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The Research on the Corrolation among Pet Attachment, Prosociality, Social Support and Loneliness Based on MF-DCCA

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Abstract: *Based on the MF-DCCA method, this paper explores the correlation between pet attachment and prosociality, social support and loneliness, selects primary and secondary school students in Chengdu for investigation, and puts forward the MF-DCCA method to study such problems for the first time on the basis of traditional linear analysis. The research shows that there is a significant correlation between pet attachment and loneliness, which also provides the possibility for the next research on children with autism.*

Keywords: *MF-DCCA, Relevance, Pet attachment, Pro-sociality, Social support, Loneliness*

1. Introduction

Multifractal characteristic analysis is an important research field in economics, physics, chemistry and social sciences. The fractal characteristics in sociology can reflect the similarity between individuals and society by studying the similarity between parts and the whole, thus to define the problems of social system caused by general groups, so as to solve related sociological issues.

Since the 1970s, some studies have shown that there is an attachment relationship between people and pets and they mainly focus on children, a relatively large group [1]. In recent years, some studies have shown that children have made breakthroughs in pro-sociality, social support, loneliness and pet attachment in society.

The fractal theory (MF-DCCA) method is suitable for analyzing the cross-correlation between two non-stationary time series with multifractal characteristics, and it could be applied in many fields such as in the stock market research [2], the port congestion index [3] and the price of crude and crops [4]. While most of the data obtained from the time series of adolescents' social characteristics are non-stationary and limited, and the cross-correlation between them can be analyzed by MF-DCCA method.

In the early stage of pet psychology research, behavioral research was relatively scarce. Experimental research involving pets is often cumbersome, and the way of writing down experiments is still relatively simple. If there is a real pet in the research, the process will undoubtedly be more troublesome. Although there have been behavioral experiments and evolutionary psychology explaining the attachment relationship between humans and pets, this type of evidence is not systematic and detailed enough [5].

Based on the MF-DCCA method, this paper conducts a systematic comparative analysis of pet attachment, pro-sociality, social support and loneliness for the first time, and the correlations among them are analyzed pairwise. Through the trend analysis of primary and secondary school age groups, it provides possiblility to predict the trend in both universal and special groups.

2. Data Sets

The data sets used in this study used the convenient sampling method. The primary school affiliated to Sichuan Normal University and the middle school affiliated to Sichuan Normal University were selected as the survey subjects. A total of 1,000 questionnaires were issued for the survey in the form of paper questionnaires. All the children are carefully screened before issuing the questionnaires, trying to select children from families who have experience in keeping pets.

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By recycling the questionnaire, eliminating those with missed answers and inadvertent answers, the valid questionnaires were screened out for statistical analysis. Each questionnaire is statistically analyzed according to the quantitative standard of each questionnaire [6], that is, inputting effective data and using mature statistical software to sort out and analyze the data.

(1). Evaluation Standards

The four variables selected in this study are pet attachment, prosocial behavior, social support and loneliness, and the four scales selected in this paper to study these four variables are widely used in China, and the questionnaires are recognized as the ones with high reliability and validity. The reliability method used in this study is Cronbach's α coefficient.

Cronbach's alpha is a method to check reliability which is the most widely used reliability evaluation tool in psychology or educational test. Cronbach's alpha coefficient was proposed by Cronbach. It does not require the test item to be only (0, 1) scoring. It can handle the calculation of internal consistency coefficient of any test. Generally, the higher the coefficient, the higher the reliability the tool has.

In basic research, the reliability should be at least 0.80 before it can be accepted, while in exploratory research, it can be accepted as long as the reliability reaches 0.70. A range of 0.70-0.98 is a high reliability, while a range below 0.35 is a low reliability and must be rejected. The α coefficient is the average of all possible split-half reliability, which is only an estimated value of the lower bound of test reliability, that is, if the α value is large, there must be higher reliability, but αsmall value cannot infer that the reliability is not high.

3. Methodology

MF-DCCA method was used to quantitatively study the cross-correlation and fractal characteristics between pet attachment and prosociality (social support and loneliness) [7].

By combining the MF-DFA method with the DCCA method, Zhou [8] proposed the MF-DCCA method which can effectively remove the influence of local trends on the scale of time series and can be used to analyze the cross-correlation and multifractal characteristics of two simultaneous non-stationary series with autocorrelation.

The wider the fractal spectrum, the greater the experimental time series fluctuate, and the maximum value of the fractal spectrum curve is 1. If the left end is higher than the right end, it means that the experimental time series has a higher probability of showing a higher position. Otherwise, if the right end is higher than the left end, it means the possibility of experimental time series showing a low position is higher. And the greater the distance between the left and right heights of the image, the bigger the difference of the possibility of time series showing high and low positions.

4. Results and Discussion

4.1. Data Analysis

Due to the limited conditions, this study was conducted by convenient sampling method in the implementation of the test. A total of 200 questionnaires were distributed to some primary and secondary school students in Chengdu, and 102 questionnaires were collected, which means a recovery rate of about 50%. The valid recovery rate is 80%, and there were a total of 80 valid questionnaires, all from students evenly distributed from the age of eight to fifteen and from the second to the ninth grade. Among those 80 questionnaires, 43.21% of them were from the males and 56.79% were from the females.

The reliability of pet attachment scale, prosocial tendency scale [9], adolescent social support scale [10] and child loneliness scale were tested.

The Cronbach's α coefficient of the total scale of pet attachment is 0.910, among which the Cronbach's α coefficients of general attachment, interpersonal replacement and pet status are 0.837, 0.823 and 0.597 respectively.

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Table 1: Reliability coefficient table of pet attachment scale

	Cronbach's alpha	Cronbach's alpha on standardized items	Guttman split-half coefficient	Number of terms
Pet attachment	.910	.915	.882	23
General gependence	.837	.844	.775	11
Interpersonal substitution	.823	.825	.764	7
Status of pets	.597	.633	.636	5

Table 2: Reliability coefficient table of prosocial tendency scale

	Cronbach's alpha	Cronbach's alpha on standardized items	Guttman split-half coefficient	Number of terms
Prosocial tendency	.946	.946	.921	26
Openness	.747	.747	.766	4
Anonymity	.802	.802	.840	5
Altruism	.748	.749	.790	4
Compliance	.745	.752	.665	5
Mood	.783	.782	.749	5
Urgency	.668	.677	.639	3

The Cronbach's α coefficient of the total scale of the prosocial tendency is 0.946, among which the Cronbach's α coefficients of openness, anonymity, altruism, compliance, emotion and urgency are 0.747, 0.802, 0.748, 0.745, 0.783 and 0.668 respectively.

Table 3: Reliability coefficient table of adolescent social support scale

	Cronbach's alpha	Cronbach's alpha on standardized items	Guttman split-half coefficient	Number of terms
Adolescent social support scale	.936	.937	.911	17
Objective support	.828	.829	.850	6
Subjective support	.830	.829	.647	5
Support utilization	.831	.832	.808	6

The Cronbach's α coefficient of the total scale of the adolescent social support is 0.936, among which the Cronbach's α coefficients of objective support, subjective support and support utilization are 0.828, 0.830 and 0.831 respectively.

Table 4: Reliability coefficient table of the child loneliness scale

	Cronbach's alpha	Cronbach's alpha on standardized items	Guttman split-half coefficient	Number of terms
Children's Loneliness	.714	.760	.766	16
Loneliness	.761	.764	.783	6
Social Adaptability and Inadaptability	.409	.547	.338	6
Main evaluation for status among peers	.842	.842	.848	4

The Cronbach's α coefficient of the total scale of children's loneliness is 0.714. Among them, the Cronbach's α coefficients of loneliness, social adaptability and inadaptability and the main evaluation of peer status are 0.761, 0.409 and 0.842 respectively.

These four questionnaires are widely used in domestic researches and are recognized as highly reliable and valid. After analysis, it can be concluded that these four questionnaires have good reliability, and the principal components obtained after the factor rotation are consistent with the number of dimensions of the questionnaire.

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4.2. Analysis of Correlation

As shown in Figure 1, it can be clearly seen that t Hq decreases as the value of q increases, indicating that for children in primary and secondary school, the correlation between children's loneliness and prosocial tendency and social support has multifractal characteristics. When q takes (-9.0, 4. 2), the values of Hq are all in the range of (0.5, 1), which indicates that there is a long-term correlation between prosocial tendency, social support and children's loneliness.

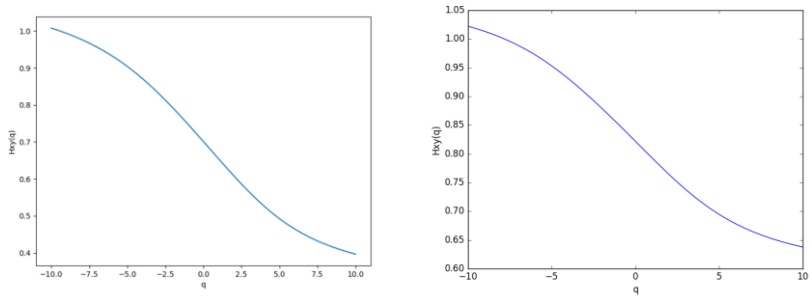

Figure 1: The q-order Hurst index grap of children's loneliness and prosocial tendency (left), and of children's loneliness and social support (right)

Figure 1 shows that the cross-correlation index Hxy(q) varies with the value of q, and Hxy(q) is not a constant, which indicates that the cross- correlation between pet attachment and children's loneliness has multifractal characteristics, which also means that it is inappropriate to describe it with a single fractal model.

The figure 2 also shows that within the value range of q, all Hurst values are greater than 0.5 and less than 1, which shows the positive long-term correlation of the time series, that is, the process is continuous. This means that higher prosocial tendency and social support corresponds to less children's loneliness.

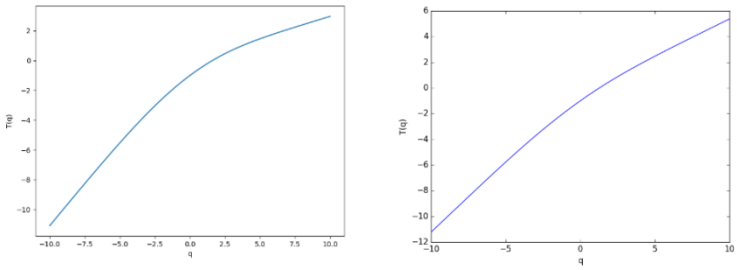

Figure 2: Renyi index chart of prosocial tendency and pet attachment (left), and of social support and pet attachment (right)

$$\tau(q)=qHxy(q)-1 \quad (1)$$

The relationship of the multiple fractals scale index (Renyi index) τ(q) obtained by MF-DCCA is:

If τ(q) and q have a linear relationship, then the cross-correlation relationship between the two sequences is single fractal; otherwise, it has multi-fractal characteristic.

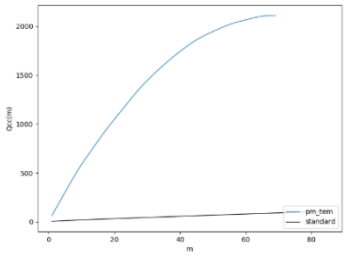

Figure 3: Analysis of the results of the correlation between pet attachment and children's loneliness

By observing Figure 3, the value range of the degree of freedom m is 1~80, calculate the critical value

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(curve standard) of chi-square distribution when the degree of freedom is no longer used, and compare it with the curve of cross-correlation test statistics of the fluctuation series of prosocial tendency. It can be seen that the curves will not overlap, which shows that pet attachment are cross-correlated with children's loneliness.

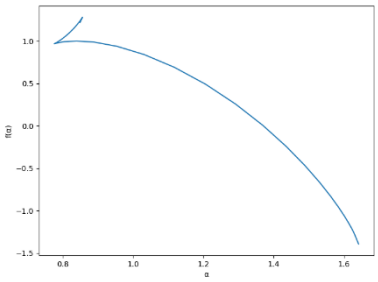

Figure 4: Multifractal spectrum of pet attachment and children's loneliness

From the f(a)— a diagram, it can be seen that the cross-correlation between pet attachment and children's loneliness presents multifractal characteristics, and it can indicate that the intensity of mutual concern between pet attachment and children's loneliness fluctuates greatly and is unevenly distributed. According to △f >0, it shows that t most of the cross-correlation between pet attachment and children's loneliness is low, and according to △a=0.It can be concluded that the multifractal correlation between children's loneliness and pet attachment is very obvious as show figure 4.

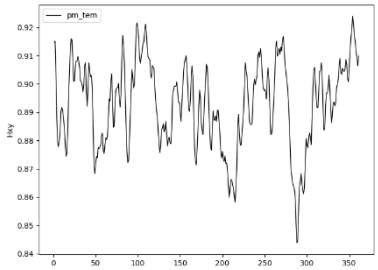

Figure 5: pm_tem curve of prosocial tendency and pet attachment

In the Multifractal Elimination Trend Cross-Volatility Analysis (MF-DCCA), the visualization of volatility correlation is very clear and detailed, but the analysis of local conditions is not reflected clearly. And Cajueiro and Tabak proposed to use the Hurst index of sliding window to analyze the fluctuation trend of the entire sequence to better observe the time evolution characteristics of the Hurst index of the entire sequence.

According to Figure 5, we can see that the curve pm_tem is basically distributed above 0.8, which indicates that children's prosocial tendencies and pet attachment are basically positively correlated.

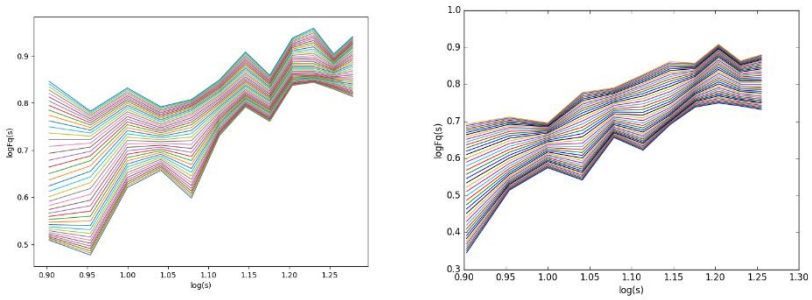

Figure 6: The log(s) index grap of prosocial tendency and pet attachment (left), and of social support and pet attachment (right)

It can be seen from Figure 6 that for different q, the wave function Fq(s) and the time scale s show a good power-law relationship. When "s" gradually increases, the image of the wave function Fq(s)

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gradually overlaps, and the curve presents a linear relationship over a period of time, that is, there is a cross-correlation between prosocial tendency and social support. This indicates that children's attachment to pets can reflect children's prosocial tendency and social support to a certain extent. The higher pet attachment the children demonstrate, the higher prosocial tendency and social support they have.

5. Conclusion

The research shows that the scales of pet attachment, loneliness, prosocial behavior and social support have positive internal consistency, indicating that the reliability of the scale is relatively ideal and meets the standards and requirements of psychometrics.

The research on the correlation of the scales based on MF-DCCA method shows that there is an interactive correlation among children's pet attachment, children's loneliness, prosociality and social support, which shows good predictability. The prediction results also shows that the higher pet attachment the children have, the higher prosocial tendency and social support they have. Children’s attachment towards pets can effectively decrease children’s loneliness and the effect can be prolonged. Thus for children with high loneliness, we can carry out pet attachment support and other auxiliary approaches.

The paper provides a new method for sample prediction and analysis of special groups such as autistic children in the future. To improve present works, the next step is to consider increasing the sample range and making predictions and verification analysis for special groups in a longer period of time.

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