Motivation of Enterprise Motivation Management Mechanism Based on Neuromanagement

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ABSTRACT

In enterprise management, motivation is an important measure and function. At the enterprise level, material motivation and spiritual motivation often become the main motivation means to employees. In this paper, we mainly use the ERP theory in neuromanagement to study the neural mechanism of internal material motivation and external spiritual motivation to destroy intrinsic motivation effect through stopwatch key experiment. The research shows that internal material motivation is not always able to play a positive role in promoting, and sometimes it may destroy the original intrinsic motivation, which is not conducive to the continuous effect of motivation, while external spiritual motivation can often enhance the motivation management mechanism of enterprises. Based on the achievements of this research, we think that the leaders of enterprises need to flexibly apply two kinds of motivation measures in the motivation management mechanism of enterprises, so as to fully play the positive effect of motivation.

Key Words: Neuromanagement, Electrocorticogram (EEG)Signal, Material Motivation, Spiritual Motivation

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Introduction

For a long time, motivation theory has been a very important part of both management and economics research (Chen *et al.,* 2015). In the management of enterprises, managers regard motivation as an important management function, and deep researches on motivation theory can effectively improve the management efficiency of enterprises (Bianco *et al.,* 2017; Marino *et al.,* 2017; Nã¤Rman *et al.,* 2014; Silvestro *et al.,* 2017; Pascu, 2015; Joldeş *et al.,* 2017). For managers, in order to take advantage of the competition, it is necessary to provide effective motivation to employees, instead of just material rewards. It is a very important problem to how to carry out effective stimulation and maximize the effect of stimulation (Martinent *et al.,* 2014). If the motivation is improper, it is not only a waste to the manpower, material resources and financial resources of the company, but also cannot effectively solve a series of problems such as the brain drain and failure to improve staff's work enthusiasm (Elliott and Lambert, 1999). At present, the enterprise management of China has single motivation mode and lower efficiency, which need to be solved urgently. However, in management science, there are many research achievements on motivation, which mainly focus on the basis of motivation or factors that can arouse and mobilize the work enthusiasm of employees (Sabatino *et al.,* 1994; Murik, *et al.,* 2002) at the very beginning; later, the researches mainly focus on the relationship between intrinsic motivation and extrinsic motivation in motivation and their interaction (Moncef, 2010). In the new century, some scholars began to study

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the motivation problem at the level of neuroscience (Livingston *et al.,* 2005; Mcneny and Zasler, 2017). However, scholars mainly study the motivation from the perspective of enterprise management, lacking quantitative analysis and research, and this paper mainly uses the advanced neural science and technology in the natural science to study the motivation problem and its neural mechanism in the motivation theory, which has certain innovation in the theoretical research.

Neuromanagement

Theoretical introduction

The concept of neuromanagement was first proposed by Professor Ma Qingguo of Zhejiang University in China. Through the literature researches of many international scholars on neuroeconomics, neuromarketing and decision-making neuroscience, he thinks that neuromanagement has integrated many subject knowledge such as neuroscience, psychology and management, and deeply analyzed and studied the problems of economic management (Cassidy and John, 1994). Neuroscience can simulate the economic management environment in the real world under the condition of laboratory, study people's brain activity and thinking process in the face of typical economic management problems and examine human decision-making behaviour and more general social behaviour and human nature through a brand-new angle (Grayand Braver, 2002). The main research fields of neuromanagement mainly include decision-making neuroscience, neuroeconomics, neuromarketing, neurosociology, and other applied researches in such fields as finance, industrial engineering, and the use of information technology (Kennedy *et al.,* 2009). Neuromanagement provides new information analyses, and management issues through the use of neuroscience technology. In management science, information can come from many levels, including industry, enterprise, individual, etc., measure the brain activity of human body through the tool of neuroscience, expand the information source, and make the research of management science produce new development space (Das *et al.,* 1999). In addition, it has long been a difficult problem to measure the information of human controlling factors. Through the study of human brain activity by neuroscience, many variables of subjective factors can be mapped on the results of brain activity, and quantitative measurement of subjective factors affecting individual behaviour by recording and analyzing brain activity has greatly promoted the development of quantitative research of management science (Mccrea *et al.,* 2009).

EEG component in Neuromanagement

With the continuous development of computer and physics technology, the researches and applications of event-related potential (ERP) technology in neuroscience have been improved step by step. ERP technology can accurately measure people's EEG activity in the process of processing information. In the process of individual decision-making, the brain will process all kinds of information from the outside and produce many kinds of brain wave components. Through ERP experiment, the brain wave components can be separated from brain EEG data. The information such as processing time and processing intensity of individual brain can be accurately reflected from each ERP EEG component graph. The most important ERP components are N2, ERN, FRN and P300 (Giacino *et al.,* 1997). In particular, there are many researches on the N2 component in ERP, which can reflect the individual's cognitive processing of external affairs in the early stage. It is a negative-going wave with a peak latency of 200-350 milliseconds, distributed in the central forehead and its associated region of the brain. Error-related negative wave (ERN) mainly appears in the moment of decision-making. Usually, the maximum value appears in the brain forehead region. The ERP component of negative deflection appears after the decision-making is completed about 50-100 ms, and in social cognitive science, ERN mainly reflects the conflict monitoring and cognitive control in the brain. The feedback-related negative wave (FRN) mainly appears in the prefrontal lobe, which is a negative ERP waveform, with the maximum value of about 250-300nis after the result feedback. P300, also known as late positive potential, is mainly used to study the cognitive function of the human brain and draws extensive attention. P300 is very widespread, appearing after the FRN component, with a latency of 300-600 ms.

Research of Influence of Internal and External Motivation on Intrinsic Motivation and Its Neural Mechanism

Internal material motivation

(1) Experispiritual process

In this paper, material motivation are mainly monetary motivations, through an experispiritual study of the influence of the withdrawal of monetary motivation on the original intrinsic motivation of the task. Randomly select 36 people to conduct the experiment and set up a reward group and a control group in the experiment. Each group includes 18 people, each of who carries out three tasks, each of which performs 60 5-second key-press tasks, as shown in Figure 1. In the reward group, the monetary motivation is given in stage 2, that's, the performance reward. The tester could get the reward of 1 yuan if failing to press the key. In stage 1 and stage 3, there is no monetary motivation, that's, the reward is fixed. In all three stages of the control group, there is no monetary motivation, namely, the fixed reward. In this experiment, the stage 2 is designed to adjust variables, so it's essential to observe the difference between the two groups in stages 1 and 3.

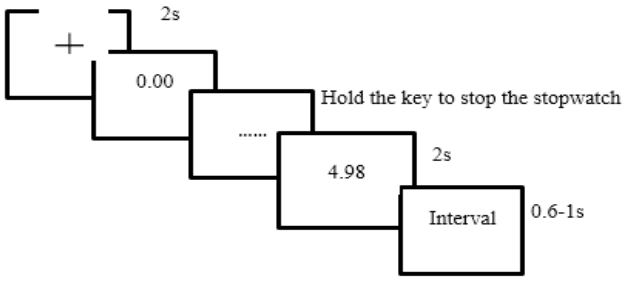

Figure 1. Experispiritual task pattern

Descriptive statistical analysis is performed on the correct number of pressing keys by the two groups in different stages of the experiment, and the specific results are shown in Table 1. The number of pressing keys for different stages of the reward group and the control group is shown in Figures 2 and 3.

Table 1. The correct number of pressing keys at different stages of the two subjects

		Mean	Standard deviation	95% confidence interval	
				Lower limit	Ceiling
The control group	Phase 1	28.752	2.196	24.962	34.063
	Phase 3	37.219	1.617	34.284	40.193
The reward group	Phase 1	27.884	2.152	24.127	32.529

Table 2. The correct number of pressing keys in two experispiritual stages

The experimental stage	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Phase 1	28.926	1.519	26.728	31.836
Phase 3	35.284	1.148	32.438	37.297

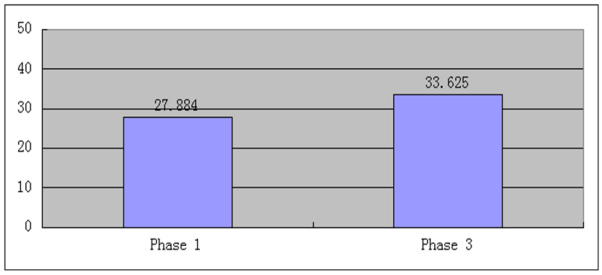

Figure 2. The number of keystrokes at different stages of the reward group

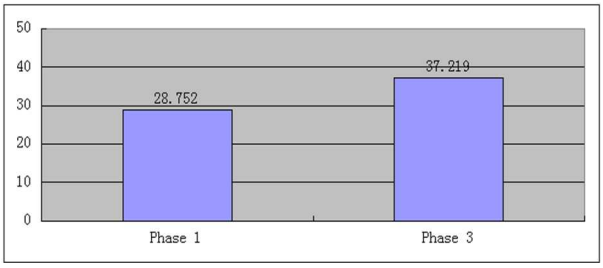

Figure 3. The number of pressing keys at different stages of the control group

In order to explain the differences between the two groups, the correct number of pressing keys by the two groups in stages 1 and 3 is analyzed by 2*2 mixed mixed design variance. Table 2 is the correct number of pressing keys in two experispiritual stages, and it is found that the correct rate of pressing keys in stage 3 is significantly higher than that in stage 1.

(2) EEG data analysis

There are win and loss at each stage for each group. Two components, FRN and P300, are analyzed in this paper.

Generally, the amplitude of FRN is the largest in forehead and central area, and 180-220ms is selected as the time window of FRN analysis. The mean amplitude of FRN is analyzed by 2*2*9*2 mixed design variance. The voltage mean and standard deviation of the FRN under different feedback results are shown in Table 3, and it can be seen that the winning feedback result in the voltage mean is higher than the losing feedback result. Because the FRN is a

Table 3. The correct number of keystrokes in two experispiritual stages

Experimental results	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Win	6.279	0.738	4.627	8.196
Lose	3.824	0.713	2.628	5.254

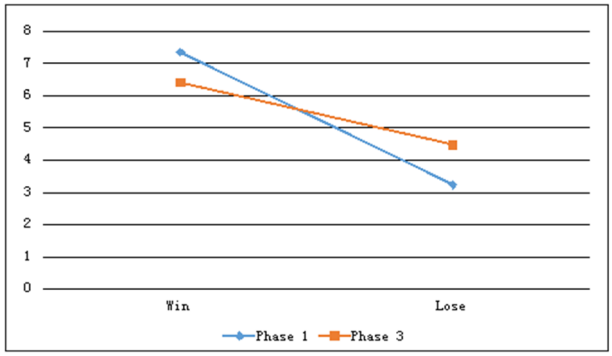

Figure 4. The mean voltage of the amplitude of FRN in the reward group stage 1 and 3

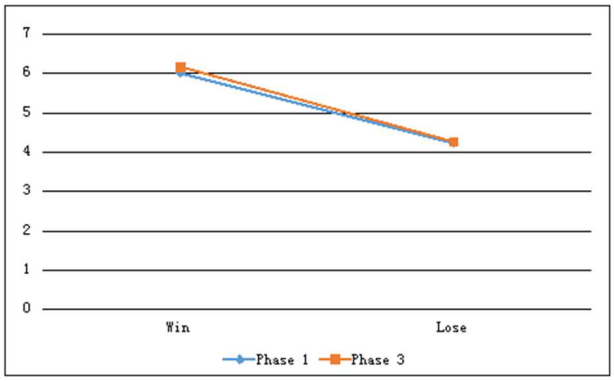

Figure 5. Control group stages 1 and 3 feedback of the FRN amplitude mean voltage

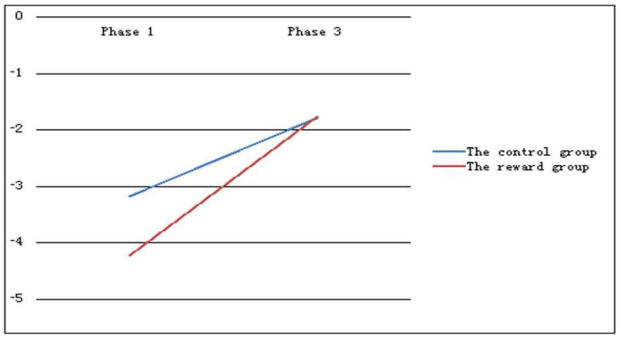

Figure 6. The mean of d-FRN voltages in stages 1 and 3 of the two subjects.

negative-going wave, the amplitude is smaller if the voltage average is larger. Thus, the losing feedback result causes a larger FRN amplitude than the winning feedback result.

In addition, the interaction effect between the feedback results and the different experispiritual stages is obvious. By analysing the differences between the two groups, it can be found that the main effect of the feedback results is significant in the reward group. As shown in Figure 4, in the fixed experiment stage, in both stages 1 and 3, the loss result induces a greater FRN amplitude than the win result.

However, in the process of analysing the control group, it is found that only the loss and win of the feedback result had the main effect. As shown in Figure 5, the result of losing in the control group (4.23μV) induces a greater FRN amplitude than the result of winning (6.01μV), but there is no significant difference between the various experispiritual stages. See Table 4 for the voltage mean standard deviation of feedback FRN amplitude in different stages of the two subjects as shown in Table 4.

Then the difference wave of FRN is statistically analysed. The difference between the two stages of the reward group is greater than that of the control group. The difference wave data is analysed by 2*9*2 mixed design variance. The results show that the main effect is significant in the experispiritual stage, and the stage 1 (-3.17μV) induces greater amplitude of d-FRN than the stage 3 (-1.79μV). The experiment group is fixed, and the effect of the experiment stage and the electrode point is analysed in each group. The results showed that in the reward group, stage 1 (-4.23μV) induces a greater amplitude of d-FRN than stage 3 (-1.77.mu.Y). In the control group, the main effect of d-FRN is not significant in the experispiritual stage. The mean and standard deviations of the FRN difference waves for the reward and control groups in stages 1 and 3 are shown in Table 5. The d-FRN voltage mean variation for stages 1 and 3 for both groups is shown in Figure 6.

The maximum amplitude region of P300 is in the central top region, and 250-350ms is selected as the time window of P300 analysis. 2*2*9*2 mixed design variance is analysed. The results show that the interaction effect between the experispiritual stage and the feedback result is significant. It is found from Table 6 that the winning feedback result induces a larger P300 amplitude than the losing feedback result, and from Table 7, it's found that stage 1 induces a larger P300 amplitude than stage 3 of the experiment.

Table 4. The voltage mean standard deviation of the amplitude of the FRN amplitude at different stages of the two subjects

	The experimental stage	The experimental results	Mean	Standard deviation	95% confidence interval	
					Lower limit	Ceiling
The control group	Phase 1	Win	5.724	1.216	3.198	8.336
		Lose	3.923	1.142	1.729	6.383
	Phase 2	Win	5.837	1.216	3.618	8.338
		Lose	4.172	1.125	1.826	6.239
The reward group	Phase 1	Win	7.326	1.304	4.827	8.837
		Lose	3.231	1.213	0.796	5.629
	Phase 3	Win	6.635	1.169	4.328	8.699
		Lose	4.612	1.004	2.507	6.527

Table 5. The voltage mean standard deviation of the amplitude of the FRN at different stages of the two subjects

	The experimental stage	Mean	Standard deviation	95% confidence interval.	
				Lower limit	Ceiling
The Control group	Phase 1	-1.846	0.728	-3.372	-0.371
	Phase 2	-1.885	0.694	-3.193	-0.499
The Reward group	Phase 1	-4.325	0.732	-5.628	-2.695
	Phase 3	-1.819	0.675	-3.194	-0.442

Table 6. The voltage mean and standard deviation of P300 amplitude of different feedback results

The Experimental results	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Win	12.024	0.952	9.538	13.251
Lose	8.829	0.861	7.156	10.629

Table 7. The voltage mean and standard deviation of P300 amplitude in different experispiritual stages

The experimental stage	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Phase 1	10.985	1.121	8.537	13.256
Phase 3	9.352	0.768	7.698	10.926

(3) Analysis of the results

There is no significant change in the amplitude of the FRN in the control group, while there is a significant change in whether or not performance compensation is given in the reward group. Both FRN and P300 can feed back the results. In the motivation management of enterprises, material motivation is not always able to play a positive role, but sometimes destroy the original intrinsic motivation, mainly because after employees get reward motivation, they will regard material reward as the cause of work, reducing the motivation of liking working itself. Therefore, enterprises should fully consider whether the measures of motivation can have influence on the current intrinsic motivation, so that they can fully play the role of motivation.

External spiritual motivation

(1) Experispiritual process

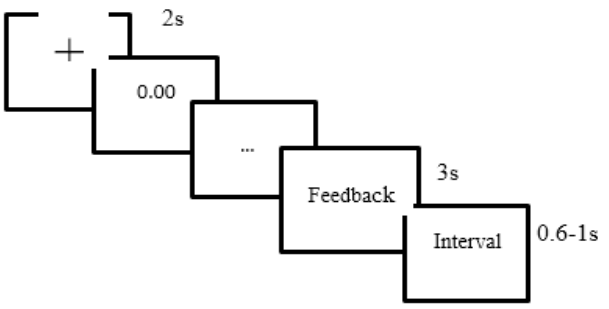

Figure 7. A model of the second phase of the reward group experiment

In reality, in addition to material motivations, the motivation measures of enterprises also include spiritual motivation. In that experiment, control group and reward group are also set up, and the difference is that in stage 2, the reward group can see the key-pressing feedback result of another person in addition to its own key-pressing feedback result, meaning that the situation of social comparison is set as the spiritual motivation, while the control group can only see its own key-pressing feedback result, see Figure 7.

Table 8. The correct number of pressing keys and standard deviation in different experiment stages.

The experimental stage	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Phase 1	29.018	1.429	26.384	31.699
Phase 3	36.745	1.196	34.463	38.925

See Table 8 and Table 9 for the mean and standard deviation of the correct number of pressing keys in different experispiritual stages and the mean and standard deviation of the

correct number of pressing keys in different experispiritual stages of different groups.

Table 9. The mean and standard deviation of pressing keys in different experispiritual stages

	The experimental stage	Mean	Standard deviation	95% confidence interval	
				Lower limit	Ceiling
The control group	Phase 1	29.979	1.832	26.184	33.634
	Phase 3	37.628	1.562	34.627	40.928
The reward group	Phase 1	29.094	1.838	24.196	32.784
	Phase 3	35.483	1.625	32.478	38.629

Table 10. The voltage mean and standard deviation of the FRN amplitude at different experispiritual stages of the two subjects

	The experimental		Mean	Standard deviation	95% confidence interval	
	Stage	Results			Lower limit	Ceiling
The control group	Phase 1	Win	5.925	1.318	3.286	8.596
		Lose	3.874	1.284	1.529	6.528
	Phase 2	Win	5.949	1.096	3.828	8.175
		Lose	4.152	1.254	1.824	6.428
The reward group	Phase 1	Win	6.383	1.361	3.721	8.859
		Lose	5.396	1.295	2.699	7.754
	Phase 3	Win	7.755	1.153	5.527	9.763
		Lose	3.962	1.262	1.706	6.424

(2) EEG data analysis

The mean amplitude of FRN is analyzed by 2*2*9*2 mixed design variance. The results show that in all experispiritual stages of two experispiritual groups, the losing result induces a greater FRN amplitude than the winning result.

In the fixed subjects, 2*2*9 variance is analyzed in each of the two subjects. In the reward group, the main effect of the feedback result is significant. In the fixed experiment stage, the main effect of the feedback result is also obvious, and the losing result (3.724μV) induces a larger FEN amplitude than the winning result (7.125μV). In the control group, the losing result (3.95μV) induces greater FRN amplitude than the winning result (6.34μV).

The results of 2*9*2 mixed design variance analysis of difference wave d-FRN show that stage 1 (-1.292μV) induces greater amplitude of d-FRN than stage 3 (-3.156μV) in the experispiritual stage. The variance analysis is carried out for fixed subjects. In the control group, the main effect of d-FRN in the experispiritual stage is not significant, while in the reward group, phase 3 (-2.838μV) induces greater amplitude of d-FRN than phase 1 (-1.515μV). Table 11 shows the mean and standard deviation of FRN differential wave amplitudes in two groups at different experispiritual stages.

Table 11. The mean and standard deviation of the amplitude of the FRN differences in the experispiritual stages of the reward group and the control group

	The experimental stage	Mean	Standard deviation	95% confidence interval.	
				Lower limit	Ceiling
The control group	Phase 1	-1.838	1.061	-4.028	0.351
	Phase 3	-1.901	0.883	-3.725	-0.169
The reward group	Phase 1	-1.123	1.107	-3.296	1.083
	Phase 3	-3.725	0.862	-5.417	-1.992

The average voltage of P300 is analyzed and 2*2*9*2 variance analysis is performed. The results show that stage 1 (11.285μV) induces greater amplitude of P300 than stage 3 (8.794μV), and the winning feedback (12.023μV) induces greater amplitude of P300 than the losing feedback (7.694μV). Tables 12 and 13 show the voltage mean and standard deviation of P300 amplitudes for different feedback results and different experispiritual phase, respectively.

Table 12. The voltage mean and standard deviation of P300 amplitude of different feedback results

The experimental results	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Win	11.425	0.915	9.547	13.158
Lose	8.838	0.829	7.169	10.624

Table 13. The voltage mean and standard deviation of P300 amplitude in different experispiritual stages

The experimental stage	Mean	Standard deviation	95% confidence interval	
			Lower limit	Ceiling
Phase 1	10.874	1.121	8.926	13.256
Phase 3	9.386	0.752	7.694	10.628

(3) Analysis of the results

In terms of spiritual motivation, the enhancement effect of intrinsic motivation is only reflected in the amplitude change of FRN, but not in the P300 component, and the difference of FRN amplitude is increased in stages 3 to stage 1. This shows that the spiritual motivation can stimulate the intrinsic motivation; enterprises should pay attention to the spiritual motivation, such as praising employees.

Conclusions

(1) The motivation measures of enterprises generally include material motivation and spiritual motivation. This paper studies the neural mechanism of internal material motivation and external spiritual motivation's damaging effect on intrinsic motivation through key-pressing

experiment. In the motivation management of enterprises, material motivation is not always able to play a positive role, and even sometimes destroy the original intrinsic motivation. Therefore, enterprises should fully consider whether the measures of motivation can have influence on the current intrinsic motivation, so that they can fully play the role of motivating.

(2) The difference in FRN amplitude is increased in stages 3 to 1 when the experiment of spiritual motivation is performed. This shows that the spiritual motivation can stimulate the intrinsic motivation, and enterprises should pay attention to the spiritual motivation in motivating, such as praising employees.

Acknowledgments

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