

where D = distance visible into the forest in feet
S = area of bare soil, in percent of surface area.

*The lower the score, the more favorable the overall impression.

According to the equation, a tract's overall impression improves as the distance one can see into the forest from a trail increases; overall impression becomes more unfavorable with increase in areas of bare soil; and it improves when top-lopping is included.

The percent error between actual OVIMP and estimated OVIMP is presented in Table 3. There are about as many estimated scores above the actual OVIMP as there are below, which means that the regression is fairly accurate. Average percent error is less than 6 percent, and this holds true for all three locations. This implies that the regression is fairly precise.

CONCLUSION

Use of the semantic differential technique contributed toward validating viewer responses to inquiriesabout landscape preferences. It is recognized that these results are based on verbal reactions and that they may have been subject to preconceived viewer biases. However the direct verbal reactions were highly correlated with two indirect measures. The data suggest that viewers prefer selection cutting over clearcutting, and patch clearcutting overstrip clearcutting. Viewers tended to favor tracts they perceived as delicate, smooth, or gentle. There is some tendency for viewers to favor top-lopped tracts over unlopped tracts. There were significant differences in the way various groups of viewers reacted to harvested tracts. In addition to validating the direct reactions, semantic differential data contributed to a partial explanation of why some tracts were rated more favorably than others. And the relationship of physical features, logging procedures and top-lopping with overall impressions of harvested tracts was demonstrated through the use of regression analysis.

Table 3-- A comparison of actual OVIMPS with estimated OVIMPS

Tract	Overall impressions scores		
	Actual	Estimated	Percent Error
Camden			
Partial--lopped	2.4	2.6	+8.3
--not lopped	2.8	2.8	---
Clearcut strip--lopped	3.7	3.3	-10.8
--not lopped	3.3	3.5	+6.1
Clearcut patch--lopped	3.0	3.2	+6.7
--not lopped	3.4	3.5	+2.9
Cuyler			
Partial cut--lopped	2.6	2.5	-3.8
--not lopped	3.0	2.7	-10.0
Clearcut strip--lopped	2.8	3.1	+10.7
--not lopped	3.4	3.5	+2.9
Clearcut patch--lopped	2.8	2.9	+3.6
--not lopped	3.5	3.4	-2.9
Northville			
Partial cut--lopped	2.3	2.6	+13.0
--not lopped	2.5	2.4	-4.0
Clearcut strip--lopped	3.7	3.4	-8.1
--not lopped	4.0	4.0	---
Clearcut patch--lopped	3.4	3.2	-5.9
--not lopped	3.6	3.5	-2.8

This approach to on-site landscape assessment required personal interaction with several potential and actual groups of viewers. The time involved must be treated as a cost, but the unexpected goodwill and public understanding of forestry that resulted from the interaction were unplanned benefits. The cost of application would be positively correlated with the time spent recruiting groups and the number of groups viewing the harvested tracts. The cost of adding the semantic differentials to the Timber Removal Evaluation Packets and the added time respondents needed to fill in the scales for each tract were not burdensome. But the analysis and interpretation of data were considerably enriched by the increase in information.

The effectiveness of the semantic differential technique was demonstrated in the broad acceptance of the results by study participants. The anticipated results were borne out in the quantified form. This should also aid management in deciding which harvesting procedures to use on which forest stands. The study procedure should be transferrable to any situation in which an indirect measurement of landscape assessment is desired. The hardware and software requirements are easily available at any computer installation that has prerecorded programs.

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