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BP neural network-based sports games promotion to autistic children social skills research

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ABSTRACT

Due to autistic children has drawn increasing attention, how to let autistic children group to integrate into society, grow healthy and happily is the problems to be urgent solved. According to information analysis, sports games may have impacts on promoting autistic children social skills, the paper also carries on research on them. The paper takes 5 to 10 years old autistic children as research objects, takes their basic communication behaviors and interpersonal fusion capacity as research factors, by letting them to participate in sports games training, makes comparative studies on their before training, first training stage, second training stage each factor, and applies BP neural network methods to make classification and integration on autistic children each factor under different states, finally it gets sports games play very important roles in autistic children social skills. Parents should let autistic children to positive participate in sports games training, let them to rapidly and healthy grow.

KEYWORDS

BP neural network; Autistic disorder; Social skills; Sports games.



INTRODUCTION

Children autism also calls children autistic disorder, is related to children emotion, language, thinking, action, perception, and social contact as well as others multiple fields' mental activities that belongs to developmental disorder. Autistic children obvious characteristics are three: social communicating obstacle, language communicating obstacle and stereotyped behaviors. In systematic, presently they are classified into mental development disorder range, is called pervasive developmental disorder. According to report, prevalence rate of autistic disorder is nearly 4~10/ ten thousand of children. By far, children autistic disorder has been widely concerned, it is universally thought that there is no single discipline field can single solve autistic disorder pathogenic problems, and also no anyone treatment method can fully solve every child concrete problems, in this background, sports games together with other methods explore the solution of these problems.

Social skills are essential conditions of children psychological normal development. By lots of practices analysis, as effective methods of autistic children psychological treatment, sports games have already played effective roles in special education field and helping children to overcome psychological disorder aspects.

LiuYing-Hai, Dan Yu-Jin through carrying on physical education intervention studies on 3-6.5 years old eight male autistic children for eight months, they got conclusions: physical education intervention could become a kind of important autistic children subsidiary treatment method. By physical education intervention, autistic children problems behaviors were decreasing, and capacity of adapting to environment and safety consciousness were strengthening; they were willing to be close to parents and teachers, and generated dependence, and also didn't reject to get together with other children; sports effects on normal children physical and psychological development reflected in autistics children to different extent, in the aspects of perception, emotion and sticking as well as other aspects, they had more normal presentation than control group; their imitative ability, cooperation consciousness were better than control group; self-care ability had been promoted, language part also had some improvements, physical quality and body shape aspects were improved to a certain extent.

Dai Ting, Ma Ting-Hui and others studied sensory integration training impacts on autistic children sports ability and balance ability, pointed out sensory integration training could effective improve autistic children dynamic and static balance abilities, promote autistic children lower limbs and waist abdominal strength, strengthen body coordination ability and heart-lung endurance, but effects on strengthening autistic children upper limbs strength and promoting autistic children sensitivity was not remarkable.

By referencing lots of literatures, the paper gets two important indicators to evaluate social skills: basic communicating behaviors and interpersonal fusion ability. By comparing before participating in sports games training, after participating in sports games training first stage, after participating in sports games training the second stage children behaviors, it evaluates sports games impacts on autistic children social skills.

MODEL ESTABLISHMENT

Use basic communicating behaviors and interpersonal fusion ability integration to express children social skills, let research objects to engage in sports games training; training divides into two aspects, and makes analysis and research on training results.

Data investigation and handling

By referencing lots of literatures, it finds that children social skills mainly reflect in basic communicating behaviors and interpersonal fusion ability two main aspects. Randomly select 10 autistic children at the age of 5 to 10, carry on sports games training on them, and divide into two stages. In training process, observe their behaviors and ask parents to score on these two aspects satisfaction index (0-2 scores). It can respectively get before training, first stage, second stage parents' feature values on

autistic children basic communicating behaviors satisfaction index and interpersonal fusion ability satisfaction index. As TABLE 1, TABLE 2, TABLE 3.

TABLE 1 : Feature value before training

| No. | Basic communicating behaviors satisfaction index | Interpersonal fusion ability satisfaction index |
|-----|--------------------------------------------------|-------------------------------------------------|
| 1 | 0.3 | 0.5 |
| 2 | 0.6 | 0.4 |
| 3 | 0.3 | 0.4 |
| 4 | 0.5 | 0.6 |
| 5 | 0.2 | 0.3 |
| 6 | 0.4 | 0.5 |
| 7 | 0.3 | 0.2 |
| 8 | 0.7 | 0.7 |
| 9 | 0.6 | 0.5 |
| 10 | 0.5 | 0.4 |

TABLE 2 : Feature value after first stage training

| No. | Basic communicating behaviors satisfaction index | Interpersonal fusion ability satisfaction index |
|-----|--------------------------------------------------|-------------------------------------------------|
| 1 | 0.8 | 0.8 |
| 2 | 0.9 | 0.7 |
| 3 | 0.8 | 0.6 |
| 4 | 0.7 | 0.8 |
| 5 | 1.0 | 0.9 |
| 6 | 0.7 | 0.9 |
| 7 | 0.9 | 0.8 |
| 8 | 0.8 | 1.0 |
| 9 | 1.0 | 0.8 |
| 10 | 0.8 | 0.8 |

TABLE 3 : Feature value after second stage training

| No. | Basic communicating behaviors satisfaction index | Interpersonal fusion ability satisfaction index |
|-----|--------------------------------------------------|-------------------------------------------------|
| 1 | 1.3 | 1.0 |
| 2 | 1.2 | 0.9 |
| 3 | 1.4 | 1.2 |
| 4 | 1.2 | 1.3 |
| 5 | 1.3 | 1.1 |
| 6 | 1.4 | 1.3 |
| 7 | 1.1 | 1.2 |
| 8 | 1.2 | 1.2 |
| 9 | 1.5 | 1.3 |
| 10 | 1.1 | 0.8 |

TABLE 4 : Judgment subjects data

| No. | Basic communicating behaviors satisfaction index | Interpersonal fusion ability satisfaction index |
|-----|--------------------------------------------------|-------------------------------------------------|
| 1 | 1.1 | 1.0 |
| 2 | 0.5 | 0.7 |

| | | |
|---|-----|-----|
| 3 | 1.2 | 0.6 |
| 4 | 0.9 | 0.9 |
| 5 | 0.4 | 0.3 |

BP neural network model

BP network model basic principle : input signal X_i acts on output node through medium node (hidden layer point), by non-linear transformation, and then get output signal Y_k , network training samples include input vector X and expected output quantity t as well as network output value Y and expected output value t deviation, by adjusting input node and hidden layer node connection strength value W_{ij} and hidden layer node and output node connection strength T_{jk} as well as threshold value, let error to decline along gradient direction, by repeatedly training, finally it defines network parameters (weights and threshold values) correspond to minimum error, training ends. Now neural network through training is that can self handle with similar samples input information and output minimum error information by non-linear transformation.

In neural network, lots of different nerve cells included axon end can enter into the same nerve cell Dendron and form into a large number of synapses. All synapses of different origins released neurotransmitters can exert on same nerve cells' membrane potential changes. Thereupon, nerve cells space comprehensive information ability that is nerve cell can integrate input information of different origins in Dendron. Base on the ability, people simulate nerve cell reaction process and create artificial nerve cell model, as Figure 1 shows, symbols definition in figure is as TABLE 5 shows.

TABLE 5 : Mathematical model's symbol definition

| Symbol | Definition |
|------------------------|----------------------------------------------------------------------|
| x_1, x_2, \dots, x_n | Nerve cell input part that is information released by previous level |
| θ_i | Nerve cell threshold value |
| y_i | Nerve cell output |
| $f[u_1]$ | Excitation function |

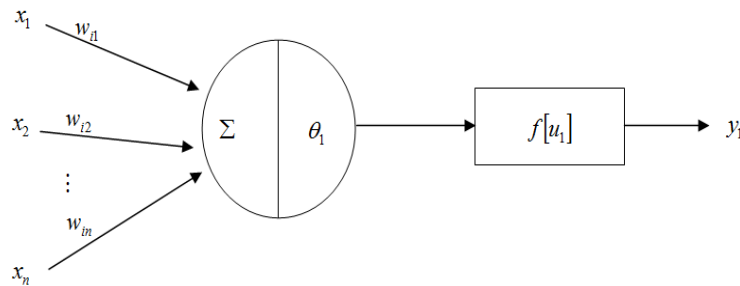


Figure1 : The schematic of mathematical models of neurons

$f[u_1]$ decides output form that arrives at threshold value θ_i under common effects of inputting x_1, x_2, \dots, x_n . Figure 2 shows two kinds of excitation functions images. The paper adopted models use the second kind excitation function.

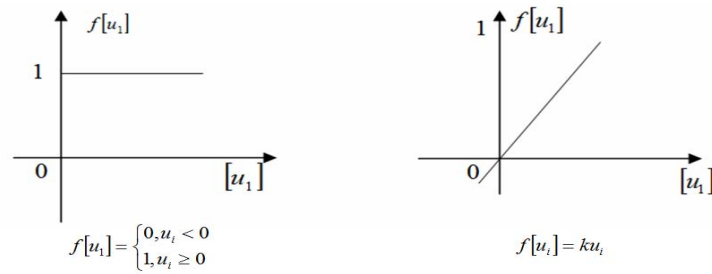


Figure2 : Typical excitation functions

Among them,

$$u_i = \sum_j w_{ij} x_j - \theta_i \quad (1)$$

So

$$y_i = f[u_i] = f\left(\sum_j w_{ij} - \theta_i\right) \quad (2)$$

Formula (2) is each nerve cell full mathematical model expression.

BP neural network model calculation steps. BP neural network is a kind of multiple layer forward network, adopts minimum mean square error computational way. When apply counter propagation algorithm into feed forward multiple network, utilize *Sigmoid* as excitation function, use following steps to make recursion solving on w_{ij} that is network weight coefficient. In case every layer has n pieces of nerve cells, for the k layer the i nerve cell, then it has n pieces of weight coefficients $w_{i1}, w_{i2}, \dots, w_{jn}$. In addition, select one more w_{jn+1} to express θ_i . When input sample x , take $x = (x_1, x_2, \dots, x_n, 1)$.

(1) Align value to w_{ij} . To every layer w_{ij} , align a very little nonzero random number, and meanwhile $w_{jn+1} = -\theta_i$. Due to the model utilizes Matlab to operate, the alignment process is computer's random process, and just because of that, same programming codes in different running processes, the results may appear differences.

Input sample value $x = (x_1, x_2, \dots, x_n, 1)$, and corresponding expected output $y = (y_1, y_2, \dots, y_n, 1)$.

(2) Calculate each layer output, for the k layer the i nerve cell output x_{ik} , it has:

$$y_i^k = f[u_i^k] \quad (3)$$

Among them,

$$u_i^k = \sum_j w_{ij} x_j^{k-1} - \theta_i^k \quad (4)$$

In formula, $x_{n+1}^{k-1} = 1$, $w_{i(n+1)} = -\theta$

(5) Solve each layer computation error d_i^k , for output layer, it has $k = m$, then it has:

$$d_i^m = x_i^m (1 - x_i^m) (x_i^m - y_i^m) \tag{5}$$

For other layers, it has:

$$d_i^k = x_i^k \left(1 - x_i^k \right) \left(\sum_j w_{ij} x_j^{k-1} - \theta_i^k \right) \tag{6}$$

(5) Correct w_{ij} and θ_i , it has:

$$w_{ij}(t+1) = w_{ij}(t) - \eta d_i^k x_j^{k-1} \tag{7}$$

(6) After solving each layer each weight coefficient, it can judge whether it conforms to requirements according to established criterion. If it don't conform, then return to the step ③, on the contrary, end computing.

Result analysis

For BP neural network Matlab operation result, it makes analysis. “*” represents first training stage children social skills, “o” represents before training children social skills.

Due to TABLE 1, TABLE 2 provide two kinds of autistic children social skills feature values, utilize *Matlab* to draw the two kinds of autistic children social skills factors distribution status as Figure 3, Figure 4 is discriminant results schematic diagram.

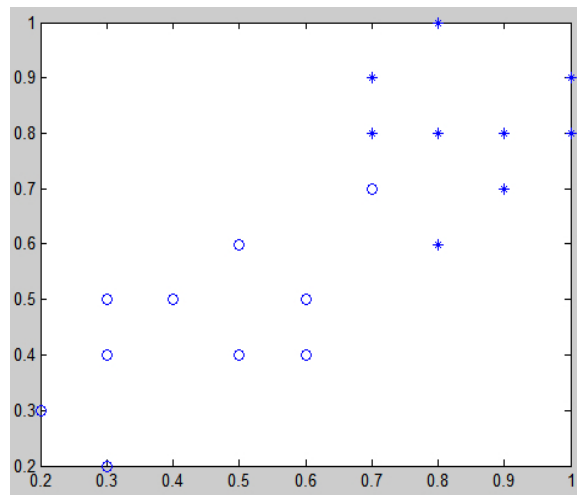


Figure 3 : Distribution of two kinds of influencing factors of autistic children social skills

From Figure 3, we can institutional see that before participating in sports games training and after first stage training autistic children social skills have distinct boundaries. Discriminant straight line is (0.2, 1.2), (0.9, 0.2).

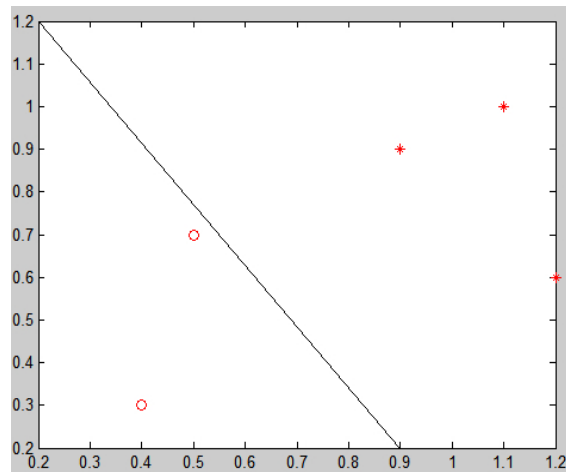


Figure4 : Discriminant result diagram

From Figure 4, it can get No. 2, 5 autistic children are children before training, No.1, 3, 4 autistic children are children in first training stage.

In the following, researches on children participate in sports games first stage and second stage. “*” represents second training stage children social skills, “o” represent first training stage children social skills.

Due to TABLE 2, TABLE 3 provide two kinds of autistic children social skills feature values, utilize *Matlab* to draw the two kinds of autistic children social skills factors distribution status as Figure 5. Figure 6 is discriminant results schematic diagram.

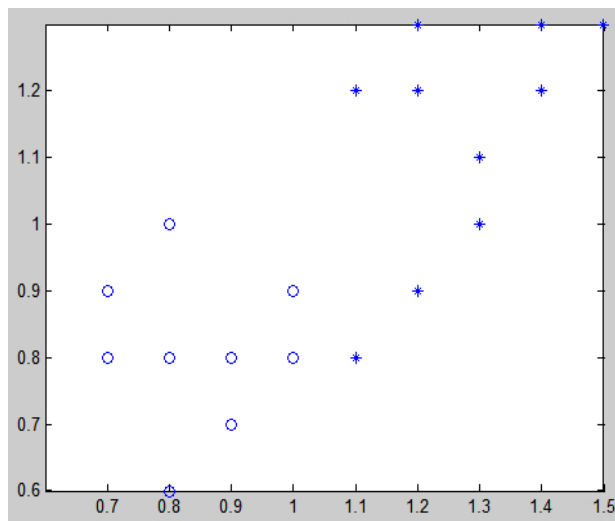


Figure 5 : Distribution of two kinds of influencing factors of autistic children social skills

From Figure 5, we can institutional see that after participating in sports games first training stage and second training stage autistic children social skills have distinct boundaries. Discriminant straight line is (0.2, 1.6), (1.3, 0.2).

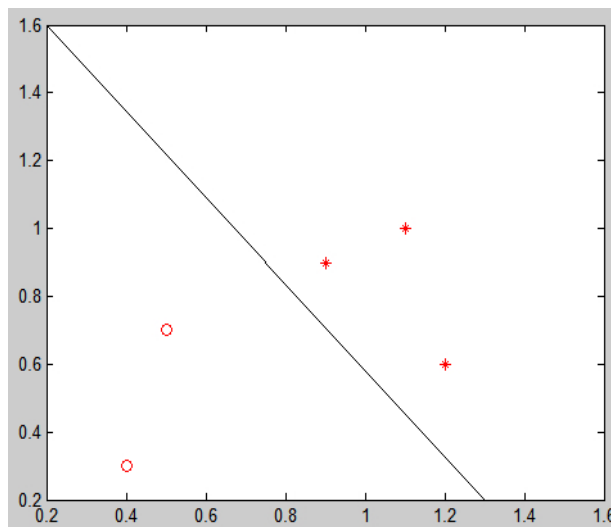


Figure 6 : Discriminant result diagram

From Figure 6, it can get No. 2, 5 autistic children are children in first training stage, No.1, 3, 4 autistic children are children in second training stage.

In order to more sufficient prove sports games can promote autistic children social skills, we use Clancy Autism Behavior Scale (CBS) to evaluate children behaviors before and after participating in sports games training, result is as TABLE 6.

TABLE 6 : Clancy autism behavior scale (CBS); (before training Δ , after first stage \diamond , after second stage \circ)

| Behavioral expression | Never | Occasional |
|----------------------------------------------------------------------------------------|-----------------------------|-----------------------------|
| 1 Not easy to play together with others | | \diamond \circ Δ |
| 2 Hear but pay no attention like the deaf | | Δ \diamond \circ |
| 3 Intensely resist learning such as rejecting imitation, speaking or doing the actions | \circ Δ | \diamond |
| 4 In spite of risks | \circ Δ | \diamond |
| 5 Cannot accept daily habits changes | Δ \diamond \circ | |
| 6 Use gestures to express demands | Δ \diamond \circ | |
| 7 Laugh inexplicably | \diamond \circ Δ | |
| 8 Don't like others' hugging | \diamond \circ | Δ |
| 9 Excessive high activity | Δ \circ | \diamond |
| 10 Avoid eye contact | | \diamond \circ Δ |
| 11 Excessive prefer to one object | | \diamond \circ Δ |
| 12 Like rotating things | \circ | Δ \diamond |
| 13 Repeatedly weird actions or games ways | \circ Δ | \diamond |
| 14 Indifferent to surrounding | | \diamond \circ Δ |

From CBS scale measured result; it indicates the children behaviors features have greatly changed in successive sports games training participation. Before training, during items as not easy to play together with others, don't like others' hugging, avoid eye contact, excessive prefer to one object, like rotating things and indifferent to surrounding, they are previously regular behavioral expressions, after participating in sports games, all basically become occasional expressions, and in don't like others' hugging and like rotating things such two items, now they almost will not do this way; Previously occasional expressions as in spite of risks and laugh inexplicably, now they will not do any more. Others some occasional items, occurrence frequency are also less than the previous. Therefore, it can clearly get that sports games exactly play positive roles in autistic children social skills.

CONCLUSION

The paper aims to study whether sports games promote to autistic children social skills or not, takes 5-10 years old autistic children as research objects, takes their basic communicating behaviors and interpersonal fusion ability as research factors, by letting them to participate in sports games training, carries out comparative research on their before training, first training stage and second training stage each factor, and applies BP neural network model into the researches.

By established model calculating, it gets conclusions: before participating in sports games training, after first training stage and second training stage, autistic children social skills have distinct boundaries. Therefore sports games play positive roles in promoting autistic children social skills. And use Clancy Autism Behavior Scale (CBS) to prove the result, it proves result conforms to calculation result, and proves the model has certain rationality.

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