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Mushin in Martial Arts and Insights from Neuroscience

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Abstract

Mushin or no-mind in martial arts is discussed in the well-known writings of Takuan Soho. Some of the common explanations of *mushin* includes as "flow", ego-less movement, fluidity, awareness without conscious thoughts, global awareness and so on. But somehow these explanations are not entirely satisfying as they do not explain the paradox in the writings of Soho. We review some results from neuroscience for a possible explanation and that the dorsal and ventral pathway of vision and motion provides a plausible and logical explanation for no-mind.

Keywords : no-mind, *mushin*, *wuxin*, human visual system, visuomotor control, dorsal visual stream, ventral visual stream, blindsight, zen, martial arts

Introduction

Mushin is a state of the mind that practitioners of Zen Buddhism and Daoism attempt to achieve. To achieve mushin the mind is to be free from attachment (Suzuki, 1949), a state whereby one's mind is not occupied by thought or emotion. The terms derived from two kanji characters meaning "without mind", also sometimes as "*no mind*". It is also termed as "*no-mindness*". However, *mushin* is not only a term used in Buddhism or Taoism, it is frequently applied in martial arts as well. It is sometimes considered to be the summit of martial arts practice. In this brief essay, we will propose a scientific explanation for the term *mushin* as used in martial arts.

Mushin in Martial Arts

Takuan Soho wrote one of the most famous collection of articles on *mushin* in martial arts. This is collected in a famous book called *The Unfettered Mind* (Soho, 2012).

Takuan wrote:

> *"If your mind leans in the directions of these thoughts, though you listen, you will not hear; and though you look, you will not see. This is because there is something in your mind. What is there is thought. If you are able to remove this thing that is there, your*

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mind will become No-Mind, it will function when needed, and it will be appropriate to its use"

The passage seems full of paradoxical statements. This is often relegated to as one of those mysterious Eastern sayings. How can we understand this?

In Finnigan et al (Finnigan & Tanaka, 2010), he wrote that Takuan admonished against thinking. He said, do not think but just act. According to them to practice *mushin* is not to put your mind anywhere. In their article, they explained that if your mind is fixated on things such as the opponents leg movement or the distance between the tip of the opponent's *shinai* to your chest, etc., then you would not be alert to possible dangers or opportunities. Secondly, they explained that when you are taken up by a thought, your responses will be slowed down. This sort of reflective thinking, focusing on a single thing, and consciously forming an action delays your action and response. So *mushin* is fluid mind that responds without thinking and that is not detained by reflective thoughts. However, how it is to be achieved cannot be explained as this would require one to breakout from the no-mind state.

In *Budo – the Martial Ways of Japan* (Bennett, 1999), it was said that when the warrior has "nothing in his heart and be translucent as a mirror", he will achieve *mushin*, or the state of "*no-mind*". Even though the term *mushin* is used in ancient martial arts ("*kubodo*"), its purpose is not to reach the state of Zen enlightenment (pp.101).

Taisen Deshimaru, a Japanese Sōtō Zen Buddhist teacher, who founded the Association Zen Internationale, wrote (Deshimaru, 1982) in response to a question on how to choose the technique of attack:

"*There is no choosing. It happens unconsciously, automatically, naturally. There can be no thought, because if there is a thought there is a time of thought and that means a flaw.*

For the right movement to occur there must be permanent, totally alert awareness, of the entire situation; that awareness chooses the right stroke, technique and body execute it, and it's all over."

He further elaborated, "*Think-first-then-strike is not the right way. You must seize upon suki*[b]*, opportunity*."

How can you be aware, yet not think first, unless awareness is not thinking?

In a journal article (Fabian, 2001) the *mushin* state is said to be when the mind is unruffled, imperturbable, unattached and unfettered. This mastery is achieved through rigorous training and spirit forging (*seishin tanren*, in Japanese) by overcoming one's own fears and weaknesses so that every response is unhesitating and appropriate.

Minoru, in his book, *Kendo - Its Philosophy History and Means to Personal Growth* (Kiyota, 2009), wrote that *mushin* refers to an altered state of consciousness, a state of mind that is free from ego and not moved by external distractions. In this state, the body and mind will function most efficiently. The ego is tamed so that external distractions will not sway the mind. *Mushin* is realized through strenuous practice over a long period of time.

In *Zen in the Martial Arts*, Hyams (Hyams, 1979) wrote about how Bruce Lee discussed *mushin* with him. Lee was quoted as saying, "when mushin functions the mind moves from one activity to another, flowing like a stream of water and filing space". This is when the actor is separate from the act and no thoughts will interfere with action. The action is unconscious, free, and uninhibited. This state is achieved through practice until it became automatic, without

[b] *suki* means gap or opportunity

thought, without conscious effort. The mind in a state of 'flow'. It was further explained that when you try to make a conscious effort to improve, that very thought impedes the flow, and mushin disappears as the mind blocks.

This idea of flow is similar to the idea of being in the zone. This state is being described as a mental state of being fully immersed and focused in an activity. It is characterized as an intense experiential involvement in moment-to-moment activity. Csíkszentmihályi (Csikszentmihalyi, 1991) described 'flow' as the state of mind when consciousness is harmoniously ordered, and they want to pursue whatever they are doing for its sake.

One of most mentioned experience of flow is the complete focus of attention on the task at hand. The flow experience is so self-absorbing that there is not enough attention to consider other things leading to the loss of self from the rest of the world. It is of "becoming one flesh" (pp. 63). It is not a loss of self-consciousness but rather a loss of consciousness of the self. Time also does not pass in the usual way; it becomes faster or slower.

It is also claimed that martial arts are a specific form of flow. It is claimed that a martial artist has reached a flow state when the movement is made without having to think or reason. The mind and body are transformed into "one-pointedness of mind". It just seems to mean that the practitioner is in intense focus and concentration that the sense of time and self is lost.

In the book, *When Buddhist Attack* (Mann, 2012), the notion that *mushin* is an instinctive reaction is considered to be wrong. This notion is found in many written descriptions. A fighter with instinctive response is easily defeated because his reaction is easily predictable. He considered mindfulness and no-mind to be two sides of the same coin – the mindfulness of *mushin* is complete awareness without the shackling of conscious thoughts. He offered that "*Mushin* is not thoughtlessness, but a state of awareness without thoughts becoming carried away, caught up in a stream of consciousness." It is free from mental activities that hinders fluidity of thought.

Keenan wrote, in *Spontaneity in Western Martial Arts* (Keenan, 1989), that the Samurai Zen practice of *no-mind* is the absence of thought that interferes with a spontaneous and creative responses. He speculated that it is the blend of Indian notion of *no-mind*, the abandonment of discriminative thinking with the Chinese Taoist focus that formed this Zen notion in martial arts.

In this short review, most characterize *mushin* as a sort of global mindfulness that is not concentrated to any particular thoughts or objects. This fits into the flow idea of self-absorption as well. However, if it is a kind of mindfulness, how do you reconcile that is *no-mind*? Another frequent idea of *mushin* is that it is somehow a kind of practiced fluid spontaneity in which there is no thinking and no reflecting. And if it is a kind of no-thinking, how can it respond to the unpredictability of combat?

Re-read the first quotation from Takuan at the beginning of this section. How do these proposed explanations illuminate the passage above? Does it illuminate the paradox? Perhaps we can offer a clearer and more logical explanation with the help of science.

Before we can offer an insight on to this, we need to make a diversion to neuroscience.

An Incursion into Neuroscience

We see so that we can distinguish objects of the external environment. On the other hand, vision also guide our actions and movements in the world. This seems like two different demands on our visual system. In the first instance we require a visual system for recognizing and categorizing objects of the world that gives us our conscious visual experience. On the other hand, we require a visual system to aid our movement and interaction with objects. This system may not necessarily require our conscious effort, but it has to be quick and accurate.

The idea of having two visual systems – one for recognizing objects and another for guiding movement - in our brain may seem absurd. The idea that we have two visual system operating at the same time, and that the visual system of our visual experiences is not the same system that guides our movements in the world, is, in fact, well supported by neurophysiological evidence.

In 1909, the Hungarian neurologist Rudolph Balint (Moreaud, 2003) described a patient who had difficulty in reaching and pickup up objects but had no issues in recognizing objects. He could see the objects perfectly well, but when asked to pick up the object, he would grope around in the general direction missing the object by inches. Balint named this disorder 'optic ataxia'. Patients with this disorder have damaged parietal lobe in the brain. The man could point correctly to different parts of his own body with his eyes closed, so this is not a motor problem or difficulty in moving his arm. This patient suffers from a visuomotor disorder that prevents the ability to utilize visual information about the location of the object to coordinate the movement of the arm.

Perenin and Vighetto (Perenin & Vighetto, 1988) tested patients with optic ataxia on their ability to reach out and insert their hand into an open oriented slot. These patients missed the slots altogether and misjudged the orientation as well. Yet they are able to say what orientation the slots are in. They are able to see and note the orientation of the slot but yet unable to make movement to reach out and orientate their hands. In general, optic ataxic patients have problems in directing their actions to visual targets in space and have trouble accommodating for object size and orientation but they have no problem distinguishing them when asked. This is a problem in visuomotor coordination and not a problem in spatial perception. In engineering terms, this may be viewed as disconnect between the optical sensors for size, shape, orientation, location, etc. and the actuators that control movement.

When we reach out to grasp some object, we unconsciously orientate and calibrate our hand, fingers, and thumb to match the orientation and size of the object. Our hand and fingers automatically adopt the final posture before we make contact. The information required for the hand posture is visual, but the posture adopted is unconscious. This was demonstrated by Jeannerod (Jeannerod, 1986). She showed that the separation of the finger and thumb unconsciously correlated to the size of the object along the trajectory of the reaching motion.

In Hu et al (Hu & Goodale, 2000), a somewhat similar experiment was performed using 3D virtual objects. The participants were shown a projected virtual 3D target block (marked by a red spot) and was either asked to reach out and grasp it or indicate the size using thumb and finger. Accompanying the target block is another block that is always 10% wider or 10% narrower than the target block. The companion block is to induce a size-contrast illusion effect. The participants consistently judged a target block paired with a large companion as smaller than the same target when it was paired with a smaller block. However, when they reach out to grasp the block, the hand posture matched the real size of the block regardless of the companion block size. In other words, the perception is affected by size-contrast, but the visual control of action is not. This indicates that perceptual coding of the scene does not influence the visual coding of size in visuomotor control of movement. In other words, the visual input to visuomotor movement is different from perceptual vision.

However, the calibration of the finger-thumb grasp size will fall prey to the size-contrast illusion when a delay is inserted between viewing and initiating the grasp movement. The delay interrupted the real-time computation of the visuomotor system and reverted to perceptual system. This is because we pick up things without thinking about the object's details. However, if this unconscious act is interrupted, we will have difficulty with the action.

In an experiment (Goodale M. , Milner, Jakobson, & Carey, 1991) a patient, Dee, who has damage to visual areas in the brain, was asked to match the orientation of a card at her hand to

an oriented slot that is visually presented in front of her. The slot could be rotated to different orientations. She was asked to manually rotate the card at her hand to match the orientation of the slot in front of her. She was not able to orient the card to match the slot any better than random guessing. However, when the experiment was modified to allow her to reach out and insert the card into the slot, she performed as well as any visually sighted person.

Dee has damage to visual cortical areas in the brain due to carbon monoxide poisoning. She was unable to identify objects by shape or form, can't read words or recognize faces, drawings, or photographs of everyday objects. Objects seems to run into each other and not separated from background. But she had no difficulty in picking up everyday objects despite not being able to name or recognize them.

In informal tests, Dee was able to walk around an unfamiliar environment with obstacles placed in her path. She was able to walk confidently without tripping over any obstacles, she effortlessly lifted her foot to avoid obstacles that are an inch or higher (up to 15 inches). She was able to estimate the height of the obstacles well as she lifted her legs clear of the obstacles.

In the Ebbinghaus illusion, two circles of the same size are perceived to be of different size because they are either surrounded by circles of smaller or larger sizes. The perceptual system is vulnerable to all kinds of optical illusion that is hard to overrule because it is not under conscious control. These are thought to be shortcuts taken by the perceptual system to understand and make sense of a pictorial scene.

Experiments (Haffenden & Goodale, 1998) were conducted to test if the scaling of the grasp was influence by the Ebbinghaus illusion. It was found that the grip aperture was not influenced by the illusion but varied according the actual size of the disk. Since then other perceptual illusions have been tested and in nearly all cases the illusions have little or no effect of the grasp dimensions.

Misjudgments caused by perceptual errors can create serious errors for visuomotor control of your actions and movements, for example, you misjudged the size and distance of any object you are trying to reach. Because the visuomotor system is largely isolated from the perception such errors are avoided as these experiments have shown. Pictorial cues do not provide accurate metrics that is required by the visuomotor pathway.

In an extension of the experiment, a delay was introduced between viewing the scene and initiating a reaching movement. When this happened the correlation between grasping size with actual object size disappears because the delay interrupted the visuomotor processing real-time pathway.

In an experiment by Creem and Proffitt (Creem & Proffitt, 2001), they presented volunteers with a series of tools with handles such as toothbrush and screwdriver. They were asked to reach out and pick up these objects whose handles are turned away from them. Nevertheless, when they reach out to grasp the object, they still grabbed the handle even it is a not so comfortable posture. However, if they were asked to recall words previously learned, they would still be able to grasp the object deftly but ignoring the handle. It would seem that in the process of recalling words, they overloaded their cognitive processing and was unable to process the functional semantics of the objects. The processing of words interfered with the recognition aspects of the object but the grasping action function as normal.

In 1982 Ungerleider and Mishkin (Mishkin & Ungerleider, 1982) presented a convincing argument that the visual system is partitioned into two separate system, one along the dorsal pathway that goes to the top of the brain in the posterior parietal area, and the other ventral pathway that goes to the bottom and sides of the brain (inferior temporal cortex). These two pathways are now called the dorsal and ventral streams. They arrived at this conclusion by summarizing experimental evidence from primates. The evidence came from mostly lesion experiments on primates and single cell-recording of the neuron. Monkeys with lesions in the

temporal lobes will have difficulty in recognizing objects but did not have visuomotor problems. On the other hand, lesions on the dorsal stream will cause them to mis-reach and fumble when reaching for food. The monkey is unable to pry food out of narrow slots at different orientations. The ventral system is what we used for perception, and the dorsal system is used for visuomotor control of movement. Newer research (Goodale & Milner, 1992) have refined the initial findings but generally the two systems still hold true.

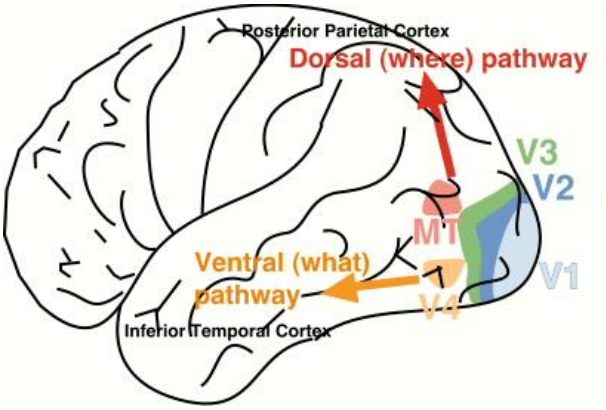

Figure 1. Dorsal and ventral pathway (Source: http://www.uwosh.edu/departments/psychology/Vreven/Lab/Images/brain.jpg)

The reason for a two-system architecture is because the computational demands for both systems are different. Visuomotor module requires computations for actions to be metrically accurate and reliable. This information has to be coded in the metrics of the real world, i.e. actual size, location, and motion. Running after a deer and throwing a spear at it requires accurate and real time data of the size, location, range, and motion of the deer that needs to be computed quickly and updated continuously. Perceptual vision does not have these demands because it is used to create representations of the world and for us to understand and reason about it

Visual perception and visual control of action depends on different brain systems. The visuomotor system that creates the motion is not perceptible, we have no direct experience of the visual information that is used, and the movement computation is entirely sub-conscious. The dorsal system is not involved in providing any visual representation of the world; it just converts visual information into sensory motor signals for action.

A New Interpretation

Let us review again the work of Takuan Soho (Soho, 2012). Can we now understand it better with our insights from neurophysiology of the visual system? Perhaps we can reinterpret these passages in new a light.

> *"When you first notice the sword that is moving to strike you, if you think of meeting that sword just as it is, your mind will stop at the sword in just that position, your own movements will be undone, and you will be cut down by your opponent. This is what stopping means."*

Earlier it was mentioned that "stopping means the mind is being detained by some matter, which may be any matter at all." The mind not stopping can be interpreted as not using conscious thoughts to enable your movement. This is because eye-motion coordination and movement are not wholly controlled by conscious thoughts. It was already shown by Hu &

Goodale (Hu & Goodale, 2000) that when the unconscious visuomotor action is interrupted or delayed, its motion would deviate from its intention.

> *"If your mind is not detained by it and you meet the rhythm of the advancing sword; if you do not think of striking your opponent and no thoughts or judgements remain; ... the sword that was going to cut you down will become your own, and, contrarily, will be the sword that cuts down your opponent.*

> *"If ten men, each with a sword, come at you with swords slashing, if you parry each sword without stopping the mind at each action, and go from one to the next, you will not be lacking in a proper action for every one of the ten. ... But if the mind stops before one of these men, though you parry his striking sword, when the next man comes, the right action will have slipped away."*

Our visuomotor movements are unconscious and autonomous. They are processed by a separate module in the dorsal system. Any attempt to use the perceptual and cognitive module interferes with the smooth movements of directed action. As discussed earlier, the Creem and Proffitt (Creem & Proffitt, 2001) experiment show that trying to recall a word list would interfere with the reaching movement. So "stopping" here means attempting to applying cognitive processes to the movement, when in fact it works perfectly fine without the extra load of cognitive processing. Overthinking or delaying the motion will interfere with the dorsal visuomotor system and disrupts the movement.

> *"If the mind stops with the sword with which a man is going to strike you, there will be an interval, and your own action will be lost. But if in the interval between your opponent's striking sword and your own action you cannot introduce even the breadth of a hair, your opponent's sword should become your own."*

> *"The non-stopping mind is moved by neither color nor smell."*

The above passage suggests the continuity of motion can be broken or interrupted by thoughts or by deliberate time delay. When that happens, the motion will be disrupted. If you hesitate and let the perceptual system take over, your judgement can be fooled by the lighting, angle, and speed. But if you let go of trying to see, the movement will be accurate.

> *"If he puts his mind in his own sword, his mind will be taken by his own sword. If he puts his mind in his own intention of not being struck, his mind will be taken by his intention of not being struck."*

There is no necessity to verbalize your thoughts, movement, strategy, or target. All that is required is to allow the intention to appear, like you are reaching for a cup, and it will move with natural ease.

> *"The No-Mind is the same as the Right Mind. It neither congeals nor fixes itself in one place. It is called No-Mind when the mind has neither discrimination nor thought but wanders about the entire body and extends throughout the entire self.*
> *The No-Mind is placed nowhere. Yet it is not like wood or stone. Where there is no stopping place, it is called No-Mind. When it stops, there is something in the mind.*

When there is nothing in the mind, it is called the mind of No-Mind. It is also called No-Mind-No-Thought."

The ancient explorers of the human psyche called it the *No-Mind*, it is actually quite an apt name for it. Sometimes it is interpreted as being spontaneous or go with the flow. Sometimes it is interpreted as not thinking about other ideas and focus on your singular task. But these interpretations do not provide a strong logical explanation of why it works. Being spontaneous or going with the flow seems like a natural explanation but by itself does not explain anything. Therefore, the dual processing theory of vision provides strong explanatory power.

We suggest that the *no-mind* refers the dorsal visuomotor module of the brain. This module processes and computes the eye-hand movement autonomously. The module computes the range, location, speed, etc. of the target from the visual input and directs the hands or limbs to target at real-time. Any perturbation of the computation with cognitive thoughts would interfere and delay the movements. Therefore, in order to make a perfect strike, it is best to let the autonomous visuomotor system take over. However, this does not mean it will automatically be perfect, the system still needs to be trained in action. Consequently, when training in action, you learn to trust your dorsal visuomotor modules, your *no-mind*.

Re-read the passage that was introduced earlier:

"If your mind leans in the directions of these thoughts, though you listen, you will not hear; and though you look, you will not see. This is because there is something in your mind. What is there is thought. If you are able to remove this thing that is there, your mind will become No-Mind, it will function when needed, and it will be appropriate to its use"

The above passage now seems to be a clear description of the autonomous dorsal visuomotor module. However, without the explanation of science behind it, it seems unintelligible and impossible to understand.

And here is the final advice:

"Completely forget about the mind and you will do all things well."

Conclusion

Our review of the neurophysiology has uncovered the veil behind the writings on *mushin* that has not been previously considered. This intersection of science and martial arts that was previously considered to be in the realms of philosophy can now be seen in a different light. This could serve as an example that ideas and writings that is previously thought to be pre-scientific has actual scientific basis that has not be previously recognized. This probably arose because of the gap in culture, science and language, and also the obscurity of the subject matter.

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