

Core Equations for Psychology

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Abstract In this paper we analyzed the reason for psychology being a disunified theory unlike classical mechanics. We tried to improve the structure of information processing theory by adding a new organ, mental screen, and shown another memory device designed according to a new principle. We introduced three new scientific concepts, mental representation, mental operation and mental force, to describe status of human mental behavior. These three quantities are all vectors as they having magnitude and type and two of them have object. Finally, we built relationships between mental operation and mental force and take them as core equations for psychology to show reason about mental status.

Keywords: *unified theory, reductionism, information processing, cognitive psychology, mental representations*

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1. Introduction

It is a wonderful dream for many psychologists, like Raymond D. Fowler, Allen Newell [1] and Staats, A.W [2], to build a unified theory of psychology and to end the disorganized situation of it. The model kept in their minds is physics. In addition, Newton's classical mechanics is a perfect one. It can describe movement status of a particle or a rigid body by a set of scientific concepts, for example, linear velocity and angular velocity, linear accelerate and angular accelerate, force and moment that are defined upon the concepts of time and spaces. It built a set of core equations that can predict movement status of a particle or a rigid body. These predictions had already been validated by vast test. Why does not psychology achieve this? It neither has a set of scientific concepts nor had found the quite right basic problem for itself. The basic problem for the classical mechanics, the only quite right one, is to build the relation between net force and acceleration. This relation can keep steady. Newton would not build the classical mechanics if he were unaware of this point. Never try to solve other problems, for example, a multy-body problem, before seeking out and solving this basic problem, nevertheless the study will be made vastly more difficult for researchers. Some psychologists made mistakes like that. Considering individuals as a whole thing, behaviorism theory try to build relationship between stimuli and behaviors provoked by it. Unluckily these relations are never steady. How should psychology do as well as the classical mechanics? We think information processing psychology is the most closed to that perfect model among all of psychologies. Luckily it avoided the same mistake made by behaviorists. It divides an individual into four functional organs, center processing unit, receptor, effector and memory device. We are going to improve it in four points. The first, we added

a new organ, mental screen like the screen for a computer. The second, we introduced three new scientific concepts, mental representation, mental operation and mental force. These three quantities are all vectors. They are like velocity, accelerate and net force in classical mechanics. Mental representation has type and magnitude. We take it as the quantity to describe status of human mental behavior. Mental operation has type, magnitude and object. A mental force can cause a mental operation. It has the same type and same object as ones of the mental operation caused by it. It has magnitude too. Mental force from receptor is called receptor force and from memory device is called recall force. Others are called CPU force. Receptor force and recall force create receptor operation and recall operation respectively. This is unlike a computer controlling receptor operation and recall operation by CPU. The third, we built relationships between mental operation and mental force and took them as core equations for psychology to show reason about mental status. We built relationships between mental representation and mental operation too. All these relationships will keep steady. Do not worry about them. They are very simple for dealing with only multiplication. Finally, we design another memory device according to a new principle. New memory device has main root connected by several elements grade 1. Each element grade 1 is connected by several elements grade 2, etc. When a set of mental representations a_1, a_2, a_3, \dots an appear in mental screen all elements grade 1 obtain a different memory strength for mental representation a_1 and element A_1 has the biggest memory strength about a_1 . Here memory strength means that mental representation with big memory strength is not easy to be forgotten and is easy to be recalled. Meanwhile all elements grade 2 gain a different memory strength for mental representation a_2 and element A_2 connected A_1 has the biggest memory strength about a_2 . When mental representations a_1, a_2, a_3, \dots an appear again in mental screen A_1 will be

activated and then A2 will be activated too. Activating A1 is called inducting activation. Activating A2 is called adjacent activation. As mentioned above, recall operation is caused by memory device, is not controlled by CPU. On the contrary, the old memory device of computer is a part of effector. So we can say that computer is an incomplete intelligent body without memory device.

2. Core Equations

2.1. Assumption

Mental representations in mental screen change in a minimum time period called time-lag.

2.2. Mental Representation

Definition: Mental representation defined here means mental representation mentioned in cognitive psychology and displaying strength in mental screen. It has type written in MRT and magnitude written in MRM, making it a vector quantity. Its magnitude or displaying strength is measured in the unit of Sr. We do not give definitions for Sr and other units in this paper. There are many types of mental representations, including external representations and internal representations. External representations include linguistic representations and graphical representations. Internal representations are sorted to distributed representations and symbolic representations. Symbolic representations contain propositional representations and analogical representations. Representation strength means strength of representation displaying in mental screen. The bigger it is the better memory will be obtained by memory device. Representation strength will be measured in the unit of Rs.

2.3. Mental Operation

Definition: Mental operation is processing mental representations. It has type written in MOT, magnitude written in MOM, and object written in MOO, making it a vector quantity too. Type: Receptor operation, recall operation and processing operations. Processing operations, like computer operating system, have many kinds such as rotation, transfer, zoom, divide, compose, replace, query, want, predicate, etc. There are many particulars for some of them and will be shown below. Magnitude of mental operation, operation strength, will be measured in unit of Sr.

2.4. Relationship between Mental Representation and Mental Operation

The relation will be:

$$\text{MRM}(t) = k \cdot \text{MOM}(t) \quad (1)$$

$$\text{MRT}(t) = B(\text{MOT}, \text{MOO1}, \text{MOO2}, \dots) \quad (2)$$

Representation strength MRM is proportional to the operation strength MOM. Type of mental representations MRT is decided by the type MOT and objects of mental operation MOOi. For examples:

MOT= divide1, MOO=abcde, MRT= a,bcde.

MOT= divide2, MOO=abcde, MRT=ab, cde.

MOT= divide3, MOO=abcde, MRT=abc, de.

MOT= divide4, MOO=abcde, MRT=abcd, e.

MOT=compose, MOO1=a, MOO2=bcd, MRT=abcd,

MOT= replace1, MOO1=(He can play football), MOO2=I, MRT= I can play football.

MOT= replace2, MOO1=(He can play football), MOO2=basketball, MRT= He can play basketball.

MOT= query, MOO= (He can play football), MRT= Can he play football?

MOT=want, MOO1= (play football), MOO2=I, MRT=I want to play basketball.

MOT= predicate, MOO1= (football), MOO2=popular sport, MRT=football is a popular sport.

2.5. Mental Force

Definition: Mental force is the effect causing mental operation. It has type written in MFT, magnitude written in MFM, and object written in MFO, making it another vector quantity. Mental force A and B are equal means they being equal in magnitude and in type and in object. Its magnitude is measured in the unit of Sf. Its type and object are the same as ones of mental operation which is generated by this mental force. Type or object of mental force is the same one of the maximal one among CPU force and receptor force and recall force. Magnitude of mental force is equal to subtract middle one from the maximal one. The minimum one is omitted. Receptor force and recall force create receptor operation and recall operation respectively. Please note again this is unlike a computer controlling receptor operation and recall operation by CPU. Calculating mental forces, such as CPU mental force and receptor force, is not a basic problem. Calculating mental force may be complex. However, the basic relationships are always simple. It is enough for us to know the force being 10kg applied on a thing weighted 10 kg when we see it being left by a hand. We never mind how this force is generated by several billion cells and neurons. In the same reason, when a CPU operation happened, there must be a related CPU force. We need not to know how this CPU force is created. Thus mental operations generated by CPU are always simple so we say that CPU, our conscious, is not complex but simple.

2.6. Sobriety Degree of Mental Screen

Sobriety degree of mental screen can influence mental operation. There exist only m+1 value for sobriety degree, 0, 1, 2 ... m. For each sobriety degree there exist a threshold of mental force that can generate a mental operation and there is no any mental operation if mental force is less than this value. For sobriety degree 0 there is no any mental operation happening regardless mental force is how big.

2.7. Relationship between Mental Operation and Mental Force

We can obtain mental operation in current time-lag by the mental force in the last time-lag. The core equations for psychology should be:

$$MOT(t) = MFT(t - T) \quad (3)$$

$$MOS(t) = MFS(t - T).SD(t) \quad (4)$$

The type of mental operation MOT in the current time-lag is the same one of mental force MF in the last time-lag. The magnitude of mental operation MOS in the current time-lag is proportional to one of the mental force MF in the last time-lag and is proportional to the sobriety degree SD of the current time-lag. The mental operation has velocity decided by velocity of the mental force happened. For example, a set of memory forces being big enough create quick recall operations, and the repeat by memory will be very fluent. Otherwise you will speak with difficulty and hesitating.

2.8. Discussion about Special Mental Status

Receptor being strongest: we have to accept very strong noise, smell, or body pain.

Recall strongest: Many things appear in our mind quickly and automatically even if we prevent recalling them. CPU strongest: In thinking.

Dream: no CPU force. Stimulation from environment and recall induced by stimulation appears alternately. For example, cold weather causes dream of being in water, to want to pee creates a dream of seeking WC.

Recall consciously: Type of CPU force is recall, there is a recall operation consciously. There is no receptor force. One is concentrating his attention on recalling and does not mind anything happened around.

Apperceive consciously: One is concentrating his attention on things he apperceives.

3. Principle of Saving Automatically

We will show how this new memory device can save mental representation automatically. We do not know where the mental representations are saved but we can recall them easily.

3.1. Structure of Memory Device

The shape of memory device is like a tree. There are Nro elements called element grade 1 which connected to main root of memory device. There are Nbr elements called element grade 2 connected to each element grade 1. There are Nbr elements called element grade Ng connected to each element grade Ng-1. An element is the senior of its branch elements. An element is the underlings of its senior. A senior will be called direct senior if the grade difference between it and its underling is equal to 1 otherwise will be called indirect senior. There are concepts of direct underling and indirect underling too.

3.2. Calculation of Recall Force

Memory strength for mental representation P saved in element k in any time-lag will be written in $SM(P, k, t)$ and will be measured in unit of Sm. The magnitude of recall force for inducing activation written in RFi is proportional to the magnitude of mental representation appearing in the

mental screen and is proportional to the memory strength of this mental representation in element k. Ci is the coefficient for inducing activation.

$$RFi = Ci.SM(P, k, t).MRS(t) \quad (5)$$

A adjacent activation will only happen if memory strength in both elements reach a threshold level. The magnitude of recall force for adjacent activation written in RFa is proportional to the memory strength of mental representation P1 in element j and is proportional to the memory strength of mental representation P2 in element k. Ka is the coefficient for adjacent activation.

$$RFa = Ka.SM(P1, j, t).SM(P2, k, t) \quad (6)$$

If there are two probabilities of inducing activation and of adjacent activation for a mental representation then it will be called double activation and the magnitude of recall force will be:

$$RF = RFi + RFa. \quad (7)$$

Recall force will be zero for an element if it is impossible to be activated by inducing activation or adjacent activation. A mental representation saved in an element can enter the mental screen by and only by inducing activation or adjacent activation. An inducing activation is always generated by same metal representation saved in the element and appearing in mental screen. Instead an adjacent activation for an element is always caused by its direct senior. Formula of recall force will be different for memory devices with other structure and principle. The problem to design a perfect memory device is open. However, there are only two kinds of recall force, inducing activation force or adjacent activation force.

3.3. Fake Memory and True Memory

Mental screen is a hub connecting all other functional organs. A mental representation in mental screen can come from memory device or receptor. In contrast, a mental representation in an element of memory device comes only from mental screen. There is only one element being activated in any time-lag. An element with no memory strength for any mental representation will obtain an increment of memory strength about a mental representation when it appears in mental screen. This is called primary memory. Memory strength of an element about mental representation 'A' will be reduced if there is another mental representation 'B' in mental screen. This is called memory scouring. It will be called memory reset if memory strength about mental representation 'A' becomes to zero. Saving a mental representation 'A' is called fake memory if the element with this mental representation has never been activated. Saving a mental representation 'B' is called true memory if the element with this mental representation has ever been activated. Readers must have experience in all these situations.

3.4. Rules for Activation and Memory

3.4.1. Multy-Address-Storage-Rule

There is a normal address for any mental representation to be saved. Normal addresses for a first one of a set of

mental representation appearing in mental screen are all of elements grade 1. Normal addresses for the second one of the set are all of elements grade 2, etc. There is an activating address for any mental representation to be saved. Activating address for a first one of a set of mental representation appearing in mental screen is the activated element. Activating addresses for the second one of the set are all direct underlings of the activated element, etc. If a set of mental representation appears in mental screen then an increment of memory strength for each mental representation of the set in its normal address will be:

$$\Delta MS_o(P, j) = Co(P, j).MRS(t) \quad (8)$$

$Co(P, j)$ is the coefficient for increment of memory strength of element j about mental representation P . $Co(P, j)$ will be different for different normal address and for different saved mental representation. This was validated by physiology tests. Different part of a brain shows preference for different mental representation. It was validated too that a mental representation has many saving addresses. Cutting a little part of a brain will not influence the memory of a person and cutting which part is not important.

3.4.2. Activation-Rule

An inducting activation always activates the element with the strongest memory in whole memory device. An adjacent activation always activates the direct underneath with the strongest memory. Any activation keeps only one time-lag and will be closed in the next time-lag. The activated element will obtain a big increase of memory strength as below:

$$\Delta MS_a(P, j) = Ca(P, j).MRS(t) \quad (9)$$

$Ca(P, j)$ is the coefficient for increment of memory strength of activated element j about mental representation P . $Ca(P, j)$ will be very big.

Example: Assume a set of mental representations $a_1, a_2, a_3, \dots, a_n$ appear in mental screen one by one as mentioned above. By Multy-Address -Storage-Rule the normal addresses for $a_1, a_2, a_3, \dots, a_n$ will gain an increment of memory strength respectively. By Activation-Rule a true memory for $a_1, a_2, a_3, \dots, a_n$ will be achieved. Instead, there may be a fake memory for $a_1, a_2, a_3, \dots, a_n$ if they have never appeared in the mental screen again and memory strength for each of them is reduced to zero by memory scouring. Difference of memory strength in different normal addresses for a same mental representation is the key point for saving and recalling automatically. Activated-Rule makes the only one element with strongest memory being activated and lets this activated element to obtain a strong memory to resist memory scouring. So we say that these two rules are the foundation of new memory principle. Adjacent activation will never be caused by the underling element. When ab, ac, ad, ae appear in the mental screen continuously each of them will enter its normal address respectively if there is no any inducting activation. ab, ac, ad, ae appearing in the mental screen repeatedly a true memory will be created. In another situation, ab appears in the mental screen repeatedly then a true memory about ab has been made. When a of ac enters

mental screen, a of ab will be activated and c of ac will enter direct underlings of the element that save a . ac and ab will share the same a . ad, ae will share the same a too. Mental representations sharing the same part make them easy to create new concepts. Babies can learn many things without teacher for this reason. Adjacent activation can create understanding memory. Let 'A' is the meaning for mental representation 'a' and B,C,D,E for b, c, d, e respectively. $a-A, b-B, c-C, d-D, e-E$ had obtained true memory. When the set of mental representations 'abcde' enters mental screen one by one 'ABCDE' will be recalled respectively and 'aAbBcCdDeE' will appear in mental screen. Thus understanding memory 'aAbBcCdDeE' will be generated. Take language learning as an example. Language learning begins from letters then words and finally whole sentences. After obtaining basic materials understanding memory is possible and then efficiency of memory will has a big progress. In contrast, there will be a very bad efficiency of memory. This is why we do not understand a strange language and cannot remember it. It will be the same situation for image representation and other mental representations. This is why one cannot recall the things that he experienced before three years old. In the famous example of psychology, Mr. MB saw many things as a blur in the several days after his obtaining sight suddenly. He had no understanding memory for these images.

3.5. Formula for Memory Strength

Formulas of memory strength for an element j with mental representation P in any time-lag will be:

$$MS(j, P, t) = \sum Ca(P, j).MRS(t) + \sum Co(P, j).MRS(t) - \sum Co(Pk, j).MRS(t) \quad (10)$$

Here $\sum Ca(P, j).MRS(t)$ is the memory strength gained by activating if there is an activation in element j and $\sum Co(P, j).MRS(t)$ is the memory strength obtained by element j being as a normal address. $\sum Co(Pk, j).MRS(t)$ is the memory strength generated by memory scouring of other mental representation Pk .

4. Discussion

Scientific theory is a container being able to contain any fact of the discipline. A perfect theory of psychology must explain all phenomena in psychology in a uniform logic and no any phenomena breach the law of this theory. In addition, it is better to describe phenomena in psychology with equations for a theory of reductionism.

Any complex status of human mental behaviors or any strange things appearing in our minds, will be considered as mental representation. Complexity of calculating the receptor force, recall force and CPU force can contain complexity of perception, memory and conscious respectively. As mentioned in understanding memory, environmental provoke is complex but we can only receive part of it. Mental representations will not be very complex. Mental representations may not be detected but they exist certainly. We can feel them by introspection. We will survey more by useful devices in the future.

The aim of this paper is to do three things, introducing new concepts, building core equations and giving principle of saving automatically. All other non basic problems should not be mentioned in this paper but in the future ones. The basic problem for building classical mechanics is giving relation between net force and acceleration. Most of mechanics specialists are not clear about this point. We are able to do the things that classical mechanics can do. Actually we did. We gave core equations for psychology. Classical mechanics neither tries to nor does it have the ability to solve problems such as finding a force applied or a problem of multi-body before basic relations are built. Psychology neither tries to nor does it have the ability to solve problems such as giving predication before basic problems are solved.

For causal relationship, all mental representation come from three kinds of mental operation, receptor operation, recall operation and processing operations. Who can give the fourth kind? No one! It is impossible that a pattern appears in a computer screen if it does not come from a monitor or is not recalled from a file or is not produced by a special program or is not drawn by an operator. In the same reason, it is impossible that a mental representation appears in our minds if it does not come from our percipience or is not recalled from our memory or is not processed by mind. Surely we can add it to our theory if we can find the fourth kind of mental operation. No any real change happens to our theory. Three kinds of mental operation are caused by three kinds of mental forces. This is the relationship between action and effect. That is the thing reductionism ought to do.

We can use computer simulation to explain our theory. For simple, we can limit mental representation within simple patterns. More complex patterns and more kinds of mental representation, but the principle keeps the same. Several things, such as memory device with different memory strength, pattern inputting with strength, pattern displaying with strength, are not difficult to be simulated by software. It is difficult to simulate CPU force. Sorts of it are simple but we do not know which kind of CPU force will happen in a given time-lag. It can be solved by

software like but being simpler than specialists system. Actually the task of it is much simple than one faced by specialists system.

There is no any reference about core equations for psychology for no one giving any paper about it. But some psychologists want to build unified theory of psychology so we list some references about it.

Scientific studying is guessing puzzles offered by god. Ideas shown in this paper is my answer to the god's puzzle in psychology. There may be an other perfect one. The ea-rlier it appears the better.

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List of Abbreviations

MRM: Magnitude of mental representation
 MRT: Type of mental representation
 MOM: Magnitude of mental operation
 MOT: Type of mental operation
 MOO: Object of mental operation
 MFM: Magnitude of mental force
 MFT: Type of mental force
 MFO: Object of mental force
 SD: Sobriety degree
 RFi: Recall force for inducting activation
 RFa: Recall force for adjacent activation
 MS: Memory strength

References

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