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Prioritizing Organizational Change Situations using Group AHP with Satisfying Pareto Optimality

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Abstract: This study presents characteristics created for an organization after implementing the organizational development program; then it proceeds to prioritize the organizational change situations in a government-affiliated educational organization. So, Group Analytic Hierarchy Process (GAHP) with satisfying Pareto optimality method has been used to prioritize organizational change situations from the employees perspective.

Key words: Organizational change, developed organization, GAHP, Pareto optimality

INTRODUCTION

Organizational Development (OD) as a definite field and a distinguished research area in management science does not have a long history. Unlike medicine, accounting, law and other professions and scientific fields, all of which have clear and fixed goals, the area of OD is fairly unique due to its inherent and fundamental vagueness. OD, despite its steady and constant growth, is a discipline that is still challenging an unresolved problem pertaining to its inherent nature, which is a combination of organizational sciences and individuals. Although, the theoreticians of organizational improvement and development have contemplated, complied and discussed its fundamental principles, there is no consensus as to its scope and parameters. In a more moderate sense it could be said that there is much disagreement on the nature of OD. The term OD was used for the first time in 1957 by Blake and Mouten. The OD consists of numerous concepts and methods for improving the organization. Also, several definitions have been suggested for OD and the diversity of approaches and techniques has caused the indefiniteness of its limits and the difficulty of its analysis (Boonstra, 2004). Beckhard (1969) defined it as an attempt which is planned, takes place all over the organization and which is directed by the top level of organization, in order to enhance the effectiveness of the organization through planned intervention in the organizational processes by exploiting behavioral sciences. Schein (1969) defines it as an interpersonal process in order to facilitate group dynamics. Philbin and Mikush (1999) defined it as a process through which an organization enhances its internal capacity so it can reach its maximum efficiency

specified in the organization's mission and can maintain it in the long run. Burke (1982) defined it as a planned process of changing the organization's culture by exploiting the theory, research and technology of behavioral sciences. Porras and Robertson (1992) defined it as a series of programmed and knowledge based behavioral actions in the working environment in order to improve the organization's operation and growth and promotion of the individuals. Jamieson *et al.* (1984) defined it as planned and long-term changes in the culture, technology and management of an organization. French and Bell (1978) define it as an attempt to improve problem-solving methods and renewing the processes in the organization, especially through the effective management of the organizational culture, with the helper of the change expediting factors and with the use of the theory and technology of applied behavioral sciences.

Warrick (1984) defines it as a series of planned and long-term systems consisting of behavioral sciences strategy in order to understand, develop and change the organization so as to promote its effectiveness and health at present and in future. Harvey (1974), too, in a different definition likens OD to a revolutionary movement that is carried out by a militant leader in order to democratize organizations. Weick and Quinn (1999), in their research organizational change and development, examine the different types of organizational change and development. They suggest that the recent analyses of organizational change imply the increasing importance of the speed and time of the changes. Also they believe that there are two types of changes: *Emergent* and *Continuous*, which are in contrast from the viewpoint of implicational metaphors and concepts, such as organization, analytical frameworks, ideal organizations, intervention theories

and the role of change factors. In the emergent change, the sequence is freeze, transition, unfreeze, while continuous change follows the sequence unfreeze, rebalance, freeze. In their view, the way of understanding the necessity of change determines whether the change is considered emergent or it is seen continuous.

Therefore, with regard to the cited definitions we suggest the following characteristics for a developed organization:

- Information and knowledge are not exclusive; the organization opens the communication doors to all who live or work in it. It cause the growth and flourishing and enhancement of knowledge and awareness of all people and it encourage its members to acquire and increase their knowledge and awareness. It also adopts the open door policy and elucidates all its operations to its personnel, customers or clients and even the society
- Trust which means believing in other people's honesty; if the members of a group, family or organization trust each other and believe in each other's thoughts and deeds, the power and strength of that group will increase. Trusting others is a characteristic, which is related to the openness of a system. That is, the more lucidly an organization behaves in its operations, the more it gains others' trust and the more it increases the sense of trust in the working environment
- It gets feedback from all the sources and factors that affect its destiny and based on the feedback, it modifies its actions and movements in order to achieve predetermined objectives. That is, the strategy of feedback which by means of it, an individual, a family or an organization can gain information from inside or outside and use it in order to conduce its movement forward or to correct it in order to attain its goal
- It opens the doors of participation, give and take of information and thoughts to all its members and encourages the members to cooperate and participate with each other. As a result, managing an organization does not fall on a small number of members; rather all the members according to their effort and their mental and physical capabilities help to carry on the operations of the organization and they regard the organizational objectives as their own objectives
- It cares about training and empowering its members and by providing the right means, it prepares them to achieve operational independence. In other words educating, giving awareness and training the

members to become independent and autonomous and finally giving them the authority to manage independently, free of other's views or supervision, are some of the developed organization's characteristics

- It naturally uses a few organizational layers and it reduces the gap between the higher and lower layers. This causes the members of the organization to communicate more easily; it also causes the work relationships and associations to assume a higher human nature

At last, we can specify the following common characteristics for developed organizations:

- C₁ = Lucid information
- C₂ = Lucid communication
- C₃ = Learning
- C₄ = Being honesty
- C₅ = Team working
- C₆ = Competency
- C₇ = Individual independence
- C₈ = Lucid tasks
- C₉ = Better supervision

In this study, in order to prioritize organizational change situations with regard to these characteristics criteria, we used group AHP with satisfying Pareto optimality.

MATERIALS AND METHODS

In the organization under study, Governmental Educational Organization of Tabriz in Iran in 2008, there are different situations for organizational change, which we want to prioritize by the criteria mentioned in the previous section. These situations are as follows:

- A₁ = Further adaptation of the organizational space to individual needs
- A₂ = Changing the cultural norms
- A₃ = Changing the structure and composition of roles
- A₄ = Enhancing the inter-group cooperation
- A₅ = Transparenting the communication system
- A₆ = Changing the motivation of the workforce

In order to prioritize these situations (alternatives), a number of teachers holding bachelor or higher degrees were chosen, using random sampling (Eq. 1):

$$n = \frac{N \times (Z_{\alpha})^2 \times p \times q}{e^2 \times (N-1) + (Z_{\alpha})^2 \times p \times q} \quad (1)$$

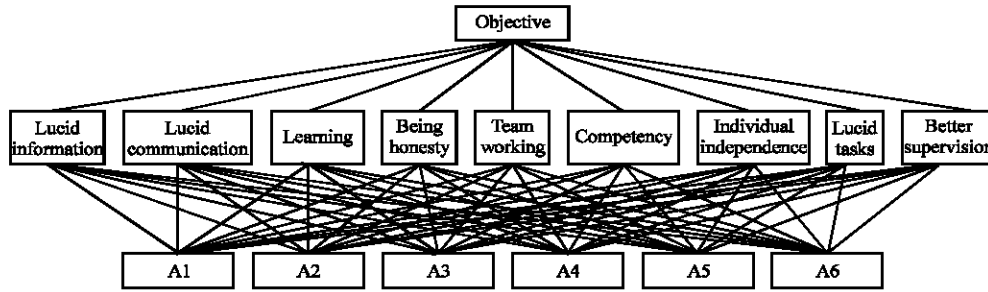


Fig. 1: Hierarchical tree

A questionnaire was used to collect the data. The questionnaire was devised on the basis of the information required for AHP model. The hierarchical tree related to the problem is shown in Fig. 1. In each of the questions in the questionnaire, the respondents were asked to make a pairwise comparison between two factors and specify the priority of one over the other. In order to determine the reliability of the questionnaire the retest method was used. For this purpose, the final questionnaire was randomly distributed among 20 members of the statistical population at two different times within an interval of two weeks. After gathering the necessary data at two times, first the geometrical mean resulting from the subjects' attitude toward each factor at each time was calculated by means of Eq. 2 (Aczel and Saaty, 1983):

$$G = \sqrt[n]{x_1 \times x_2 \times \dots \times x_n} \tag{2}$$

Finally, Spearman's rank correlation coefficient ρ (rho) was calculated and the significance of it in the statistical population was tested (Eq. 3):

$$\rho = 1 - \frac{6 \sum_{i=1}^k d_i^2}{n(n^2 - 1)} \tag{3}$$

In order to generalize the findings of the sample to statistical population, we can approximate the rank correlation coefficient ρ (rho) with normal distribution for values $n > 10$, in which case expected value and variance will be needed. Expected value and variance ρ can be obtained from Eq. 4 and 5:

$$E(\rho_s) = 0 \tag{4}$$

$$V(\rho_s) = \frac{1}{n - 1} \tag{5}$$

Aczel and Saaty (1983) showed that the only mathematical method to mix pairwise comparisons is the

use of geometric mean provided that the resulting matrix also has all the characteristics of one pairwise comparison matrix. Saaty (1994) suggested that in order to compare the convergence of the views of each individual to the views of the group (geometric mean), we can use compatibility index. If $V = (V_1, V_2, \dots, V_n)^T$ is the weights resulting from an individual's judgments and $W = (W_1, W_2, \dots, W_n)^T$ is the weights resulting from the geometric mean, we can calculate compatibility index by using the hadamard product of the two matrices (Eq. 6):

$$CI = \frac{1}{n^2} e^T V \circ W^T e \tag{6}$$

$$W = \frac{w_i}{w_j}, V = \frac{v_i}{v_j}$$

Saaty suggests that this value should not exceed 1.01. Exceeding this value leads to violation from Pareto's optimality. According to this principle, if all members prefer A to B, then the group should also prefer A to B. What leads to this in practice is the dispersion of judgments around the geometric mean. In other words, lack of dispersion in each one of the judgments around the geometric mean leads to compatibility at the group level, but vice-versa is not true. Saaty and Vargag (2007) defined geometric dispersion as follows (Eq. 7):

$$S_G(x_1, x_2, \dots, x_n) = \left[\prod_{k=1}^n \frac{x_k}{\bar{x}_G} \right]^{-1/n} \tag{7}$$

$$= \left[\prod_{k=1}^n e^{\left| \ln \frac{x_k}{\bar{x}_G} \right|} \right]^{1/n}$$

They computed the geometric dispersion of randomly generated samples of size 20,000 under the assumption that the judgments are distributed according to a continuous reciprocal uniform distribution:

$$RU\left[\frac{1}{9}, 9\right]$$

for groups consisting of n individuals. They have concluded that with the increase in the value of n , the distribution dispersion moves toward a distribution of three-parameter gamma with the situation parameter ($\gamma=1$) and values α (shape) and β (scale) (Eq. 8):

$$\text{Gamma}(\alpha, \beta, \gamma) = \frac{\beta^\alpha}{\Gamma(\alpha)} (x - \gamma)^{\alpha-1} e^{-\beta(x-\gamma)} \quad (8)$$

The values of α (shape) and β (scale) with $\gamma = 1$ and for $n = 4, 5, \dots, 50$ are shown in Table 1.

They have also presented a linear regression model to calculate the values of α and β for other values of n as follows (Eq. 9):

$$\begin{aligned} \alpha(\text{shape}) &= -3.48226 + 1.40829 * n \\ \beta(\text{scale}) &= -0.897865 + 0.504361 * n \end{aligned} \quad (9)$$

Thus, the geometric dispersion value obtained from the judgments of individual members on each pairwise comparison can be tested against the statistical hypothesis by using the gamma function and at the confidence level of, % $(1-\alpha)$ (Eq. 10):

$$p = P[S_g(n) < s_g] \leq \alpha \quad (10)$$

For example, for a group of size 6, whose judgments on a given issue are equal to $\{2, 3, 7, 9, 1, 2\}$, the geometric dispersion of the group is equal to 1.9052169. Taking the usual significance level of 5 percent, we observe that:

$$P[S_g(6) < 1.9052169] = 0.0376176 < 0.05$$

Thus, the p -value corresponding to the sample geometric dispersion indicates that it seems rare to observe values of the geometric dispersion smaller than

Table 1: Gamma distribution parameters

n	Shape	Scale
4	2.80	1.28
5	4.04	1.77
6	5.40	2.28
7	6.56	2.69
8	7.68	3.11
9	9.29	3.69
10	10.42	4.09
11	11.83	4.60
12	13.06	5.05
13	14.46	5.55
14	16.02	6.11
15	17.50	6.65
20	24.24	9.02
25	31.40	11.61
30	38.56	14.15
35	45.64	16.70
40	53.16	19.39
45	60.10	21.85
50	67.25	24.43

the sample geometric dispersion and hence, the geometric dispersion of the group is not unusually large, which in turn implies that the geometric mean can be used as the representative preference judgment for the entire group.

RESULTS

The present study, statistical population consists of 2516 teachers who hold bachelor, or higher degrees. With regard to (Eq. 1) and the following values, the sample volume is:

$$\begin{aligned} \alpha &= 0/05, e = 0/095, q = 0/5, p = 0/5 \\ N &= 2516, n = 111 \end{aligned}$$

The required calculations to determine the reliability of the questionnaire, in which each pairwise comparison has been shown in Table 2 in order to facilitate the computer calculations and optimal use of the collected data.

The reliability test of the questionnaire relating to the local weights of the primary factor (lucid information) with the confidence level of 95% was carried out and given as a sample as follows:

- Statistical hypothesis:

$$\begin{cases} H_0 : \rho = 0 \\ H_1 : \rho \neq 0 \end{cases}$$

- Spearman's correlation coefficient:

$$\rho = 1 - \frac{6 \sum_{i=1}^k d_i^2}{n(n^2 - 1)} = 1 - \frac{6 \times 210}{15(15^2 - 1)} = 1 - \frac{1260}{3360} = 0.625$$

- Statistic test:

$$E(\rho_s) = 0$$

$$V(\rho_s) = \frac{1}{n-1} = \frac{1}{15-1} = 0.071$$

$$Z = \frac{\rho - E(\rho_s)}{\sqrt{V(\rho_s)}} = \frac{0.625 - 0}{\sqrt{0.071}} = \frac{0.625}{0.266} = 2.35$$

Table 2: Pairwise comparison of alternatives over C_1

	I	II	III	IV	V	VI
I	Adaptation of the organizational space to individual needs	a	b	c	d	e
II	Changing the cultural norms		f	g	h	i
III	Changing the structure and composition of roles			j	k	l
IV	Enhancing the inter-group cooperation				m	n
V	Promotion of the communicative systems					o
VI	Changing the motivation of the workforce					

- **Critical value:** Since, $n > 10$; therefore, the distribution is approximately normal and we will have:

$$w(-1.96 \leq z \leq 1.96)$$

$$Z_{\alpha/2} = Z_{0.05/2} = \pm 1.96$$

Table 3: Data relating to the local weights of the lucid information criterion

	X	Y	X order	Y order	d	d ²
a	1.13	1.19	14.0	14.0	0.0	0.00
b	0.99	1.03	11.0	10.5	0.5	2.50
c	0.91	1.10	7.0	13.0	-6.0	36.00
d	1.13	1.20	15.0	10.5	4.5	20.25
e	0.94	0.95	9.0	3.0	6.0	36.00
f	0.78	0.98	3.5	5.0	-1.5	2.25
g	0.78	0.91	3.5	6.0	-2.5	6.25
h	0.83	1.01	5.0	8.0	3.0	9.00
i	0.93	1.00	8.0	12.0	-4.0	16.00
j	0.76	0.85	1.0	2.0	-1.0	1.00
k	0.77	0.72	2.0	1.0	1.0	1.00
l	0.95	0.96	10.0	5.0	5.0	25.00
m	0.85	0.96	6.0	4.0	2.0	4.00
n	1.08	1.16	13.0	15.0	-2.0	4.00
o	1.00	1.02	12.0	5.0	7.0	49.00

Table 4: Statistic test calculated for all the factors influencing the organizational development

Criteria	Z-value
Lucid information	2.35
Lucid communication	2.68
Learning	1.97
Being trusty	-2.08
Team working	2.12
Competency	2.59
Individual independence	2.68
Lucid tasks	2.68
Better supervision	2.11

Table 5: Individual judgments of group in comparison of A₁ and A₂ over criterion C_i

Individual	Judgment	Individual	Judgment	Individual	Judgment	Individual	Judgment
1	3	31	4	61	0.17	91	1
2	6	32	3	62	0.14	92	3
3	0.2	33	4	63	0.12	93	1
4	9	34	5	64	0.33	94	0.2
5	5	35	0.2	65	3	95	0.2
6	9	36	1	66	4	96	1
7	5	37	3	67	2	97	3
8	0.17	38	9	68	5	98	0.2
9	1	39	0.11	69	1	99	0.2
10	0.14	40	0.11	70	0.2	100	2
11	0.25	41	5	71	4	101	0.17
12	6	42	4	72	6	102	4
13	0.5	43	0.11	73	3	103	6
14	0.25	44	0.12	74	0.2	104	2
15	3	45	7	75	0.25	105	0.2
16	8	46	6	76	0.2	106	0.2
17	0.17	47	5	77	4	107	0.5
18	7	48	3	78	0.33	108	0.33
19	0.33	49	2	79	0.25	109	3
20	0.17	50	1	80	5	110	2
21	0.11	51	0.5	81	2	111	8
22	2	52	0.3	82	1		
23	0.17	53	7	83	6		
24	0.2	54	4	84	3		
25	0.25	55	0.33	85	1		
26	4	56	0.5	86	1		
27	0.33	57	6	87	0.33		
28	0.33	58	3	88	0.25		
29	0.25	59	1	89	2		
30	0.25	60	6	90	1		

- **Decision-making:** Since, z is calculated ($z = 0.2.35$), it is located in the critical zone; therefore, the null hypothesis is rejected (Table 3)

Thus, it can be claimed that there is a significant correlation at the recognition level ($\alpha = 0.0.5$) between the two variables X and Y. Likewise, the statistic test (z) has been calculated for all of the factors influencing the organizational development according to Table 4.

Because all of the calculated statistics are placed in the critical zone, then the null hypothesis is rejected. Thus, it can be claimed there is a significant correlation at the recognition level of $\alpha = 0.0.5$ between the first and second times.

In order to test the geometric mean values obtained from the group members' judgments, we apply the gamma test explained in the previous section to each of the comparisons made in the pair comparison table. For instance, Table 5 depicts the judgments of the group in the comparison of the two items, adaptation of the organizational space to individual needs over changing the cultural norms relating to the criterion information.

Table 6: Revised individual judgments of group in comparison of A₁ and A₂ over criterion C₁

Individual	Judgment	Individual	Judgment	Individual	Judgment	Individual	Judgment
1	2.75	31	3.00	61	0.38	91	1.07
2	2.26	32	2.12	62	0.24	92	2.01
3	0.57	33	2.16	63	0.23	93	1.61
4	6.32	34	3.10	64	0.44	94	0.57
5	1.95	35	0.44	65	1.58	95	0.21
6	5.69	36	2.23	66	1.60	96	1.17
7	5.59	37	2.22	67	1.41	97	2.17
8	0.18	38	4.11	68	1.45	98	0.42
9	1.02	39	0.31	69	1.54	99	0.76
10	0.27	40	0.25	70	0.45	100	1.51
11	0.63	41	2.39	71	3.27	101	0.19
12	2.55	42	1.72	72	3.11	102	1.95
13	0.32	43	0.38	73	3.71	103	4.35
14	0.32	44	0.48	74	0.30	104	1.61
15	2.94	45	4.29	75	0.28	105	0.46
16	4.85	46	2.17	76	0.37	106	0.45
17	0.20	47	2.59	77	2.99	107	0.52
18	5.35	48	2.48	78	0.51	108	0.65
19	0.33	49	1.15	79	0.39	109	2.61
20	0.13	50	0.98	80	2.34	110	0.98
21	0.09	51	1.22	81	0.97	111	1.79
22	1.79	52	0.63	82	1.03		
23	0.24	53	2.66	83	4.33		
24	0.28	54	2.63	84	2.17		
25	0.39	55	0.46	85	0.64		
26	2.86	56	0.79	86	1.17		
27	0.36	57	4.58	87	0.64		
28	0.50	58	2.37	88	0.42		
29	0.57	59	0.83	89	1.59		
30	0.33	60	3.39	90	1.10		

The parameters of gamma distribution function to n = 111 will be as follows (Eq. 11):

$$\begin{aligned} \alpha(\text{shape}) &= -3.48226 + 1.40829 \times 111 = 152.8379 \\ \beta(\text{scale}) &= -0.897865 + 0.504361 \times 111 = 55.0962 \end{aligned} \quad (11)$$

The geometric mean value will be 1.0229, the geometric dispersion value will be 3.6738 and the value of p obtained testing the statistical hypothesis will be as follows (Eq. 12):

$$p = P[S(111) < 3.6738] = 0.3345 > 0.05 \quad (12)$$

In which case the statistical hypothesis is rejected and the value of geometric mean cannot be used as group's judgment.

This has been done for other matrices as well and in the case of rejection, the matrices revised by the group members have been used (Table 6).

The geometric mean value will be 1.0272, the geometric dispersion value will be 2.4028 and the value of p obtained from testing the statistical hypothesis will be as follows:

$$p = P[S(111) < 2.4028] = 0 < 0.05 \quad (13)$$

And the statistical hypothesis will be accepted. This is done for all other pairwise comparison matrices. The

Table 7: Global weights of organizational change situations

Organizational change situations	Global weight	Priority
Further adaptation of organizational space to individual needs	0.1573	Sixth
Changing the cultural norms	0.1636	Third
Changing the structure and composition of roles	0.1635	Fourth
Enhancing the inter-group cooperation	0.1695	Second
Promotion of the communicative system	0.1720	First
Changing the motivation of the workforce	0.1613	Fifth

results of testing the statistical hypothesis against each pairwise comparison matrix value show that all the judgments were homogeneous and there is no dispersion.

The results of testing the statistical hypothesis against each pairwise comparison matrix value show that all the judgments were homogeneous and there is no dispersion. Thus, we proceed to calculate the global weights of the alternatives (Table 7).

CONCLUSIONS

The extreme closeness of the priorities determined by the group indicates the absence of complete consensus on the issue by the group. Nevertheless, in the studied organization, the teachers gave the highest priority to promotion of the communicative system and the lowest priority to the enhancing the inter-group cooperation. But the third and fourth priorities, which are related to

changing the cultural norms and changing the structure and composition of roles, are not much different. Finally, the fifth priority is related to changing the motivation of the workforce.

REFERENCES

- Aczel, J. and T. Saaty, 1983. Procedure for synthesizing ratio judgements. *J. Math. Psychol.*, 27: 93-102.
- Beckhard, R., 1969. *Organization Development: Strategies and Models*. Addison-Wesley, Reading, MA, USA.
- Boonstra, J., 2004. *Dynamics of Organizational Change and Learning*. John Wiley and Sons, Ltd., USA.
- Burke, W., 1982. *Organization Development: Principles and Practices*. Scott, Foresman, Glenview, IL, ISBN: 978-0673390189.
- French, W.L. and C.H. Jr. Bell, 1978. *Organization Development: Behavioral Science Interventions for Organization Improvement*. 2nd Edn., Prentice Hall, Upper Saddle River, NJ., ISBN: 978-0132422314.
- Harvey, J.B., 1974. Organization development as a religious movement. *Train. Dev. J.*, 28: 24-27.
- Jamieson, D.W., D.K. Bach and C.E. Kur, 1984. *Organization Development*. In: *The Handbook of Human Resource Development*, Nadler, L. (Ed.). Wiley, New York, ISBN: 978-0471506539, pp: 29.1-29.16.
- Philbin, A. and S. Mikush, 1999. A framework for organizational development: The why, what and how of OD work. <http://www.mrbf.org/>.
- Porras, J.I. and P.J. Robertson, 1992. *Organizational Development: Theory, Practice and Research*. In: *Handbook of Industrial and Organizational Psychology*, Dunnette, M.D. and L.M. Hough (Eds.). 2nd Edn., Vol. 3, Consulting Psychologists Press, Palo Alto, CA, ISBN: 978-0471886426, pp: 719-822.
- Saaty, T.L. and L.G. Vargag, 2007. Dispersion of group judgements. *Math. Comput. Modell.*, 46: 917-945.
- Saaty, T.L., 1994. *Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process*. RWS Publications, Pittsburgh, PA., ISBN: 978-0962031762.
- Schein, E.H., 1969. *Process Consultation: Its Role in Organization Development*. Addison-Wesley, Reading, MA, USA., ISBN: 978-0201067361.
- Warrick, D.D., 1984. *Organization Development*. In: *Human Resources Management and Development Handbook*, Tracey, W.R. (Ed.). American Management Association, New York, ISBN: 978-0814401163, pp: 915-925.
- Weick, K.E. and R.E. Quinn, 1999. organizational change and development. *Annu. Rev. Psychol.*, 50: 361-386.