Chapter 10
Personal relations

In this chapter, we will show how to analyze relations between individuals with the help of the reflexive games theory.

10.1. Son, mother, father

A son is contemplating marriage. He may marry either α or β. The son has good relations with both his mother and his father, but their relations are tense. The mother inclines him to choose α, and the father wants him to choose β. Can the son make a choice, and, if so, which one? This situation is depicted in the following graph:

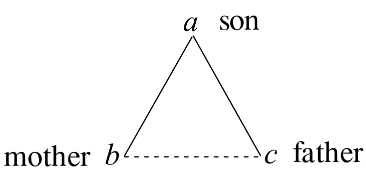

Fig. 10.1.1. Graph of relations

The universal set consists of two actions:

$$\alpha - \text{marry } \alpha ,$$
$$\beta - \text{marry } \beta .$$

Set M consists of four alternatives:

$1 = \{\alpha, \beta\}$ not realizable (we assume a society where polygamy is not practiced)

$\{\alpha\}$ realizable

$\{\beta\}$ realizable

$0 = \{\ \}$ realizable

Alternative 1 means "to marry" without specifying whom; 0 means "not to marry." The following polynomial corresponds to the graph in Fig. 10.1.1:

$$a\,(b + c), \tag{10.1.1}$$

the diagonal form

$$\begin{array}{lll} & & [b] + [c] \\ & [a]\,[b + c] & \\ [a\,(b + c)] & & \end{array}\quad, \tag{10.1.2}$$

and the equation for the son is

$$a = (b + c)\,a + \overline{a}\,. \tag{10.1.3}$$

This equation has a solution only if $b + c = 1$. The value of b is the mother's influence; the value of c is the father's influence. In the given case, $b = \{\alpha\}$, $c = \{\beta\}$. Since $\{\alpha\} = \overline{\{\beta\}}$, then $\{\alpha\} + \{\beta\} = 1$, and equation (10.1.3) has a solution

$$a = \{\alpha,\ \beta\} = 1. \tag{10.1.4}$$

With the given influences, the son chooses alternative 1, i.e., makes the decision to marry without specifying whom. Set $\{\alpha\}$, as well as set $\{\beta\}$, is realizable.

Let us now see what would happen if both mother and father inclined the son not to marry. Then $b = 0$, $c = 0$. After substituting these values into (10.1.3), we obtain

$$a = \overline{a}\,. \tag{10.1.5}$$

This equation has no solution; thus, the son is in a state of frustration and cannot make a choice. The son will also be in frustration if both mother and father strongly incline him to choose the same alternative, for example, α. In this case, $b = \{\alpha\}$, $c = \{\alpha\}$, and equation (10.1.3) is

$$a = \{\alpha\}a + \overline{a}\ , \tag{10.1.6}$$

where $A = \{\alpha\}$, $B = 1$. Condition $A \supseteq B$ is not met, thus (10.1.6) has no solution.

If father (or mother) pushes the son choose $1=\{\alpha, \beta\}$ (to marry), then the son will choose 1, because in this case A=1, B=1, i.e., equation (10.1.3) has solution the $a = 1$.

Let us change the relations between mother, father and son: the son is now in conflict with both parents, and the parents have good relations. Their graph of relations is as follows:

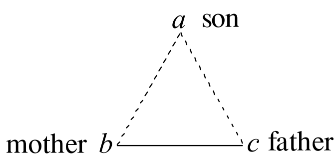

Fig. 10.1.2. Graph of relations

This graph corresponds to the polynomial

$$a + bc, \tag{10.1.7}$$

and the diagonal form

$$[a + bc]^{[a]+[bc]^{[b][c]}}, \tag{10.1.8}$$

and the equation for the son is

$$a = a + bc\,\bar{a}, \tag{10.1.9}$$

$A = 1$, $B = bc$, $A \supseteq B$. Equation (10.1.9) has solutions for any values of b and c; therefore, the son cannot be in a state of frustration.

Let mother and father incline the son to choose different alternatives: $b=\{\alpha\}$, $c=\{\beta\}$. Since

$$\{\alpha\}\{\beta\} = 0, \tag{10.1.10}$$

we can write (10.1.9) as

$$a = a, \tag{10.1.11}$$

i.e., the son has freedom of choice.

If mother and father incline the son to choose the same alternative: b =$\{\alpha\}$, c =$\{\alpha\}$, equation (10.1.9) becomes

$$a = a + \{\alpha\}\overline{a} \ , \tag{10.1.12}$$

$A = 1$, $B = \{\alpha\}$. Solutions of this equation satisfy the inequalities

$$1 \supseteq a \supseteq \{\alpha\} \ . \tag{10.1.13}$$

Hence, the two solutions to equation (11.1.12) are:

$$a = 1 = \{\alpha, \beta\},$$
$$a = \{\alpha\}.$$

Therefore, the model predicts that the son can choose one of two alternatives: either make the decision to marry ($a = \{\alpha, \beta\}$), or choose α ($a = \{\alpha\}$). If he chooses 1, to realize his choice he will need to pick either α or β. If the son chooses alternative $\{\alpha\}$, this means that he decides to marry α and no longer considers β.

Let us analyze now the case where there are three candidates: α, β and γ. The universal set consists of three actions and set M contains eight alternatives:

$1 = \{\alpha, \beta, \gamma\}$ not realizable,
$\{\alpha, \beta\}$ not realizable,
$\{\alpha, \gamma\}$ not realizable,
$\{\beta, \gamma\}$ not realizable,
$\{\alpha\}$ realizable,
$\{\beta\}$ realizable,
$\{\gamma\}$ realizable,
$0 = \{\ \}$ realizable.

Consider the scenario related to the graph in Fig.10.1.1. Let the mother incline the son to choose $\{\alpha\}$, and the father $\{\beta\}$. We saw that with such influences in the case of two candidates the son makes the decision to marry. What happens if there are three candidates? Substitute values $b = \{\alpha\}$ and $c = \{\beta\}$ into (10.1.3) and we obtain

$$a = (\{\alpha\} + \{\beta\})a + \overline{a}$$

or

$$a = \{\alpha, \beta\}a + \overline{a} \ , \qquad (10.1.14)$$

where $A = \{\alpha, \beta\}$, $B = 1 = \{\alpha, \beta, \gamma\}$. Thus, relation $A \supseteq B$ does not hold and equation (10.1.14) does not have a solution. This means that the son cannot make a choice and is in a state of frustration. Therefore, the third available action may radically change the subject's ability to make a choice.

Here is another case. The mother does not want the son to marry α, and the father does not want the son to marry β. In the framework of our model, we consider "unwillingness" to choose x as equal to pressure toward $\overline{x}$. Thus, if the mother does not want the son to choose $\{\alpha\}$, she inclines him to choose $\overline{\{\alpha\}} = \{\beta, \gamma\}$, and the father's unwillingness to see the son choose $\{\beta\}$ means that he pushes the son toward $\overline{\{\beta\}} = \{\alpha, \gamma\}$. What will the son choose? The mother's and father's influences are

$$\begin{aligned} b &= \{\beta, \gamma\} \ , \\ c &= \{\alpha, \gamma\} \ . \end{aligned} \qquad (10.1.15)$$

In the case of the scenario in Fig.10.1.1, the substitution of these values results in the equation

$$a = (\{\beta, \gamma\} + \{\alpha, \gamma\})a + \overline{a} \qquad (10.1.16)$$

or

$$a = \{\alpha, \beta, \gamma\}a + \overline{a} \ , \qquad (10.1.17)$$

or

$$a = a + \overline{a} = 1 \ . \qquad (10.1.18)$$

Therefore, the son makes the decision to marry, without specifying whom.

What will be the son's choice in the case of a scenario related to Fig.10.1.2? Substitution of the values from (10.1.15) into equation (10.1.9) results in

$$a = a + \{\beta,\gamma\}\{\alpha,\gamma\}\overline{a} \qquad (10.1.19)$$

or

$$a = a + \{\gamma\}\overline{a} \ .$$

This equation has the solution:

$$1 \supseteq a \supseteq \{\gamma\} \ .$$

All subsets of set $\{\alpha, \beta, \gamma\}$ that contain the element γ are located between 1 and $\{\gamma\}$:

$$1 = \{\alpha, \beta, \gamma\}, \{\alpha, \gamma\}, \{\beta, \gamma\}, \{\gamma\}. \qquad (10.1.20)$$

The son can choose any of these subsets.

Consider now examples of reflexive control over the son's choice where the universal set is $\{\alpha, \beta, \gamma\}$. The mother wants the son to marry either α, or β, and the father does not want the son to marry at all. Their relations are given in Fig.10.1.1. What influence must the father exert over the son for him not to marry? Substitute the value of the mother's influence, $b = \{\alpha, \beta\}$, into equation (10.1.3):

$$a = (\{\alpha,\beta\} + c)a + \overline{a} \ . \qquad (10.1.21)$$

The father controls the value of c and can use it to exercise reflexive control. He cannot make the son to choose 0, because there is no value of c for which equation (10.1.21) has the solution 0, but the father can move the son into a state of frustration by inclining him to choose one of the following alternatives:

$$\{\alpha, \beta\}, \{\alpha\}, \{\beta\}, \{\ \}. \qquad (10.1.22)$$

Since condition $A \supseteq B$, necessary for equation (10.1.21) to have a solution, does not hold if c takes values from set (10.1.22), the son will be in a state of frustration and will not make any choice, including the choice "to marry."

Let us analyze reflexive control aimed at the son’s unconscious domain. If the mother has good relationships with father and son, but the father and son are in conflict, their relations are depicted in Fig.10.1.3:

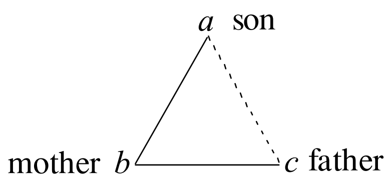

Fig. 10.1.3. Graph of relations

This graph corresponds to the polynomial

$$b\ (a + c), \tag{10.1.23}$$

and the equation for a is

$$a = [b\ (a + c)]^{[b]\,[a + c]^{[a] + [c]}}. \tag{10.1.24}$$

Let the mother influence the son on both the conscious and unconscious levels (see section 9.4). The mother is represented by letter b. These letters are independent variables on the first and second tiers: b_1 and b_2. Equation (10.1.24) changes to

$$a = [b_1\ (a + c)]^{[b_2]\,[a + c]^{[a] + [c]}}. \tag{10.1.25}$$

If the mother does not want the son to marry, her goal is to make him to choose 0. To achieve this, the values must be $b_1 = 0$, $b_2 = 1$. Therefore, influencing on the subconscious level the mother has to incline the son to remain unmarried, but on the conscious level she must incline him to marry.

10.2. Escape from jail

Five inmates - John, Tom, Peter, Bob, and Larry - are contemplating an escape. The graph of their relations is given in Fig.10.2.1:

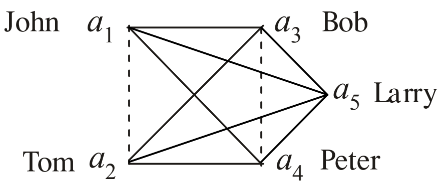

Fig. 10.2.1. Graph of relations

We see that John (a_1) and Tom (a_2) are in conflict, and Bob (a_3) and Peter (a_4) are in conflict. Larry has good relations with everyone. Each inmate – a_1, a_2, a_3, a_4, a_5 – has his own plan of escape. We designate these plans as α_1, α_2, α_3, α_4 и α_5, respectively. Every inmate tries to persuade the others to accept his plan. What will be their individual choices? The graph in Fig.10.2.1 is decomposable. It corresponds to the polynomial

$$a_5\ (a_1 + a_2)\ (a_3 + a_4) \tag{10.2.1}$$

and the diagonal form

$$\begin{array}{lll} & & [a_1] + [a_2] \qquad\qquad [a_3] + [a_4] \\ & [a_5]\ [a_1 + a_2] \qquad\qquad [a_3 + a_4] & \\ [a_5\ (a_1 + a_2)\ (a_3 + a_4)] & & \end{array} \tag{10.2.2}$$

Every plan is an action. Alternatives $\{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}$ constitute the universal set. The power set of the alternatives, M, consists of the $2^5 = 32$ subsets of this set. We assume that the plans are incompatible with each other. A choice of $1 = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}$ is interpreted as decision “to escape” (independently from the plan), and a choice of $0 = \{\ \}$ as a decision to reject an escape. Set M has only six realizable alternatives:

$$\{\alpha_1\}, \{\alpha_2\}, \{\alpha_3\}, \{\alpha_4\}, \{\alpha_5\}, \{\ \} . \tag{10.2.3}$$

The influences are given in the following table:

Table 10.2.1
Matrix of influences

	a_1	a_2	a_3	a_4	a_5
a_1	a_1	$\{\alpha_1\}$	$\{\alpha_1\}$	$\{\alpha_1\}$	$\{\alpha_1\}$
a_2	$\{\alpha_2\}$	a_2	$\{\alpha_2\}$	$\{\alpha_2\}$	$\{\alpha_2\}$
a_3	$\{\alpha_3\}$	$\{\alpha_3\}$	a_3	$\{\alpha_3\}$	$\{\alpha_3\}$
a_4	$\{\alpha_4\}$	$\{\alpha_4\}$	$\{\alpha_4\}$	a_4	$\{\alpha_4\}$
a_5	$\{\alpha_5\}$	$\{\alpha_5\}$	$\{\alpha_5\}$	$\{\alpha_5\}$	a_5

Diagonal form (10.2.2) corresponds to equations of the type

$$x = a_5(a_1 + a_2)(a_3 + a_4) + \bar{a}_5 , \tag{10.2.4}$$

where $x = a_1, a_2, a_3, a_4, a_5$. To compute the values of x for each inmate, we take the values of other variables from the corresponding columns. Let us start from Larry, (a_5): $x = a_5$. The values of other variables are taken from the last column of the matrix of influences. As a result, we obtain equation for a_5:

$$a_5 = a_5(\{\alpha_1\} + \{\alpha_2\})(\{\alpha_3\} + \{\alpha_4\}) + \bar{a}_5 \tag{10.2.5}$$

or

$$a_5 = \{\alpha_1, \alpha_2\}\{\alpha_3, \alpha_4\}a_5 + \bar{a}_5 \ . \tag{10.2.6}$$

Since

$$\{\alpha_1,\ \alpha_2\}\ \{\alpha_3,\ \alpha_4\} = 0, \tag{10.2.7}$$

equation (10.2.6) becomes

$$a_5 = \bar{a}_5 . \tag{10.2.8}$$

Thus, Larry is in a state of frustration and cannot make a choice.

Consider now John (a_1); for $x = a_1$, the values of other variables are taken from the first column of the matrix of influences and substituted for variables in equation (10.2.4):

$$a_1 = \{\alpha_5\}(a_1 + \{\alpha_2\})(\{\alpha_3\} + \{\alpha_4\}) + \overline{\{\alpha_5\}} \qquad (10.2.9)$$

or

$$a_1 = \overline{\{\alpha_5\}}\,, \qquad (10.2.10)$$

since

$$\{\alpha_5\}(\{\alpha_3\} + \{\alpha_4\}) = 0\ .$$

Similarly, find equations and solutions for the other inmates

$$a_2 = \overline{\{\alpha_5\}}\,, \qquad (10.2.11)$$

$$a_3 = \overline{\{\alpha_5\}}\,, \qquad (10.2.12)$$

$$a_4 = \overline{\{\alpha_5\}}\,, \qquad (10.2.13)$$

Therefore, four inmates reject Larry's plan and choose the alternative

$$\overline{\{\alpha_5\}} = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4\}\ , \qquad (10.2.14)$$

then, they try to reach an agreement about which plan to realize. The new universal set is $1 = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4\}$. Set M consists of sixteen alternatives: 1 means the decision "to escape," 0 means not to escape.

Let Larry propose not escaping and let the other inmates keep insisting on their own plans. The new matrix is given in Table 10.2.2. All the rows except the last one contain the same values as in Table 10.2.1. In the last row, there is a new instance of pressure by Larry (a_5). He inclines the others to choose alternative 0, that is, to reject the idea of exodus. The pressure on Larry by other inmates does not change, so that, equations (10.2.5) and (10.2.8) correspond him in the new situation as well, and Larry continues in a state of frustration.

Table 10.2.2
Matrix of influences

	a_1	a_2	a_3	a_4	a_5
a_1	a_1	$\{\alpha_1\}$	$\{\alpha_1\}$	$\{\alpha_1\}$	$\{\alpha_1\}$
a_2	$\{\alpha_2\}$	a_2	$\{\alpha_2\}$	$\{\alpha_2\}$	$\{\alpha_2\}$
a_3	$\{\alpha_3\}$	$\{\alpha_3\}$	a_3	$\{\alpha_3\}$	$\{\alpha_3\}$
a_4	$\{\alpha_4\}$	$\{\alpha_4\}$	$\{\alpha_4\}$	a_4	$\{\alpha_4\}$
a_5	0	0	0	0	a_5

Let us write the equation for John. We substitute values from column a_1 of the matrix of influences (Table 10.2.2) into equation (10.1.4) and obtain

$$a_1 = 0(a_1 + \{\alpha_2\})(\{\alpha_3\} + \{\alpha_4\}) + \overline{0}, \qquad (10.2.15)$$

i.e.,

$$a_1 = 1.$$

Similarly, write equations for the other inmates and find that the choices of Tom (a_2), Bob (a_3), and Peter (a_4) are the same as John's (a_1):

$$a_2 = 1, \qquad (10.2.16)$$

$$a_3 = 1, \qquad (10.2.17)$$

$$a_4 = 1. \qquad (10.2.18)$$

So, Larry is in a state of frustration, and other inmates choose alternative 1, to escape; that is, they again reject the plan suggested by Larry.

Our analysis demonstrates that a group may contain an outcast whose plans are always rejected. The reason is Larry's "total friendliness." Let us test this hypothesis.

We change the scenario and put Larry in conflict with everyone. The universal set is $1 = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}$. The graph of relations is given in Fig.10.2.2.

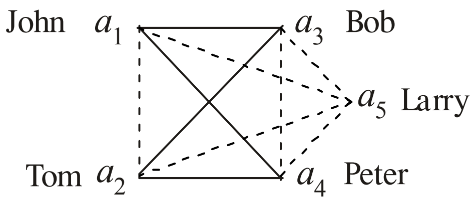

Fig. 10.2.2. Graph of relations

This graph is decomposable. It corresponds to the polynomial

$$a_5 + (a_1 + a_2)(a_3 + a_4) \tag{10.2.19}$$

and the diagonal form

$$[a_1] + [a_2] \qquad [a_3] + [a_4]$$
$$[a_1 + a_2] \qquad [a_3 + a_4]$$
$$[a_5] + [(a_1 + a_2)(a_3 + a_4)]$$
$$[a_5 + (a_1 + a_2)(a_3 + a_4)] \quad . \tag{10.2.20}$$

After transformation of (10.2.20), we obtain

$$a_5 + (a_1 + a_2)(a_3 + a_4) + \overline{a_5 + (a_1 + a_2)(a_3 + a_4)} \equiv 1 \,, \tag{10.2.21}$$

i.e., the group becomes superactive, and each inmate, including Larry, chooses the same alternative

$$1 = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}, \tag{10.2.22}$$

meaning "to escape," regardless of the specific plan.

We see that in the new scenario, where Larry is in conflict with everybody, he is not in a state of frustration, and the others do not reject his plan.

10.3. Theft

Imagine now that only Larry escapes and is not caught. The other four blame each other for not escaping, and their relations change. John (a_1) and Tom (a_2) become allies in conflict with Bob (a_3) and Peter (a_4), who are also allies. The new relations are presented in Fig.10.3.1:

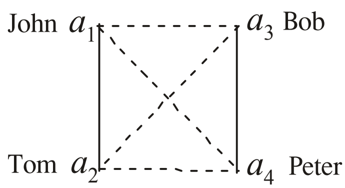

Fig. 10.3.1. Graph of relations

This graph corresponds to the polynomial

$$a_1a_2 + a_3a_4, \tag{10.3.1}$$

and the diagonal form

$$\begin{array}{ccc} & \begin{array}{cc} & [a_1]\,[a_2] \\ [a_1a_2] & \end{array} & \begin{array}{cc} & [a_3]\,[a_4] \\ +\,[a_3a_4] & \end{array} \\ [a_1a_2 + a_3a_4] & & \end{array} . \tag{10.3.2}$$

All of a sudden, John (a_1) notices that his well-hidden cigarette has disappeared. He begins to suspect that one of his cell-mates stole it. It could be his new friend, Tom (a_2), who knew where the cigarette was hidden. On the other hand, it is natural to suspect that John's enemies, Bob (a_3) or Peter (a_4), may have stolen it. Besides, John admits that he might have lost his cigarette or smoked it and forgotten that he did so.

Let John try to figure out what happened to the cigarette. John's universal set contains the following actions:

α_2 – to blame Tom,
α_3 – to blame Bob
α_4 – to blame Peter.

Set M consists of eight alternatives, all of which are realizable:

$1 = \{\alpha_2, \alpha_3, \alpha_4\}$ John suspects Tom, Bob, and Peter,
$\{\alpha_2, \alpha_3\}$ John suspects Tom and Bob
$\{\alpha_2, \alpha_4\}$ John suspects Tom and Peter
$\{\alpha_3, \alpha_4\}$ John suspects Bob and Peter
$\{\alpha_2\}$ John suspects Tom
$\{\alpha_3\}$ John suspects Bob
$\{\alpha_4\}$ John suspects Peter
$0 = \{\,\}$ nobody is suspected; the cigarette was not stolen.

After choosing a non-empty alternative, John can realize any non-empty set of actions contained in that alternative. Let us write the equation for John. It follows from (10.3.2) that

$$a_1 = a_1 a_2 + a_3 a_4. \quad (10.3.3)$$

John suspects everyone in his cell, that is, each of them unknowingly inclines John to suspect himself. Thus,

$$a_2 = \{\alpha_2\},\ a_3 = \{\alpha_3\},\ a_4 = \{\alpha_4\}. \quad (10.3.4)$$

By substituting these values into (10.3.3), we obtain

$$a_1 = a_1\,\{\alpha_2\} + \{\alpha_3\}\,\{\alpha_4\}, \quad (10.3.5)$$

or

$$a_1 = a_1\,\{\alpha_2\}\,. \quad (10.3.6)$$

This equation can be rewritten as

$$a_1 = \{\alpha_2\}a_1 + \{\,\}\overline{a}_1\,, \quad (10.3.7)$$

where $A = \{\alpha_2\}$ and $B = \{\,\} = 0$. Since $A \supset B$, the equation has the solutions

$$\{\alpha_2\} \supseteq a_1 \supseteq \{\,\}\,, \tag{10.3.8}$$

and John can choose either of the alternatives:

$$\begin{aligned} &\{\alpha_2\}, \\ &\{\,\} = 0. \end{aligned} \tag{10.3.9}$$

The choice of $\{\alpha_2\}$ means that John would think his friend Tom stole the cigarette; a choice of $\{\,\}$ means that John would think that the cigarette was not stolen.

10.4. The boss and the award

There are five people working in an office: Alex, Bart, David, Gregory, and Edward, who is their boss. Edward's superior informs him that he can nominate one of his subordinates for a departmental award. Edward's group knows that one of the members may be nominated and that they can influence this decision. The graph of relations in the group is shown in Fig. 10.4.1:

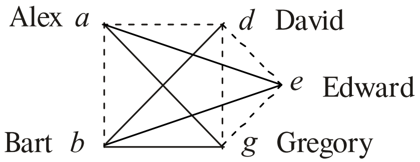

Fig. 10.4.1. Graph of relations

Edward's universal set consists of four actions: α, β, δ and γ, where α means to nominate Alex, β to nominate Bart, δ to nominate David, and γ to nominate Gregory. Alex and Bart do not think of the young and inexperienced David as their competitor, and to demonstrate their disinterest, they pressure Edward to choose David. They are sure that David will not be nominated. Gregory and David will be happy if any person from the office is nominated. So,

$$a = \{\delta\},\ b = \{\delta\},\ g = \{\alpha, \beta, \gamma, \delta\} = 1,\ d = \{\alpha, \beta, \gamma, \delta\} = 1. \tag{10.4.1}$$

The graph in Fig. 10.4.1 is not decomposable, because it contains subgraph $S_{(4)} : \langle a, b, g, d\rangle$. To make a choice, Edward must remove the least significant coworkers one by one. Let their significance diminish in the following order:

Alex, Bart, Gregory, David.

The least significant is David; Edward removes him, and the graph in Fig.10.4.1 now appears as follows:

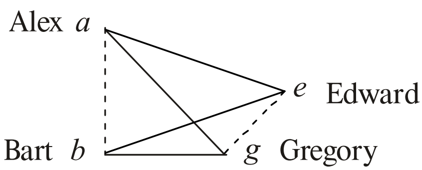

Fig. 10.4.2. Graph of relations after David's removal

This graph is decomposable and corresponds to the polynomial

$$(a + b)\ (e + g), \qquad (10.4.2)$$

and the diagonal form

$$\begin{array}{lllll} & & [a] + [b] & & [e] + [g] \\ & [a + b] & & [e + g] & \\ [(a + b)\ (e + g)] & & & & , \end{array} \qquad (10.4.3)$$

and the equation for Edward is

$$e = (a + b)\ (e + g). \qquad (10.4.4)$$

By substituting the values of variables from (10.4.1) into this equation, we obtain

$$e = (\{\delta\} + \{\delta\})\ (e + 1) = \{\delta\}. \qquad (10.4.5)$$

Edward chooses David, the least significant coworker, who was "excluded" from the graph of relations to make it decomposable. Note that removing d from the graph of relations does not change e's set of alternatives. The alternatives containing element δ can be chosen, and other subjects can incline subject e toward choosing them.

Let us now see what would happen if Alex and Bart did not try to persuade Edward of their disinterest and inclined him to choose them instead. Gregory, in this case, does not change his influence, and David's influence is not significant, because he is excluded from the graph of relations.

The new influences are as follows:

$$a = \{\alpha\},\ b = \{\beta\},\ g = \{\alpha, \beta, \gamma, \delta\} = 1. \tag{10.4.6}$$

By substituting these values into (10.4.4), we find

$$e = \{\alpha, \beta\}. \tag{10.4.7}$$

Edward chooses the alternative containing Alex and Bart, and then selects one of them. In this case, Alex and Bart have a chance of being nominated.