

# Clarifying the Positive Thoughts Structure of Sport Societal Values by Neural Network Approaches in COVID-19 Pandemic

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**Abstract:** Purpose of this study was to clarifying the relationship structures with social values of complex sports and positive thought under today's COVID-19 social anxiety by neural networks and network-centric analysis. The Value items were the terminal ones (benevolence, equality, accomplishment, global stability, hope for future, proud country, family bond etc.) and the instrumental ones (consistent, creative, light hearted, honest, ambition, creative, polite, etc.). The subjects (university students; n = 221) received an explanation of the study's structure and of various sports-related benevolent activities such as donations, charity matches and voluntary disaster relief activities. Next, they were asked, 'What types of values do you recognize in benevolent sports activities in world-wide health anxiety under COVID-19 pandemic?' Neural network model, random forest model and correspondence analysis were executed and discussed some relation structure of societal human values of sport with the positive thoughts under COVID-19 pandemic. Current study shows the possibility of supporting the understanding of the complex, gradual, transitive, and central structures of diverse sport values by approaching network analysis. As a result, it was clarified that the social wisdom of these sports would be a desire to support the survival of the physical society more creatively. Under the social unrest in the advanced information society, the importance of tactile communities such as sports was confirmed.

**Keywords:** Sports, Societal Human Value, Network Analysis

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## 1. Introduction

In recent years, human value of sport has been discussed in relation with social goals such as the Sustainable Development Goals ("ethics", "globalization and economic growth", "development and peace", "health", "climate", "environment", "gender", "inequality", "social justice", etc.) [2, 9, 15, 17, 28].

The authors have studied the values of sports under social anxiety such as large-scale disasters [19]. It is an approach that considers the importance of complex social values by ranking the terminal value group and the instrumental value group [16, 19-21]. One study raised the ultimate value of "accomplishment", "benevolence", and "global concerned". People would accumulate diverse values and form the wisdom and motivation to survive in the conflicts of daily life [19].

Athletes seeking excellence are committed to lasting

contribution for trainings or matches in solitary battles. The possibility of altruism was also suggested on the coexistence of the universal life value of "happiness" and the finite life value of "accomplishment", "life-force", and "inner harmony" [20]. Athletes' lives are difficult and they experience loneliness while achieving victories and records. They would feel pressurized to be the last man on the podium. Therefore, they might desire "true friendship" and "family-bonds" with people sharing the same supreme desire, like fellow soldiers. However, if the loneliness is accompanied by some sense of societal pride, the combination could offer a positive social force for the future [20, 15, 29].

Purely following the goal would be a kind of heterogeneous and unique in a good sense. However, its mind would be to co-evolve community and social philosophy. The originality might exert the power to connect society with intense change, high uncertainty, complex era. The value of sport life force

means an extremely tactile information and create a direct communication community in the so-called information network society [21].

Network analysis has been developed in communication network studies. Some traditional studies were introduced in the period from 1960 to 1970, including the “small world phenomenon”, “the strength of weak ties”, and “scale free network”. Sociological approaches are widely used for predictive models of big data in the field of information technology [7, 18, 25]. Network analysis methodologies have been applied in social and natural science approaches used in sport sciences. Within the social-science approaches, there are social psychological debates on how sports assist the development of cooperation values within a specific society [19, 25].

How does the importance of network dynamism discuss? There exist important hub functions, sub-group communities, and actors playing some central roles within a network. The important role of network analysis would be to reveal the decisive and pragmatic structures required to obtain specific goals among complex networks. This could be discussed from the perspective of network centrality [22, 31]. Network centrality clarifies an organization’s temporal and bipartite or multilayered structures, which would help us understand the driving force of the network dynamism [13, 27].

Artificial neural network is machine learning how to simulate human learning activities [29]. It is one of the most intelligent fields in artificial intelligence. Especially after 2010s, the research work in the field of machine learning widely used in many fields including sport science (agility in volleyball; [29]; swimming skills; [11]; injury estimation; [10]; decision making support [26, 30].

## 2. Methods

### 2.1. Questionnaire

We adopted Rokeach’s human values model contains 15 terminal and 16 instrumental values which suggest that their prioritization will be affected by the particular context. For example, ‘pride in country’ and ‘global concern’ would tend to assume higher priority in a situation of international conflict. Thus, to adapt Rokeach’s model to Japan’s current social conditions, the authors made various alterations to Rokeach’s set of items. In the category of terminal values, the authors changed “national security” (protection from attack) to “proud country” (to represent citizens’ willingness to work together for their country’s good). “Happiness” was changed to “hope for the future” so as to represent an ontological commitment to improving people’s existence rather than an absolute state. “An exciting life” was changed to “life force”, “a comfortable life” to “prosperity”, “a world at peace” to “global stability”, “salvation” to “benevolence”, “mature love” to “culture” and “pleasure” to “light hearted”. Among the instrumental values, “obedient” (dutiful) was changed to “respectful” to mean proactive rather than passive willingness.

### 2.2. Subjects

The subjects were university students ( $n = 221$ : male = 131, female = 90, age = 19-21 years, average age = 20 years). The research was conducted in October and November 2021. Subjects received an explanation of the study’s structure and of various sports-related benevolent activities such as donations, charity matches and voluntary disaster relief activities. Next, they were asked, ‘What types of values do you recognize in Japanese benevolent sports activities in world-wide health anxiety under COVID-19 pandemic?’ In response to this question, the participants were asked to rank the 15 terminal and 16 instrumental values each. In the item ordering, the highest-ranked item was given 15 points at terminal value and 16 points at instrumental value. Furthermore, they evaluated their positive mind to live in daily life in 5 grades (1; very negative ~ 5; very positive: 1 and 2 are negative group:  $n=52$ , 3 is middle group;  $n=121$ , 4 and 5 are positive group:  $n=48$ ).

### 2.3. Neural Network & Radom Forest Model

A neural network is a computational graph created by connecting differentiated transformations. Training data (75%) and test data (25%) from the initially normalized data were separated. In the first model, after the input vector (Layer) was multiplied by a weight matrix and added with a bias vector, it linearly converted to the middle layer (hidden layer). Machine learning methods using neural networks with a large number of such middle layers are deep learning. If the input layer, the middle layer, and the output layer is one at a time, the model is called an architecture with three layers.

The hidden layer of the neural network receives the result of applying a linear transformation to the previous layer, from which it outputs a nonlinear transformation applied. The function that performs this nonlinear transformation is called the activation function in the context of a neural network. Here, we used logistic sigmoid function. The number of units in the hidden layer was set to 1, the learning rate was set to 0.01, and the threshold to stop learning was 0.01.

The influence (weight) toward the hidden layer and the bias value (constant value in the regression model) at each step are derived, and the smallest error value (MSE; mean squared error: loss function) between the training data and the test data is estimated.

In the second model, the prediction accuracy index RMSE by training data is calculated, and the model is reconstructed by tuning parameters. Among the number of hidden layers and the combination of units, we identify the number of hidden layers and units, showing the lowest RMSE (Root Mean Squared Error) value. If the error value is lower than previous model, the new one would be evidenced as a relatively good model [4].

Random forest analysis is performed as another machine learning technique to confirm the importance of an item. Bootstrap samples made from datasets generate decision trees. As it is a regression problem, the importance order is obtained from the increment of the purity of the node of the decision

tree [24]. The importance graph is an algorithm that shows the items with the highest importance from top to bottom.

In the final analysis process, centering resonance analysis using network centrality is performed in order to clarify the characteristics of the value order (importance) item of the positiveness grade. Network centrality analysis is a method of understanding which specific value is strongly associated with other peripheral values in the value item group. These step-by-step approaches would help us understand that people are trying to move toward positive future behavior in the society with what kind of priority structure of human values.

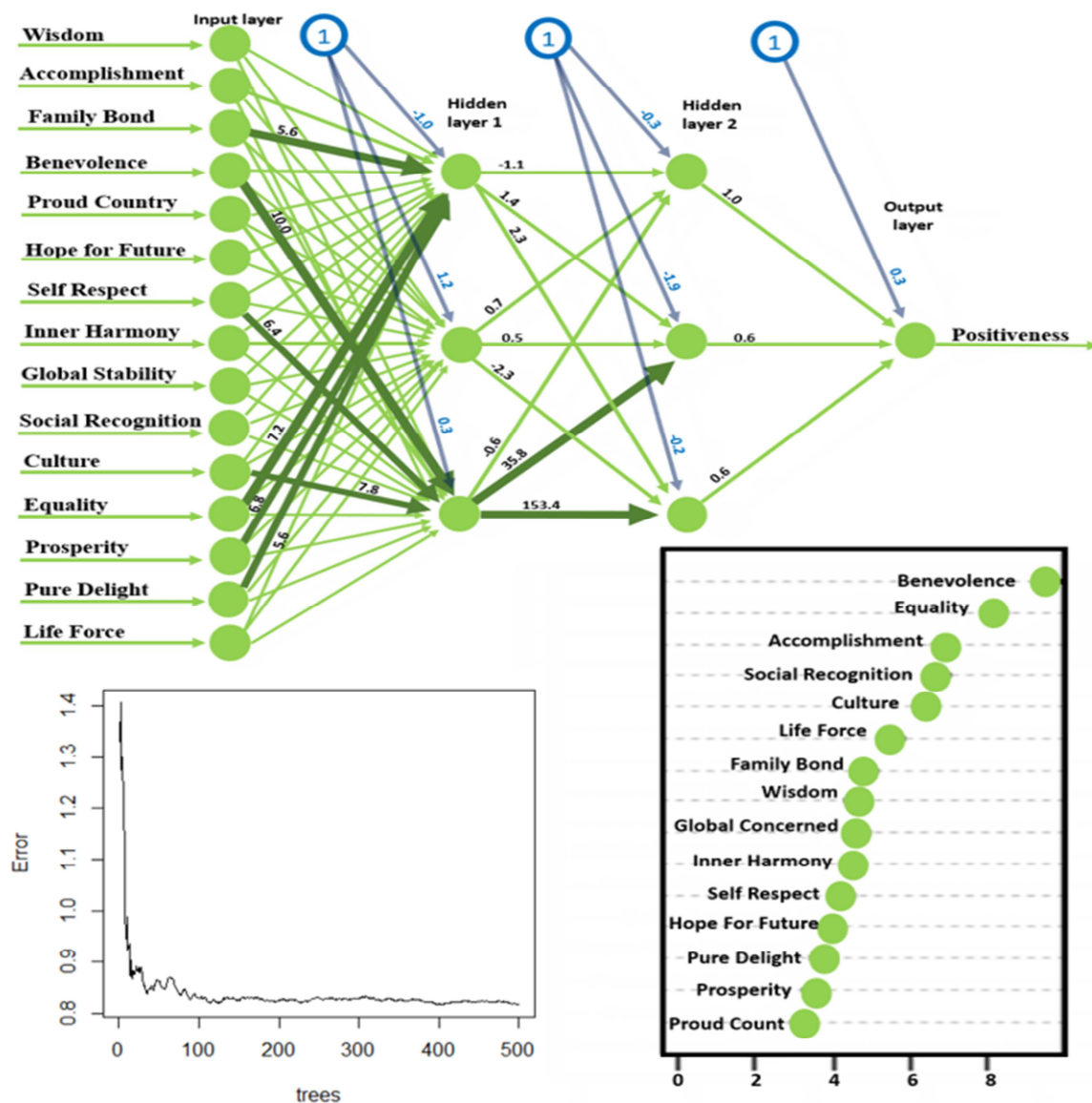
### 3. Results

#### 3.1. Neural Network and Random Forest ; Terminal Values

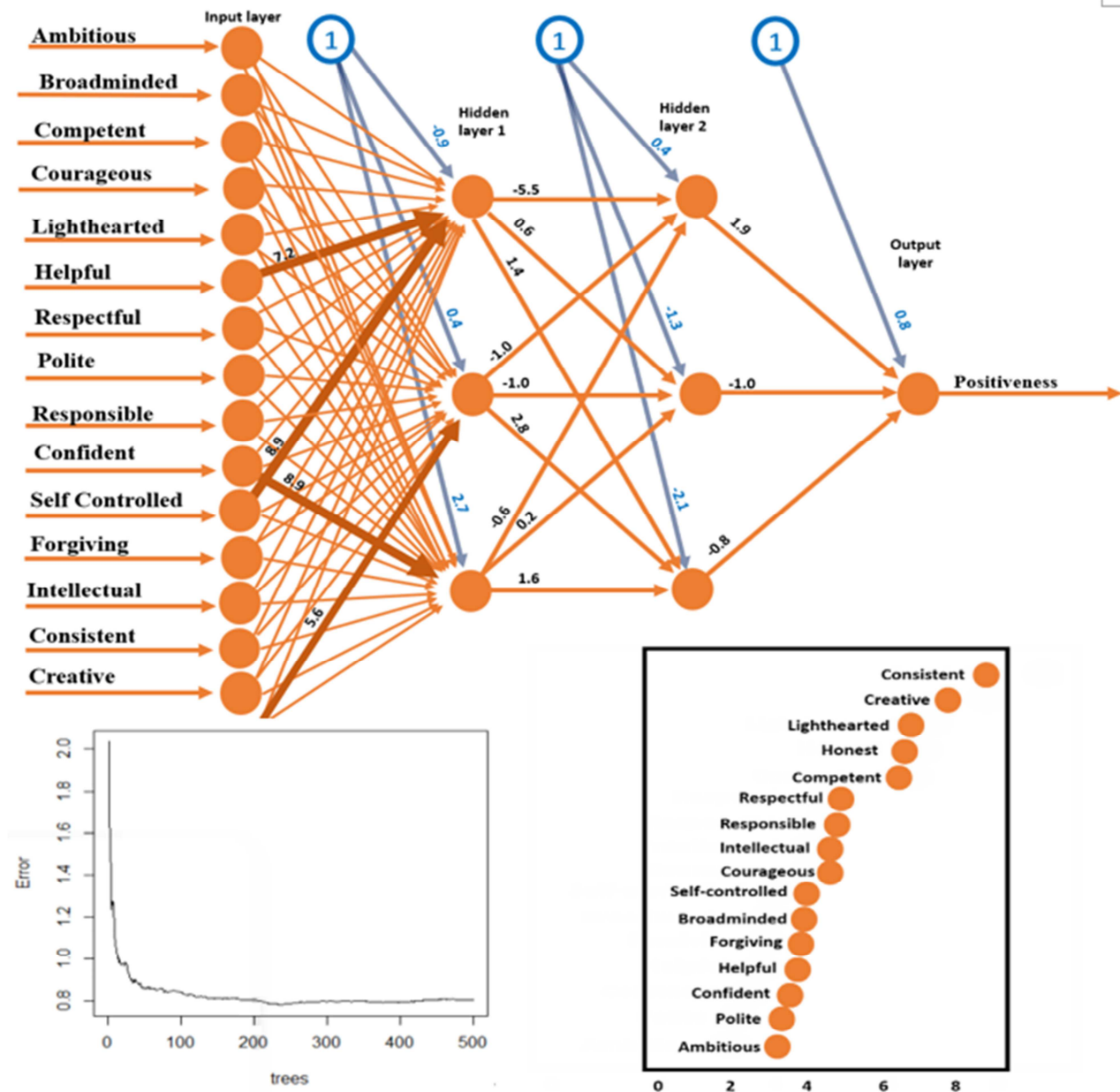
The first neural network created an influence network from

the input layer (terminal values) to the hidden layer 1, and it connected to the output layer (positiveness) through the hidden layer 2. In the first model, the MSE (mean squared error; i.e., the square sum of “the difference between the correct answer label value and the predicted value” divided by 2) was 3.28. The number of steps before learning converged was 456 times. The MSE value of the tuned model (figure 1, upper) was reduced to 1.71 (5,535 steps).

Values with an impact level of 5 points or more from the input layer to hidden layer 1 (thick lines and numerical markings) were “benevolence”, “culture”, “equality”, “prosperity”, “family bond”, and “light hearted”. In the random forest model, the error rate was stable with more than 100 decision trees (figure lower left), and high important values (node purity) were “benevolence”, “equality”, “a sense of accomplishment; lasting contribution”, “social recognition”, “culture”, “life force”, “family bond”, “wisdom” and “global concerned” etc.



**Figure 1.** Tuned neural network of terminal values with high positiveness (TPH: upper), random forest (error and decision tree; lower left) and the importance order (node purity) by random forest (lower right).



**Figure 2.** Tuned neural network of instrumental values with high positiveness (IPH: upper), random forest (error and decision tree; lower left) and the importance order (node purity) by random forest (lower right).

### 3.2. Neural Network and Random Forest; Instrumental Values

As a result of tuning used the same technique as above, a model with increased accuracy was generated with an MSE value of 3.99 (40 steps) to 1.59 (2,565 steps) (Figure 3 upper). In the random forest model, the error rate was stable with more than 200 decision trees (figure 2, lower left).

Values with an impact level of 5 points or more from the input layer to hidden layer 1 were “confidence”, “self-controlled”, “helpful” and “honest”. The important values understood in the random forest was “consistency”, “creative (imaginative)”, “light hearted”, “honest”, “competent”, “respectful”, “responsible”, “intellectual”, and “courageous”, etc.

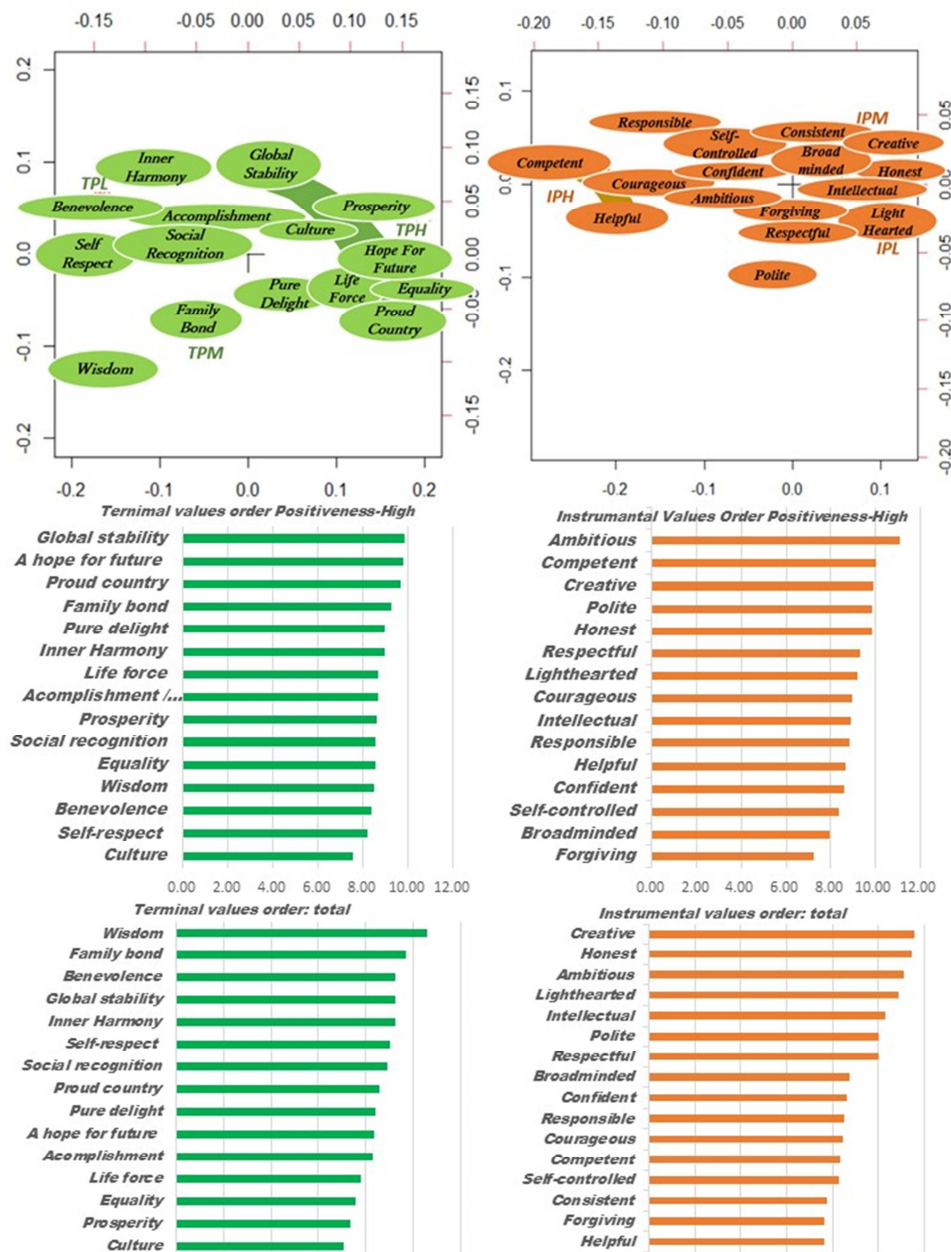
### 3.3. Correspondence Analysis

We conducted a correspondence analysis for a detailed view among positive thought grades [high, middle, low] (Figure 3). This centering resonance analysis could develop a relative comparison of the vertexes that were common (centered position) among the multiple networks. In addition to the characteristics among each group, this analysis could allow us to grasp the similarities and uniqueness within a specific group. To maximize the relationship between row and column items, correspondence analysis sorts both the rows and columns to identify the relationships between them. In the axial contribution ratio of terminal values space, the accumulated ratio on the second axis was 100% (82.09%, 17.91%), suggesting that the data was adequately represented



(Figure 3, upper left). As a characteristic of terminal value group with high grade of positive thought (TPH: terminal values with positive high), “hope for future”, “equality”, “proud country”, “life force” and “prosperity” were shown as societal human values of sport. As a characteristic of the group with middle grade of positive thought (TPM: terminal values with positive middle), “wisdom”, “family bond” were shown. As a characteristic of the group with low grade of positive thought (TPL: terminal values with positive low), “benevolence”, “self-respect” and “inner harmony” were shown. These characteristics might be interpreted as value chain space of “time perspective for future and attribution”, “ontological commitment”, and “coexistence of altruism and self-respect” (Figure 3; middle left and lower left). In the axial contribution ratio of instrumental values space, the

accumulated ratio on the second axis was 100% (90.27%, 9.79), suggesting that the data was adequately represented same as the terminal values space (Figure 3; upper right). As a characteristic of instrumental value group with high grade of positive thought (IPH: instrumental values with positive high), “competent” and “helpful” were shown as societal human values of sport. As a characteristic of the group with middle grade of positive thought (IPM: instrumental values with positive middle), “creative (imaginative)”, “consistent” were shown. As a characteristic of the group with low grade of positive thought (IPL: instrumental values with positive low), “respectful”, “polite” and “light hearted” were shown. These characteristics might be interpreted as value chain space of “thought of cooperation”, “Continuation of creation”, and “sincere broadminded” (Figure 3; middle right and lower right).



**Figure 3.** Correspondence analysis; characteristics of the centrality of the value network with three levels of positive thought grade (left; terminal values, right; instrumental values).

## 4. Discussion

### 4.1. Terminal Values

Machine learning models called neural network and random forest were constructed. Terminal values those have a relatively large impact from the input layer to the hidden layer 1 were, “benevolence”, “culture”, “equality”, “prosperity”, “family bond” and “pure delight”, “sense of accomplishment (lasting contribution)”, “social recognition”, “life force”, “wisdom” and “global stability”. It might be possible to interpret that sport contributes to the chain of society, culture, and life. As a characteristic of the group with a high grade of positiveness (TPH: terminal values with positive high), “global stability” was positioned at the top (figure 3; left middle). The following orders were “hope for future”, “equality”, “proud country”, “life force” and “prosperity”. It can be said that the TPH recognizes the function that sports play great benevolent cause to the world and country under uneasiness society. The overall data graph (Figure 3; left under) would show that these values may concerned the wisdom of sports and may raise the family-like bonds. The characteristic of TPH in the correspondence graph (figure 3; left upper) would be the path of values (shown by a thick green line) that would connects “global stability” with “proud country”. Our past study suggested that “hope for the future”, “family bod”, “a sense of accomplishment”, and “broad minded” could make a pride bridge in the country. In world-wide health anxiety during COVID-19 pandemic, the existence of tactile communication society of sports might connect the value chains of cross-border hope, life force, culture, and equality. The path of values in Figure 3 (upper left) might be said a big community road of sport pride.

### 4.2. Instrumental Values

Instrumental values with a relatively large impact from the neural network input layer to hidden layer 1 were “confidence”, “self-controlled”, “helpful”, “honest”, “consistent”, “creative (imaginative)”, “lighthearted”, “competent”, “respectful”, “responsible”, “intellectual”, “courageous” etc. It may be possible to interpret that sport contributes to the chain of executions that continue self-affirmation and connect to altruistic creativity. As a characteristic of the group with a high degree of positiveness (IPH: instrumental values with positive high), “ambitious” was positioned at the top (Figure 3; right middle). The following orders were “competent”, “creative (imaginative)”, “polite” and “light hearted”. There might be a reason for the existence of sports like the ability to execute and creativity to accomplish something. It would be interesting result of overall data graph (Figure 3; right under) that showed the highest evaluation of “creative” value of sport in instrumental values. It might suggest a challenge to the limits of the body, a positive thought that overcomes fear (terror management), and a thought to the possibility of human adaptability.

The characteristic of IPH in the correspondence graph

(figure 3; Right upper) would be the path of values (shown by a thick orange line) that would connect “helpful” with “competent”. Although these altruistic values reported in the past, “creative” values listed as a top of the whole data in this study have never been highly valued. It might be serious uneasy society in which creative adaptive thinking bring by sports behavior is desired.

In an advanced information society, the spread of today's pandemic anxiety has brought about deep social loneliness and a decline in social communication skills. When physical anxiety increases, people become dependent on social harmony [1]. Sociological discussions have been developed with including “The Lonely Crowd” [14], “The Habit of the Mind” [3] and “the bowling alone” [12]. As an ontological strategy, if loneliness involves benevolences or altruism such as social pride, the combination might have the potential to provide positive terror management movement for the future [20, 8, 23].

Such a survival strategy was sometimes shared as a fiction and a myth, and made the human society live [6]. As mentioned in the introduction, the value of sports vitality means very tactile information and means to build a direct communication community that would be extremely unique to the so-called information society.

## 5. Conclusion

From the viewpoint of today's sports high performance, management of complex values is required. Leadership, coaching, strategic interactions, resources, support, and information management have been tried in relational network analysis visions [5]. Current study shows the possibility of supporting the understanding of the complex, gradual, transitive, and central structures of diverse sport values by approaching network analysis. As a result, it was clarified that the social wisdom of these sports would be a desire to support the survival of the physical society more creatively. Sports would need the ability to continue to hold values in social confusion and the ability to continue to work together to continue to create clues to solving problems by making full use of the latest information science.

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## Conflicts of Interest

The author declares no conflicts of interest associated with this manuscript.

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