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PREDICTING MODEL FOR AGGRESSIVE DIRECTIVENESS IN LIGHT OF TADEUSZ TOMASZEWSKI'S THEORY OF ACTION: STRUCTURAL AND DATA MINING APPROACH

The study focused on verifying the relationship between the ability to meet parental goals, parental difficulty, the child's representation in the parent's mind, and aggressive directiveness. The project refers to Tomaszewski's theory of action as well as to Gurycka's theory of parental mistakes, in which the inability to achieve parental goals is treated as the main cause of experienced parental difficulties. The analyses were performed on data collected from 158 mothers of preschool children. The analyses were performed using structural equations as well as associative algorithms and artificial intelligence algorithms: cluster analysis and artificial neural networks. The structural model revealed strong relations between variables. The cluster analysis revealed three characteristic profiles in the maternal population that are distinguished by the level of analyzed variables. The artificial neural network revealed that, on the basis of the variables included in the model, the parents' results in aggressive directiveness can be predicted.

Key words: theory of action, parental goals, difficult situation, aggressive directiveness, predictive model

Introduction

When we talk about upbringing, we refer to a multiple-element system which influences the shaping of a child's personality. This system is comprised not only of the environment (family, school, kindergarten, peer group) but also the situations that arise in it. As Tomaszewski (1975) notes, "by the human situation, we will thus refer to the arrangement of his/her relations with other elements of his/her environment at a certain moment of time" (p. 17). If we

were to simulate an upbringing process today, we would have to describe the elements of the upbringing environment (parents, teachers, colleagues), their situation, and the relationships between themselves and the child whose upbringing process we are interested in. This is a complex network of mutual references and relations. We cannot currently simulate the upbringing process entirely, because our knowledge of the individual relations between the elements of the upbringing environment and their possible influence on the development of the child is too limited and - in particular - inaccurate. We nevertheless strive intensely to discover these interactions between elements, and the acquired knowledge allows us to connect the elements in a network of mutual relations, which we can not only indicate but also verify. This process is called *modeling*. It is a natural consequence of acquiring knowledge. Acquiring new data that reveal new relations, often, at least seemingly, mutually contradictory, has created the need for modeling in order to coherently describe the phenomena (Błaszczuk, 2009). Indeed, knowledge must be composed in the form of coherent models. It cannot exist as an enormous amount of unrelated correlations, as it then becomes dissociated and useless (Tadeusiewicz, 2007). We are building models that allow us to put together the knowledge we have gathered. Once we do this, we will be able to simulate psychological reality.

In order to simulate even a part of the upbringing process, we must be able to identify all the elements involved, as well as their interrelations, exactly as described by Tomaszewski (1975). Simulating how a child's upbringing process proceeds is, however, currently unrealistic. There are too many conditions in this situation that could interfere with our understanding because we know too little about them, such as the influence of the child-parent relationship, the temperament of the child, and so on. This does not mean that it will never be possible, nor does it mean that we know nothing. However, to achieve a deeper understanding, the necessary data and information need to be collected. Theories, serving as signposts, support this process. Nowadays, theories are mainly used to describe phenomena and, in particular, to build models describing causes and effects. In building such models, of particular relevance are the structural theories constructed by their creators in such a way as to describe their constituent concepts and the relations among them (Jonkisz, 1998; Szymańska, 2016). Tomaszewski's theory of action, which served as the basis on which further psychological theories were developed, was one such theory. This article will illustrate how Tomaszewski's theory explains the predictive model of parental adoption of aggressive directiveness. The relations among the variables determining the use of aggressive directiveness will be outlined. It will also be determined how prevalent high aggressive directiveness is among parents of preschool children and whether the variables described in the model can predict the usage of aggressive directiveness by mothers.

A Model of Aggressive Directiveness

Directiveness is the act of speech through which the speaker turns to the other person to ask them do something for speaker (Searle, 1983). The speaker does this through requests, tips, commands, and questions (Szymańska, 2012). Directiveness can take different forms: positive or negative. Szymańska distinguishes *warm-hearted directiveness*, characterized by a nice and respectful manner of delivery to the other person, and *aggressive directiveness*, characterized by an unpleasant manner of delivery, without respect for the other person (Szymańska, 2012, 2015). Directiveness understood in such a way is different from the notion of directiveness proposed by Ray (1984), who defined it as follows: "This scale was originally designed to pick out the sort of person who is prone to behave as the Nazis did – in an aggressive, domineering, and destructive way towards other people" (p. 145). During her experiments, Daphne Bugental observed that when a parent held a negative mental representation of the child, they reinforced the use of aggressive communication toward him/her (Bugental & Happaney, 2000). That study did not explain how the negative representation of the child develops in the mind of the parent. However, psychological theories concerning stress and experienced difficulties clearly indicate that experiencing stress gives rise to a negative representation of the stress-causing object (Reykowski, 1966; Szymańska & Dobrenko, 2017). Basing on these theories, it is possible that a parent experiencing difficulties in their relationship with their child can shape a negative mental representation of that child.

In conclusion, *aggressive directiveness* is the result of a negative representation of the child in the mind of the parent, with said negative representation arising from the experience of difficult situations (i.e., stress) in relationship with the child. The question is: Where do the difficult situations come from? How do they arise and what is their cause?

According to Tomaszewski (1975), human reactions to difficult situations "are very complex and are usually termed as stress" (p. 35). At this point, Tomaszewski refers to Reykowski (1966), who described *stress* as the commonplace term for the scientific definition of "the experience of difficulty". According to Tomaszewski, a difficult situation arises when the ability to perform a task is reduced due to the appearance of unnecessary elements or the absence of the necessary elements. The difficult situation is the *situation of deprivation*. It can occur in task situations such as raising a child. It is known that task situations determine *values* and *possibilities*. In turn, *values* determine the direction of activity, while *possibilities* determine whether a given value will be reached. If the task situation cannot be resolved, that is, the value is not reached due to, for example, the impossibility to achieve it, the situation becomes difficult. Values, as

Tomaszewski points out, can be both positive and negative. A person may, in his or her behavior, strive for something or strive to avoid something (Tomaszewski, 1975). It must be emphasized that one can either attempt to avoid something or to achieve something.

Achieving a goal is an important determinant of what the person's situation will be: whether satisfactory or difficult. In the upbringing process, parents set up goals that determine what psychological characteristics they will attempt to develop in their child. These goals can consist of various personal characteristics because one of the goals of upbringing is the development of the child's personality (Gurycka, 1979). Of course, the achievement of these goals is determined not only by parental skills but also by the child's abilities. Parental goals are an anticipated state, but their achievement is a factual state. In order to achieve the goal, parent must designate a plan or a program and take steps to implement that program. If the result is worse than the desired goal, an *outcome error* occurs. On the other hand, if the program planned to achieve the goal differs from the actual activities being undertaken, *error of action* (Tomaszewski, 1975) occurs. According to Gurycka (1979), if the parent cannot meet the planned goal, they experience difficulties. The parent may not be able to meet the planned parental goal because of an error of activity. The distance between the goal and the result, and between the program and the activity is referred to as *divergence*. This discrepancy, according to Tomaszewski's theory, should directly determine the experienced parental difficulty. The theoretical model described here is shown in Figure 1. It has also already been described by Szymańska (2012). This article will present its verification, together with further theoretical considerations enabling a deeper understanding of this model and the results it yields in light of Tomaszewski's theory of action.

Discrepancy of the Parental Goal from the Current Level of the Child's Development: The Error of Agency

Because discrepancy is the model's main exogenous variable from which the analysis of the entire process begins, in this sense it is the model's most important variable. Thus, it is worth devoting more attention to it. The discrepancy of the parental goal from the current level of the child's development is the distance between the child's level of developmental characteristics the parent seeks to improve and the child's actual development. In this case, we talk about the goal and the result. When the result is significantly different from the parental goal, an *outcome error* occurs. It should be noted that this notion of discrepancy is different from discrepancy understood as the distance between the program and the activity, that is, the distance between how the parent planned to achieve their goal and what action they took to achieve that goal. If the distance between the program and the activity is significant, an *action error* (Tomaszewski, 1975) occurs. Bokus

and Hernik (2015) distinguish one more error: the *error of agency*. It is based on the fact that, although the person has set a goal, developed the program, has taken action, and the result has been achieved, it was not due to that person's actions (Bokus & Hernik, 2015). It seems that the *error of agency* may be of particular importance in the study of the psychology of upbringing. This is due to the fact that so many adults are involved in the child's upbringing process that the achievement of the parental goal could be a consequence of the actions taken by others, such as the school educator. This complicates the analysis of the upbringing process, which according to Gurycka (1979) should begin with measuring the distance between the parental goal and the current level of the child's development. This should constitute the main link of the upbringing process, from which all further analyses should begin (Gurycka, 1979). Researchers studying the process of upbringing should examine the effectiveness of parental methods in the context of the achieved parental goals by comparing the effectiveness of upbringing (i.e., the attainment of the parental goal) with the applied methods of upbringing: this is the evaluation of the *upbringing process* (it can also be applied to the didactic process; Gurycka, 1979). The error of agency described by Bokus and Hernik (2015) can significantly influence the incorrect conclusions of the study. In this sense, it has far-reaching methodological implications. Ignoring it can seriously undermine the correctness of the conclusions drawn from research in which goals and achievements are analyzed. Not taking it into consideration is as dangerous as not controlling for spontaneous changes or the pretest (Nowak, 2007). Many experimental models have been developed to control these effects, since failure to do so has led to false conclusions about the impact of the experimental stimulus, describing which is, after all, the key objective of each experiment.

In the theoretical model, discrepancy is a variable that measures the distance between the parent's goals and the child's level of development in the goal-related areas. Discrepancy controls the outcome error: it is itself its determinant. The greater the distance between the child's current developmental level and the parental goals, the greater the outcome error. Unfortunately, the measurement of discrepancy does not take into account the error of cause, as this would require controlling for whether the result was achieved due to person's actions or other circumstances or actions taken by others. In other words, the theoretical model described here does not take into consideration the important aspect of the *error of agency*. The model was also reconstructed on the basis of Gurycka's (1979) theory: When it was originally proposed, this error was not yet described. Obtained results will elucidate the relations between discrepancy and other variables, but not controlling for the error of the cause can distort the picture of these relations.

Methods

Aim of the Research

The aim of this study was to test the theoretical model presented in Figure 1. The following hypotheses were assumed:

- H1: The discrepancy between the parental goal and the child’s current level of development determines the likelihood of experiencing of parental difficulties (this hypothesis was explicitly put forth by Gurycka, 1979).
- H2: The experience of parental difficulties determines the formation of a negative mental representation of the child by the parent (this is the implicit hypothesis put forth by Gurycka, 1979, based on Reykowski’s, 1966, theory of stress).
- H3: The parent’s mental representation of the child is associated with the use of aggressive communication (this hypothesis is based on research by Bugental; see Bugental & Happaney, 2000).

In addition, this study seeks to answer two questions:

1. How many people in the studied population have high, moderate, and low results in the analyzed variables? In other words, how large a percentage of the population is actually affected by the phenomenon described in the theoretical model?
2. Can the level of aggressive directiveness be predicted on the basis of the variables described in the theoretical model? In other words, on the basis of the variables of (a) discrepancy, (b) parental difficulties, and (c) the parent’s mental representation of the child, can individuals’ aggressive directiveness be predicted?

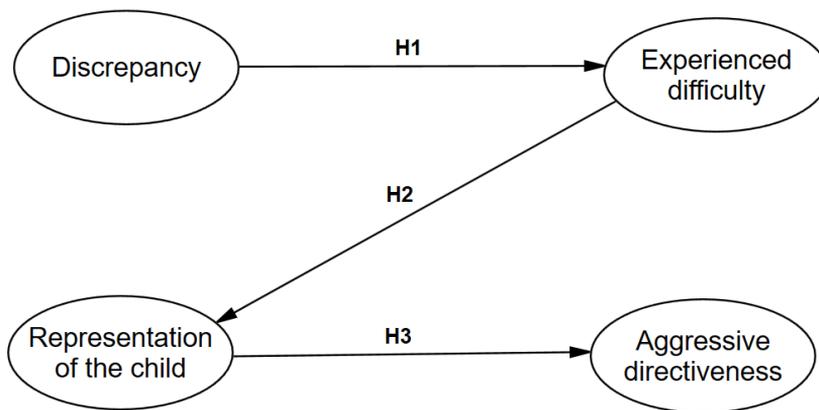


Figure 1. Theoretical model tested in the research. .

Data Analysis

In order to validate the theoretical model presented in Figure 1, modeling using structural equations was used. It determines whether the variables and relations described in the model are well described by empirical data. In other words, this method verifies whether the theoretical model fits the data (Konarski, 2009; Szymańska, 2016) and establishes how strong the relations among the variables in the model are.

In order to answer the first question about how many people achieve high results in the variables described in the theoretical model, the *k*-mean cluster analysis method, conducted by data mining algorithms, was used. With this method, it became possible to determine the affiliation of the participants to clusters because all the variables are described in the theoretical model simultaneously. The cluster analysis constructed clusters, which not only determined the participants' scores for all variables in each cluster, but also the number of people belonging to each cluster. With the assumption of a random sample being met, it is possible to find out what percentage of the studied population belongs to the given cluster. The method was described in more detail by Szymańska (2017) in *Psychological Studies*. In order to answer the second question (regarding whether parents' aggressive directiveness could be predicted on the basis of the variables described in the theoretical model), artificial neural networks were used.

The purpose of the artificial neural network was to predict the participants' aggressive directiveness score on the basis of the variables described in the theoretical model, that is, discrepancy, the difficulty experienced by the parent, and the parent's mental representation of the child. A network teaching method called *method with teacher* was used. In it, the artificial network sees the participants' aggressive directiveness score when learning, which allows it to compare the scores predicted by the network with the ones the participants achieved. The data set was divided into three parts. Seventy percent of the data set was a *learning set*. In this set, the artificial network has learned to anticipate its solution and set values in hidden neurons in such a way as to best predict the participants' scores. Fifteen percent of the data set was the *testing set*. On this set, the network checked its predictions while learning. Another 15% of the data set created a *validation set*. This set has never been shown to the network while learning. Its solution is very important for the researcher, as it reveals the network's prediction. The result of the validation set is compared with the results of the other sets, namely, the learning and the testing sets. The discrepancy between the sets should not be large, otherwise the forecast of the validation set may be unreliable. Predictions for networks are presented in the form of correlation values that show the relationship between the true result of the participants and the results predicted by the network.

Each variable in the theoretical model that is the basis for prediction for the network is an *input variable*. The network has three input variables: discrepancy, experienced difficulty, and the parent's mental representation of the child. The network has only one *output variable*: aggressive directiveness. However, in order to be able to give predictions, the network still needs neurons in the hidden layer. Their number is relative and depends on how "smart" the network has to be to predict the results in the output variable well. The network must be all the more intelligent, that is, it must have more neurons in the hidden layer, the more rules and relations between the levels of variables it must generate, and this is not the same number as the number of input and output variables in the model. There may be a large number of input variables and few hidden neurons, and vice versa, or there may be few input variables, but the network may need many neurons. The number of neurons is chosen by a program that assists the researcher in determining their number. Too small or too big a number of these neurons can completely destroy the learning process. As Tadeusiewicz (2007) observes, with too few neurons, the network resembles a "neuronal fool" who does not have enough brainpower to understand the necessary dependencies. But with too many neurons, the network becomes so "intelligent" that it can try to outwit the researcher. The network learns all values by heart and, as a result, can predict nothing. This means that the network has not learned the rules that govern the relations between variables in a set, it simply memorized the solutions without bothering to find the rules. Such a network is useless, as the purpose of building neural networks is the creation of predictions. A network that fails to do this is useless, even if it is very "intelligent".

Research Sample and Procedure

The research was carried out online: Questionnaires were posted on a website. Kindergartens were selected from the list of preschools provided by the Ministry of Education in Poland. The interval draw was constant ($k = 6$). Preschools representing all voivodeships and provinces in Poland were drawn (group draw) proportionally for the largest provinces. The selected kindergartens were then informed about the study, and directors were asked to inform the parents about it. A large number of people invited to take part in the study refused to participate. Those who agreed to take part acquainted themselves with the information on how the study is conducted.

At the beginning of the study, parents were asked to think about their child, who is currently attending kindergarten, and to answer questions thinking only of that child until the end of the study. This guarded against criss-crossing of responses if the parent had more than one child. A total of 319 parents of children attending kindergarten participated in the study. Only on the results from the maternal sample are presented here, however. This is justified by that the fact that the relations in the whole parent population may differ significantly

from the results achieved in just mothers. This will help to determine if the relations in the maternal population are higher than in the whole parental population.

A total of 158 mothers participated in the study. Their age ranged from 19 to 54 years. The largest group of respondents was between 28 and 35 years old. Dominant was 33, and the median was 27 years old. Most of the women were well-educated, with the largest group being mothers with university education (74.7% of the sample), 18.4% of the sample had secondary education, 3.8% of the sample had primary and/or vocational education, and 3.1% had a PhD.

The participants mainly lived in large cities (58.9% of the sample). Participants from rural and small towns comprised 42.1% of the sample. The study involved a similar number of mothers of boys (82; 51.9% of the sample) and girls (76; 48.1% of the sample). The distribution of the children's gender in the different age groups was also equal. Ninety-three children (60.4% of the sample) attended state-run preschools, 32 children (20.7% of the sample) attended Catholic kindergartens, and 29 children (18.8% of the sample) attended other preschools.

Study Plan and Measurement Tools

The study was correlational. The explanatory variables were discrepancy, experienced difficulty, and the parent's mental representation of the child. Aggressive directiveness was the explained variable.

Discrepancy. This variable referred to the distance between the parent's upbringing goals, which are the mental characteristics that parents want to shape in their child (Gurycka, 1979; Szymańska & Aranowska, 2016; Szymańska & Dobrenko, 2017), and the child's current state, that is, the degree to which the child has developed the desired characteristic (Gurycka, 1979). The discrepancy scale consists of 12 items, which are arranged in pairs. Each pair of questions measures the parent's upbringing goal and the child's current level of development in the area of the characteristic (parental goal). An example of a pair of questions is given in Table 1.

The first three pairs of questions referred to positive parental goals, that is, the characteristics that parents want to develop in their child. The next three pairs of questions referred to negative traits that parents do not want their children to develop. Within each pair, the result of the second question was subtracted from the result of the first question. In this way, the amount of discrepancy was calculated. If the child has developed the desired characteristic, the discrepancy is 0 because $7 - 7 = 0$.

Validity. The results of the exploratory factor analysis confirmed the existence of two factors. The factor explaining 30.5% of the variability of the results measured the distance from the negative goals. The second factor (explaining the 29.9% of the variability of the results) measured the distance from the positive goals.

Table 1. First Pairs of Questions in the Discrepancy Scale Test on Parental Goals

INSTRUCTIONS

Please list three traits that are especially important to you as a parent and for which you make an effort to make sure your child develops them.

Trait one: (enter trait name here)

Mark how important this trait is to you as a parent, the extent to which you wish your child to be like this.

- 7 - 6 - 5 - 4 - 3 - 2 - 1 0 1 2 3 4 5 6 7

(-7) *definitely not like this* (7) *definitely like this*

Mark the extent to which (write your child's name) has developed the trait in question.

- 7 - 6 - 5 - 4 - 3 - 2 - 1 0 1 2 3 4 5 6 7

(-7) *definitely has not* (7) *definitely has*

Reliability. The scale has very good reliability for the discrepancy from positive goals ($\alpha = .774$, $\rho = .533$) and for the discrepancy from negative goals ($\alpha = .866$, $\rho = .682$).

Experienced parental difficulties. This refers to an external condition characterized by tension, motivating to reduce the discrepancies. This is a reaction to the discrepancy at the emotional-motivational level. Measurement is done with the *Experienced difficulty in the parenting process* scale. It consists of eight, highly correlated questions that make up one factor explaining 75% of the variation in results. The reliability of the scale is very high ($\alpha = .973$, $\rho = .816$).

Representation. This reflects the image of the child in the parents mind, that is, the result of experiences in interacting with the child. This study measured the representation of the child and their tasks as less important than the representation of the parent and their tasks. The scale of representation consists of two factors:

1. Representation of the child's tasks as less important than the parent's tasks. This scale explains 29.12% of variation in results. It has a reliability of $\alpha = .886$, $\rho = .721$.
2. Representation of parents and their tasks as more important than the tasks of the child. This scale explains 41.42% of variation in results. It has a reliability of $\alpha = .897$, $\rho = .636$.

Aggressive directiveness. This refers to the an act of speech through which the speaker turns to the other person to ask them to do something for him. This scale consists of six dimensions: commanding, giving help, punishing, severity, demanding obedience, and humiliation. It has a reliability of $\alpha = .731$, $\rho = .081$.

Analysis Results

In the first stage of the analysis, the theoretical model presented in Figure 1 was tested using structural equations. The graphical figure of the structural model is shown in Figure 2. The model's fit statistics are presented in Table 2.

Based on the fit statistics, it can be concluded that the theoretical model fits the empirical data well. Three statistics show this: the *comparative fit index* (CFI), which exceeded the value of .900; the value of the *root mean square error of approximation* (RMSEA), which was lesser than the critical value of .08 and χ^2/df lesser than 2.5. All relations in the model were high, that is, they exceed the value of .700. The relation between the discrepancy and the difficulty experienced by the parent was $\beta = .850$ ($p < .005$). Discrepancy, meaning the inability to meet parental goals, explained as much as 72% of the variability of the results in the experienced parental difficulties. It is a strong relation between the two variables. The first hypothesis of the theoretical model was thus confirmed.

Table 2. Fit Results of the Structural Equation Modeling (SEM)

Received values	Expected values to not reject H0
$\chi^2(343) = 648.239, p < .0005$	$p > .05$
$df = 343$	
$\chi^2/df = 1.890$	< 2.5
CFI = .915	$> .900$
RMSEA = .075	$< .08$

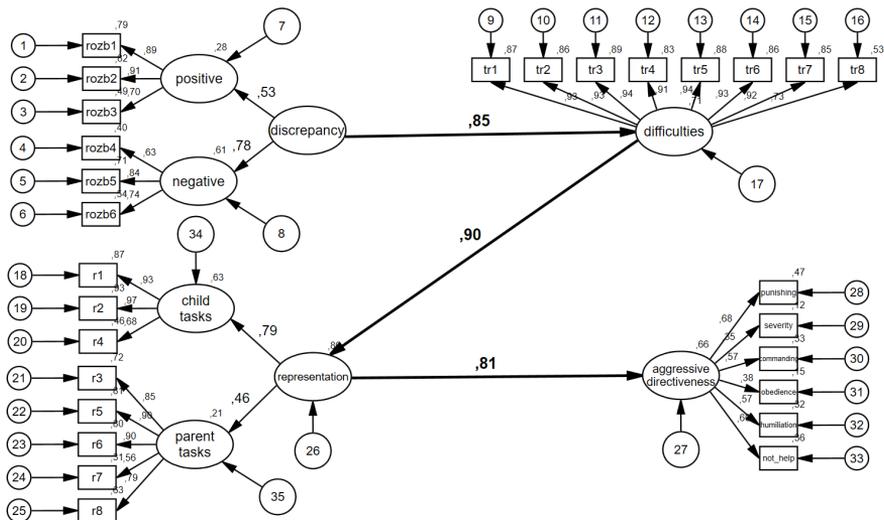


Figure 2. Results of a model tested using structural equations. roz1-roz6 are items of discrepancy scale; r1-r8 are items of representation scale; tr1-tr8 are items of difficulty scale.

The relation between parental difficulty and the parent's mental representation of the child, based on the perception of the child and his or her tasks, was less important than were the parent's tasks ($\beta = .900, p < .005$). It means that experiencing difficulty by the parent explained 81% of the variability in the results in the child's representation. This is a very strong relation, which confirms the second hypothesis claiming that as a result of the experience of difficulty, the representation of the object which caused this experience is formed. Finally, the relation between the representation of the child and the application of the aggressive directiveness toward the child was $\beta = .810 (p < .005)$. This means that the representation explains 66% of the variability in the aggressive directiveness scores. It is also a strong relation, and it confirms the third hypothesis of the theoretical model. The more negative the child's representation in the parent's mind is, the more likely the parent is to use aggressive directiveness toward the child.

Based on the results of the structural model, it is clear that there is no reason to reject the theoretical model as incorrect. Moreover, the correlations described in the model are high. Therefore, we are likely to assume that in the face of the impossibility of achieving parental goals, parents experience difficulties and develop a negative representation of their child, which, in consequence, leads to the application of aggressive directiveness toward that child.

How much of the population experiences these difficulties? Is the process described experienced by a large part of the mothers in that population? Unfortunately, structural equation modeling was not able to provide this information. The answers were obtained using the clustering method, performed by data mining algorithms (Szymańska, 2017). Its solution is shown in Figure 3. The cluster analysis assigned each individual in the examined group of mothers to one of the clusters based on the similarity to other people in terms of the model's variables. The cluster analysis' solution was achieved by presenting the results of people in the form of profiles. Algorithms have found three profiles in the mothers' group.

The first profile was identified as *low*. It shows that there are mothers of children in the preschool population who had low scores in the following areas: (a) discrepancy, that is, the impossibility to achieve parental goals, (b) experience of parental difficulties, (c) the mental representation of the child and their tasks as less important than the parent's tasks, and (d) aggressive directiveness. This profile fit 65.57% (80 people) of the sample. It can be said (on the basis of the representative sample) that in the kindergarten population, about 65% of the mothers have low scores on the model's variables.

The second profile, called *average*, revealed that 21.31% (26 individuals) in the maternal population had higher scores in discrepancy and the experience of parental difficulties. They also had high scores in the representation of the child and their tasks as less important than their own tasks (almost as high

as the people in the third profile, that of *high*). Finally, their results in aggressive directiveness were also greater.

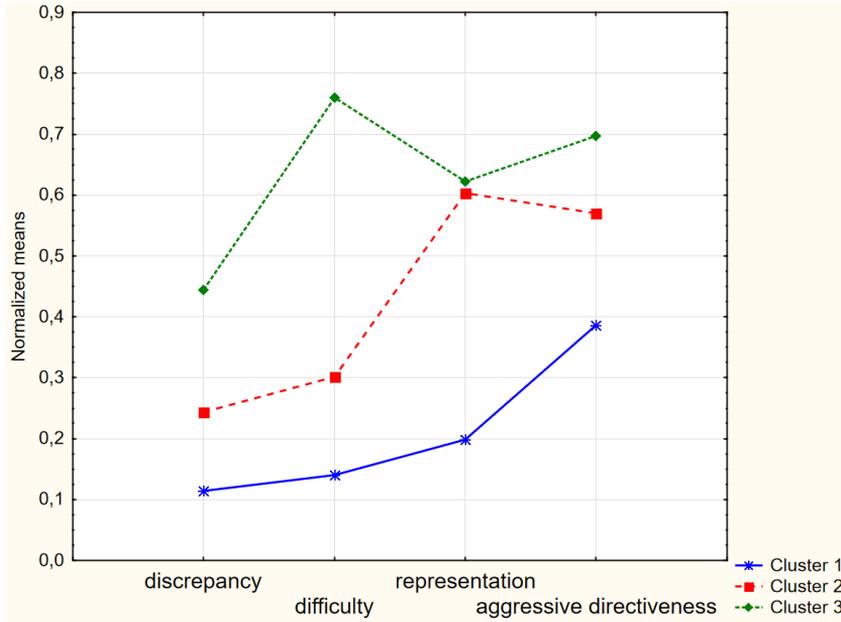


Figure 3. Graph of the cluster analysis (*k*-means method) conducted by data mining algorithms for variables in the model. *direct_agr* = aggressive directiveness.

The third profile, labeled *high*, is represented by the smallest percentage of the population (13%; 16 people). This profile included people who had high an elevated scores in the variables presented in the model. Table 3 shows the results, revealing statistically significant differences between profiles for all variables. It can be seen that the cluster analysis has classified people in such a way as to make the differences significant.

Table 3. Analysis of Variance (ANOVA) for Clusters in the Group of Mothers.

	Between SS	df	Within SS	df	F	p-value
Discrepancy	1778389	2	2294814	119	46.1101	.005
Experienced difficulty	32449	2	11591	119	166.5724	.005
Representation	8623	2	4777	119	107.4179	.005
Aggressive directiveness	1788	2	2961	119	35.9257	.005

Note. SS = sum of squares.

Neither the structural equation model nor the cluster analysis revealed very important information about how predictors of people's results in terms of explanatory variables (*viz.*, aggressive directiveness) could be established

on the basis of variables in the theoretical model. The artificial neural network was used to predict the results. This method allowed to determine how (on the basis of the participants' model variable results) the explained variable (aggressive directiveness) results can be predicted.

The theoretical model had three variables that explained aggressive directiveness: discrepancy, experienced difficulty, and the parent's mental representation of the. These three variables created inputs for the artificial neural network. The network had as many as 21 hidden neurons to predict, on the basis of input variables, the results of the individuals in terms of the applicable aggressive directiveness. In the learning process, the patterns were divided into three sets: (a) a learning set that represents 70% of the studied sample (112 mothers), (b) the test set comprising 15% of the studied sample (23 mothers), and (c) the validation set, with the remaining 15% of the examined sample (23 mothers). Data was divided in such percentages according to default settings of STATISTICA program. The learning set was used by the network to learn, the test set - to verify its predictions during the learning process, and the validation set - to validate the forecasting of the network and compare it with the expected values in the pattern. It was conducted after the network completed its learning and it reveals the correctness of the network predictions for the participants' outcomes (their results for aggressive directives) on the basis of input variables, that is, the scores in discrepancy, difficulty, and representation.

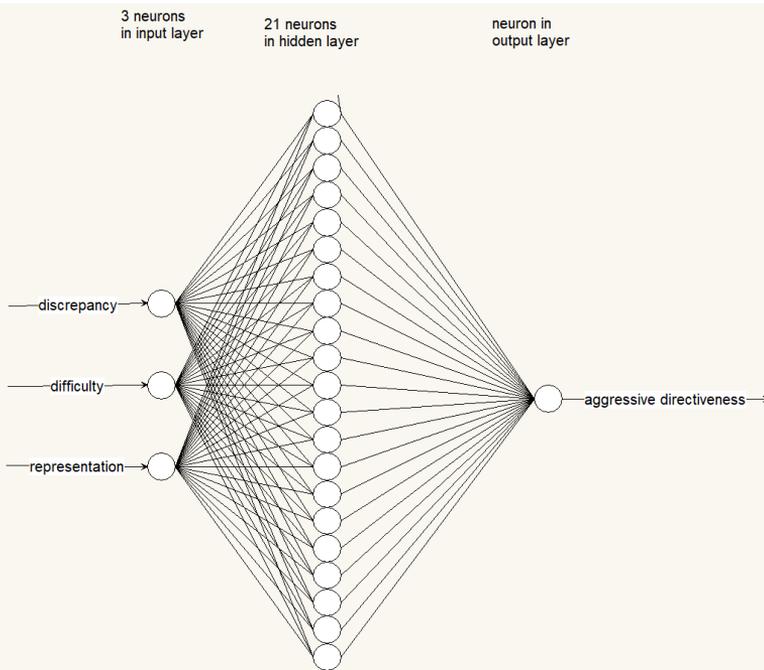


Figure 4. Artificial neural network with three inputs, 21 neurons in the hidden layer, and one output.

Based on the validity of the forecasting for the validation set, the degree of suitability of the network was determined. A total of 200 neural networks have been constructed, of which the single best trained network was selected. It had three entrances, 21 neurons in the hidden layer, and one exit. It was labeled as *RBF 3 - 21 - 1*. The validity of the network's prediction (quality validation) was .641, of teaching .639, and of testing .680. The network, therefore, has a moderate chance of predicting the usage of aggressive directiveness. What is surprising is the divergence between the very high correlations between the variables in the structural model and the average correlation (.641) between the true results of the participants and those predicted by the neural network. It would seem that with such a high level of relations in the structural equation model, the artificial network should have had a much higher chance of predicting the mothers' results. This led to the verification of the discriminant validity of the structural model with the formula developed by Aranowska (Aranowska & Szymańska, 2017). It turned out that the model had a validity of $v = .797$ and the operational validity of the latent variable (aggressive directiveness) was $\gamma = .551$. After subtracting the operational validity of aggressive directiveness from the validity of the model ($v - \gamma = .797 - .551 = .246$), it became evident that the model explains the aggressive directiveness variable better than the observed variables assigned to the latent variable (aggressive directiveness). Differences in results should be zero or negative. This undermines the model's discriminative validity, because the latent variable of the aggressive directiveness is too weakly operationalized. This is why the neural network cannot predict the results of the participants at a higher level. In the future, the scale of aggressive directiveness must undergo another modernization in spite of its fairly good psychometric parameters (Szymańska, 2015). With the use of neural networks and Aranowska's coefficients, it was possible to verify the value of this model as moderate.

Summary of Results

The results show that there are strong relations between the variables described in the theoretical model among mothers of kindergarten children. Moreover, it has been shown that the majority of mothers in that population have low scores on the variables described in the theoretical model. Almost 66% of mothers did not experience a strong discrepancy in their assigned goals from the level of the child's development, did not experience strong parental difficulties, and had low results in the negative mental representations of their children. These mothers also had average results in the usage of aggressive directiveness. Approximately 21% of mothers achieved higher scores in the range of variables presented in the model. Only 13% of mothers had moderate and high levels in all variables in the model. The model also allows, on a moderate level, to predict the results of people in aggressive directiveness.

Discussion

The obtained results revealed a great deal of information on the relations between variables in the prediction of aggressive directiveness and the distribution of results among mothers. The usage of data mining and artificial intelligence methods (artificial neural network) in combination with structural models has allowed for a very deep penetration between the variables in the set: Data mining methods are used for such deep explorations (Elder et al., 2012; Nisbet, Elder, & Miner, 2009), but they are rarely employed in psychological research.

Unfortunately, the current study has two serious limitations. In spite of the most advanced methods of data analysis, they are methodological and psychometric in nature. The limitation of the model resulting from the failure of taking the *error of agency* into account resulted in the discrepancy scale not controlling whether the achievement of the parental goal was caused by the parent's actions or as a result of other circumstances. Future research must be expanded in such a way as to control it. Unfortunately, when the scale was originally created, the *error of agency* was still unrecognized.

The second major limitation of the model is the construction of the scale of aggressive directiveness. As revealed by the results calculated by Aranowska's formulas, the scale of aggressive directiveness is better explained by other variables in the model than by its own observable variables. This undermines the discriminant validity of the model. It clearly indicates that the scale of aggressive directiveness should be improved in the future. Finally, the results show that the variables in the model are more strongly associated in the population of mothers than in the whole preschool parent population (Szymańska & Aranowska, 2016).

Finally, in the future research it is worth expanding the model taking into account other variables such as personal characteristics of parents, the temperamental traits of children. These variables can of course moderate relations in the model. It seems, however, that then model should be tested by other methods like multilevel structural equations.

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