

Model and Instance on Evaluation Index Weight Calculation for Mental Health

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Abstract. It is an important measure to strength the level of mental health, and comprehensive cultivated provides a new method to solve mental health issues. This article base on G1 method to research the weight of index system. First, construct evaluation index system based on Cartel the sixteen personality factor questionnaire; Then, construct comprehensive mathematical model based on the G1 algorithm thought; Finally, calculate the index weight according the experts' sequence arrangement of indicators importance. The advantages of this paper are without having to construct judgment matrix, and will not need consistency test, there is no limit on the number of indicators, the calculation is simple and intuitive and the results is reliable.

Introduction

With the rapid development of society, life rhythm are increasing, more and more intense competition, interpersonal relations are becoming more complex; Thanks to the rapid advances of science and technology, knowledge explosive increasing, people have to constantly update knowledge; People haven entered an emotion weight loading age, their concept awareness and emotion attitudes are complex evolution. College students, as a special social group, there are many special problems, including: the new learning environment and tasks adaptation; the professional selection and study adaption; the conflict between ideal and reality; the contradiction between professional adaptation, learning and love, the future career choice, and so on. How to avoid or eliminate this kinds of psychological stress, psychological crisis or psychological barriers caused by psychological pressure. It becomes the urgently required of all colleges and the problem of common concern to promote physical and mental health, state the current social environment with a positive abnormal mental, prevent the occurrence of mental disorders and psychosomatic diseases, strength mental health education for college students [1,2]. It is an appropriate solutions to take effective means based on the evaluation result for mental health of college students. When using a comprehensive evaluation index system, as the relative importance of different indexes, and different weights will give different results of the evaluation, so it is a basic work of systematic review to make sure the reasonable weight. This paper based on G1 method constructed Cartel the Sixteen Personality Factor Questionnaire weights, to provide support for Mental Health Evaluation

Cartel the Sixteen Personality Factor Questionnaire

The Sixteen Personality Factor Questionnaire (16PF), is a self-report personality test developed over several decades of empirical research by Raymond B. Cattell, Maurice Tatsuoka and Herbert Eber. The 16PF provides a measure of normal personality and can also used be used by psychologists, and other mental health professionals, as a clinical instrument to help diagnose psychiatric disorders, as well as help with prognosis and therapy planning. The 16PF instrument provides clinicians with a normal-range measurement of anxiety, adjustment, emotional stability and behavioral problems. The measurement of normal personality trait constructs is an integral part of Cattell's comprehensive theory of intrapersonal psychological variables covering individual differences in cognitive abilities, normal personality traits, abnormal (psychopathological) personality traits, dynamic motivational traits, mood states, and transitory emotional states which

are all taken into account in his behavioral specification/prediction equation. 16PF factor as shown in Fig .1 [3].

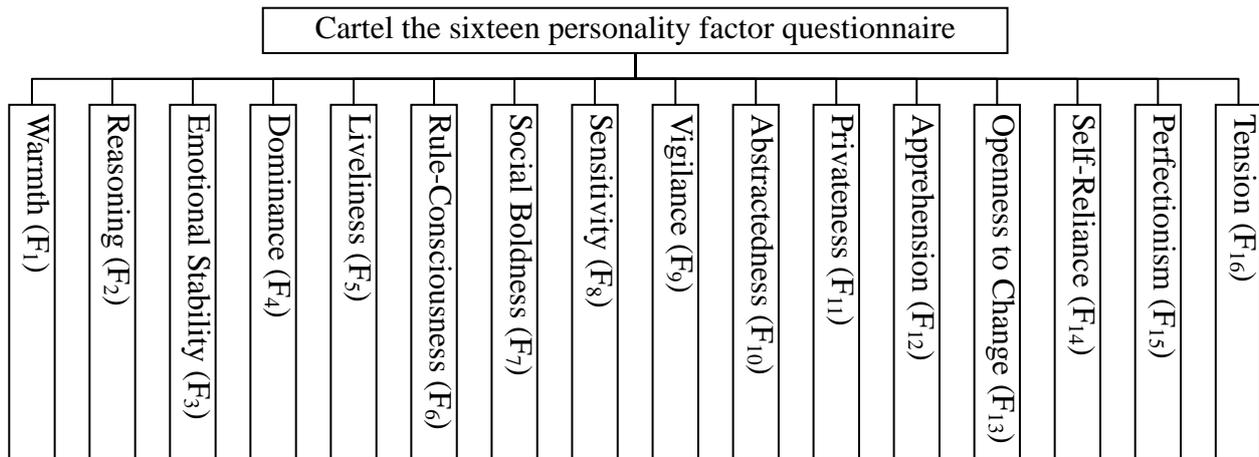


Fig. 1. Raymond Cattell's 16 personality factors

Warmth (F1). Descriptors of Low Range: Impersonal, distant, cool, reserved, detached, formal, aloof; Descriptors of High Range: Warm, outgoing, attentive to others, kindly, easy-going, participating, likes people. Reasoning (F2). Descriptors of Low Range: Concrete thinking, lower general mental capacity, less intelligent, unable to handle abstract problems; Descriptors of High Range: Abstract-thinking, more intelligent, bright, higher general mental capacity, fast learner. Emotional Stability (F3). Descriptors of Low Range: Reactive emotionally, changeable, affected by feelings, emotionally less stable, easily upset; Descriptors of High Range: Emotionally stable, adaptive, mature, faces reality calmly. Dominance (F4). Descriptors of Low Range: Deferential, cooperative, avoids conflict, submissive, humble, obedient, easily led, docile, accommodating; Descriptors of High Range: Dominant, forceful, assertive, aggressive, competitive, stubborn, bossy. Liveliness (F5). Descriptors of Low Range: Serious, restrained, prudent, taciturn, introspective, silent; Descriptors of High Range: Lively, animated, spontaneous, enthusiastic, happy go lucky, cheerful, expressive, impulsive. Rule-Consciousness (F6). Descriptors of Low Range: Expedient, nonconforming, disregards rules, self-indulgent; Descriptors of High Range: Rule-conscious, dutiful, conscientious, conforming, moralistic, staid, rule bound. Social Boldness (F7). Descriptors of Low Range: Shy, threat-sensitive, timid, hesitant, intimidated; Descriptors of High Range: Socially bold, venturesome, thick skinned, uninhibited. Sensitivity (F8). Descriptors of Low Range: Utilitarian, objective, unsentimental, tough minded, self-reliant, no-nonsense, rough; Descriptors of High Range: Sensitive, aesthetic, sentimental, tender minded, intuitive, refined. Vigilance (F9). Descriptors of Low Range: Trusting, unsuspecting, accepting, unconditional, easy; Descriptors of High Range: Vigilant, suspicious, skeptical, distrustful, oppositional. Abstractedness (F10). Descriptors of Low Range: Grounded, practical, prosaic, solution oriented, steady, conventional; Descriptors of High Range: Abstract, imaginative, absent minded, impractical, absorbed in ideas. Privatness (F11). Descriptors of Low Range: Forthright, genuine, artless, open, guileless, naive, unpretentious, involved; Descriptors of High Range: Private, discreet, nondisclosing, shrewd, polished, worldly, astute, diplomatic. Apprehension (F12). Descriptors of Low Range: Self-Assured, unworried, complacent, secure, free of guilt, confident, self-satisfied; Descriptors of High Range: Apprehensive, self doubting, worried, guilt prone, insecure, worrying, self blaming. Openness to Change (F13). Descriptors of Low Range: Traditional, attached to familiar, conservative, respecting traditional ideas; Descriptors of High Range: Open to change, experimental, liberal, analytical, critical, free thinking, flexibility. Self-Reliance (F14). Descriptors of Low Range: Group-oriented, affiliative, a joiner and follower dependent; Descriptors of High Range: Self-reliant, solitary, resourceful, individualistic, self-sufficient. Perfectionism (F15). Descriptors of Low Range: Tolerates disorder, unexact, flexible, undisciplined, lax, self-conflict, impulsive, careless of social rules, uncontrolled. Tension (F16). Descriptors of Low Range: Relaxed, placid, tranquil,

torpid, patient, composed low drive; Descriptors of High Range: Tense, high energy, impatient, driven, frustrated, over wrought, time driven.

Mathematical Model on Calculation Weight

There are many ways to determine the weight, the more common is Analytic Hierarchy Process (AHP, Analytic Hierarchy Process), AHP Puzzlers is the judgment matrix [4]. G1 method can obtain the relative importance ratio between the any two targets and no need to construct judgment matrix, and easily calculate the weight value of each index, and if construct this judgment matrix based it, then the obtained matrix must be exactly same, and there is no limit on the number of indicators. This has an assumption that there is a schedule of indicators order by relative importance size when building AHP judgment matrix, it will be lost the basic of infrastructure judgment matrix without this premise. Because there is no clear order relation when constructing judgment matrix, it often produces confusion between the comparison judgment of indicators, especially when the number of indicators more, even be reverse or "recycling killer" phenomenon [5]. To be avoid this phenomenon, this paper empowerment index using G1 method, calculation steps as follows:

Step 1: Identify the important order relationships of indicators. Experts select the most important index among index set as u_1^* with vote or discussion format; then select the most important index among the remain indicators as u_2^* ; In the same way, through $m-1$ selection, the last index as u_m^* . That gets the sort relationship of evaluation index importance, $u_1^* \succ u_2^* \succ \dots \succ u_m^*$. In order to facilitate writing, the ordering relationship marked:

$$V = \{v_1, v_2, \dots, v_m\} \quad (v_1 \succ v_2 \succ \dots \succ v_m) \quad (1)$$

Step 2: Determine the importance level ratio of indicators. The importance level ratio between v_{k-1} and v_k is $r_k, k = m, m-1, m-2, \dots, 3, 2$. The importance level ratio is expressed as follows:

$$r_2, r_3, \dots, r_k, \dots, r_m \quad (2)$$

The value of r_k (the importance of the indicators) as shown in Table 1 [6]. It can be corrected according to the actual situation during practical application.

Table 1. Weight determining reference table of r_k

r_k	Assignment instructions
1.0	Compared with the index v_{k-1} and index v_k are equally important
1.1	Compared with the index v_{k-1} and index v_k are between the equally important and slightly important
1.2	Compared with the index v_{k-1} and index v_k are slightly important
1.3	Compared with the index v_{k-1} and index v_k are between the slightly important and obviously important
1.4	Compared with the index v_{k-1} and index v_k are obviously important
1.5	Compared with the index v_{k-1} and index v_k are between the obviously important and highly important
1.6	Compared with the index v_{k-1} and index v_k are highly important
1.7	Compared with the index v_{k-1} and index v_k are between the highly important and extremely important
1.8	Compared with the index v_{k-1} and index v_k are extremely important

There is the following theorem about quantity constraint of $v_k : v_1, v_2, \dots, v_m$ has the formula(1), then v_{k-1} and v_k must be met:

$$r_{k-1} > 1/r_k \quad (3)$$

Step 3: Calculate the weight coefficient. The weight calculation formula of v_m is [7]:

$$w_m = \left[1 + \sum_{k=2}^m \prod_{i=k}^m r_i \right]^{-1} \quad (4)$$

The weight calculation formula of other indicators is:

$$w_{k-1} = r_k w_k \quad (k = m-1, m-2, \dots, 1) \quad (5)$$

Instance on Index weight Calculation

Step 1: Identify the important order relationships of indicators. After experts to discuss, the important order result is:

Rule-Consciousness ($v_1=F_6$), Reasoning ($v_2=F_2$), Perfectionism ($v_3=F_{15}$), Dominance ($v_4=F_4$), Abstractedness ($v_5=F_{10}$), Openness to Change ($v_6=F_{13}$), Warmth ($v_7=F_1$), Privatness ($v_8=F_{11}$), Sensitivity ($v_9=F_8$), Tension ($v_{10}=F_{16}$), Social Boldness ($v_{11}=F_7$), Vigilance ($v_{12}=F_9$), Emotional Stability ($v_{13}=F_3$), Self-Reliance ($v_{14}=F_{14}$), Liveliness ($v_{15}=F_5$), Apprehension($v_{16}=F_{12}$).

$$r_2, r_3, r_4, r_5, r_6, r_7, r_8, r_9, r_{10}, r_{11}, r_{12}, r_{13}, r_{14}, r_{15}, r_{16} = 1.1, 1.2, 1.2, 1.1, 1.1, 1.1, 1.2, 1.1, 1.3, 1.2, 1.1, 1.1, 1.1, 1.3, 1.2, 1.1$$

Step 3: Calculate the weight coefficient. According the formula (4), can get that:

$$w_{16} = \left[1 + \sum_{k=2}^{16} \prod_{i=k}^{16} r_i \right]^{-1} = \left[\begin{array}{l} 1 + r_2 r_3 r_4 r_5 r_6 r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_3 r_4 r_5 r_6 r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} \\ + r_4 r_5 r_6 r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_5 r_6 r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} \\ + r_6 r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_7 r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} \\ + r_8 r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_9 r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_{10} r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} \\ + r_{11} r_{12} r_{13} r_{14} r_{15} r_{16} + r_{12} r_{13} r_{14} r_{15} r_{16} + r_{13} r_{14} r_{15} r_{16} + r_{14} r_{15} r_{16} + r_{15} r_{16} + r_{16} \end{array} \right]^{-1}$$

$$= \left[\begin{array}{l} 1 + 1.1 \times 1.2 \times 1.2 \times 1.1 \times 1.1 \times 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.2 \times 1.2 \times 1.1 \times 1.1 \times 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.2 \times 1.1 \times 1.1 \times 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.1 \times 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.2 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.3 \times 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.2 \times 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.1 \times 1.3 \times 1.2 \times 1.1 \\ + 1.3 \times 1.2 \times 1.1 \\ + 1.2 \times 1.1 \\ + 1.1 \end{array} \right]^{-1}$$

$$= [1 + 60.2130]^{-1} = 0.0163$$

According the formula (5), can get that $w_{15} = r_{16} w_{16} = 1.1 \times 0.0163 = 0.0180$.

Similarly, we can calculate the weight of other indicators, as shown in Table 2.

Table 2. Weight calculation results on Cattell's 16 personality factors

Indicator Name	Code	Weight	Indicator Name	Code	Weight
Warmth	F_1	0.0640	Vigilance	F_9	0.0308
Reasoning	F_2	0.1339	Abstractedness	F_{10}	0.0845
Emotional Stability	F_3	0.0280	Privatness	F_{11}	0.0582
Dominance	F_4	0.0930	Apprehension	F_{12}	0.0163
Liveliness	F_5	0.0180	Openness to Change	F_{13}	0.0768
Rule-Consciousness	F_6	0.1473	Self-Reliance	F_{14}	0.0216
Social Boldness	F_7	0.0339	Perfectionism	F_{15}	0.1116
Sensitivity	F_8	0.0448	Tension	F_{16}	0.0373

We can see from Table 2, the total weight of the first seven indicators "Rule-Consciousness (F_6 , 0.1473), Reasoning (F_2 , 0.1339), Perfectionism (F_{15} , 0.1116), Dominance (F_4 , 0.0930), Abstractedness (F_{10} , 0.0845), Openness to Change (F_{13} , 0.0768), Warmth (F_1 , 0.0640)" is 71.11 percent. It has a significant effect to focus on improving these seven indicators when increasing students' psychological health.

Conclusion

With the economic and social development and the accelerated pace of life, learning pressure, interpersonal tensions, the employment outlook is bleak, the impact of bad values, poor physical health, more and more kinds of tests and other factors make college students has the growing psychological pressure, so mental health is not ignored [8]. The comprehensive evaluation based on this paper, provides a new means to address the mental health of college students. The advantage G1 method is that without building judgment matrix, and no need consistency test; The computational doubly reduced compared with structuring AHP judgment matrix; G1 method has no limit the number in applications; The calculation is simple, intuitive, and easy to use; There is no limit to the number of elements in the same level; The order relations given full express the will of experts, and the results are fully trustworthy.

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