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the supremacy of the vestibular sense

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by Michael Cheikin

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This paper was originally written in 1982, on a typewriter. In converting it to electronic form, I chose not to edit it. While my writing style has improved since then, this important discovery was a product of my consciousness at that time. Therefore I chose to leave the expression of that consciousness as it was.

**Introduction**

In this paper, I will demonstrate that the vestibular sense, the sense of movement in space, deserves to be, and logically needs to be considered a separate sense in itself. In so doing, I will be correcting an oversight laid down by Aristotle, and which has been propagated, with its limitations, in the body of scientific knowledge since that time. As the purpose of science is to differentiate natural phenomena into its components, and to describe the relationship between the components (ideally in a causal fashion), by not granting vestibulation the status of a separate "letter", our conceptual "words" and conceptual "grammar" in the perceptual sciences has been limited.

The "method" that I will use will be experimental and analytical; I have attempted to free the major arguments from any dependence upon empirical "data", as doing so would limit the validity of any conclusions made. I will therefore base my arguments upon the most common of experiences. Indeed, if the reader does grant validity to my arguments, which concern the way in which science conceptualizes the class of senses, the same arguments can be used to show that we probably have eight to ten separate senses. Many gaps in our understanding of perceptual processes, and our theories of consciousness, can be explained by this oversight, and I will devote a final section to applications of these concepts, "applications" being the test of the power of a theory.

One concept that needs to be addressed at this point is the use of the word "sense", as opposed to "percept". The distinction between these words is fuzzy, varying with context and author. However, I do not intend to address this problem here. Hopefully, my arguments will circumvent this issue, and perhaps may add insights that will help clarify these definitions. I will refer to "sense" and "perception" in their most common usages, i.e., that a sense is a measure of something outside the mind, be it light, smell, or the palpitations of the heart; and that perceptions are the way these senses are available to (perceived by) consciousness, granting some distortion due to memory, learning and psychological states.

**Definition of the Sense**

"Vestibulation" is the sense of movement through space, mediated by the semicircular canals in the inner ear. It is the sense of change in position with respect to the earth's gravitational field. Vestibulation is intimately involved with the laws of inertia--it is designed to detect changes in inertia, or, on the other hand, a lack of change. Furthermore, as the sensory organ is constantly under the force of gravity, this pull towards the earth's center acts as a constant reference point. Indeed, our heightened sensitivity to movements with or against gravity, compared to movements parallel to the earth's surface, demonstrates that this sense does give us information about the external environment.

Vestibulation is often included in the sense of "kinesthesia", the sense of movement, off-handedly referred to as our sixth sense. However, kinesthesia, which I will define as the sense of muscle and joint position and motion, is not the same as vestibulation. The sensory organ for vestibulation is in the inner ear, while for kinesthesia the sensory apparatus are located in the muscles, tendons and joints (and perhaps some contribution from the skin). In addition, vestibulation is not only intimately involved with movement; it is also intimately involved with vision and audition. So, to include vestibulation with kinesthesia, or to say that it merely "contributes" to kinesthesia, is as fallacious as to include it with vision.

To clarify another point, vestibulation is not the same as "the sense of balance". The ability to balance involves a coordination between the vestibular and kinesthetic senses--fine changes in the tone of the postural muscles in response to changes of the body's relation to gravity. For example, in the

training of dancers, an art that requires the most extreme precision in balance, the dancer must be taught to use the head (vestibulation) and body (kinesthesia) as one. Though there is a neurological relationship, though they contribute to each other (as vestibulation and vision also do), they do not work as one functional unit.

Indeed, upon this word "contribution" rests the issue of whether vestibulation is indeed a separate sense. Does vestibulation merely contribute to vision, kinesthesia and audition, or is it a separate sensation, as separate as any of the other senses to which we grant separateness? My demonstration will rely upon showing that the sense can be perceived in a pure, separate form, and that the sense has the same characteristics as the other phenomena which we call senses.

### **The Pure Sense of Vestibulation**

Vestibulation is actually composed of two sub-modalities (as color and shape are two sub-modalities of vision). These are the senses of linear motion through space, and circular (rotatory) motion. This distinction is consistent with the structure of the semicircular canal. More importantly, both submodalities are experienced daily in their pure form.

The linear sense can be felt while ascending or descending in an elevator. This is apart from any associated noises or vibrations. Indeed, some people are very sensitive to this experience, while others might need practice before they can appreciate this sensation in its pure form. The linear sense can also be felt when moving parallel with the earth's surface, but is less pronounced. An example of this would be to close the eyes during a very smooth, fast car ride.

The rotatory sense can be felt by simply spinning around with the eyes closed, and then coming to a quick stop. Surely these spinning sensations are not dependent upon the motion of the arms or legs, or any other kinesthetic (muscle-joint) input.

Many childhood games involve immersion in this sense. Amusement park rides, such as the roller coaster, the whip, even the ferris wheel with the eyes closed are means of experiencing this sense in the pure form; perhaps they have evolved to help master the sense. The "fear of falling", one of the most powerful instincts, does persist into adulthood. Perhaps such mastery is essential for development. More on this later.

Furthermore, a deficit in the pure sense, as experienced in stroke, sea-sickness and Meniere's disease, is experienced as much more debilitating than the loss of vision. This argues for the supremacy of the sense.

### **Logical Arguments for Granting Separateness**

Aristotle begins Book III of "On Psychology" (or "On the Soul") with, "We may be sure that there is no sense apart from the five that we have mentioned--sight, hearing, smell, taste and touch...", and then proceeds to discuss the senses in terms of air, water, fire and earth, the elements of that period's science. Some have argued that Aristotle neglected the kinesthetic sense, and the sense of the internal organs, because he was concerned with the "external" senses, those which gave us information about the environment, external reality. However, this argument cannot be used to neglect vestibulation, because, as I have described, the earth, which is as external as a piece of food in the mouth, is sensed by vestibulation (perhaps the moon is also sensed?!).

The main argument, however, has to do with the way science organizes concepts, the way it groups objects and phenomena into classes in which all the elements of the class share similar characteristics. I mean to demonstrate that vestibulation shares all the characteristics that are possessed by "the big five", and that, if anything, vestibulation has more of a right to be called a separate sense than does taste, which is not "separate".

I must again address this distinction between "contribution" and independence. To consider that vestibular "input" merely "contributes" to the visual image, is as fallacious as saying that visual "input" contributes to the sense of vestibular stability. (Indeed, a dancer, when he spins around, must use visual "spot" in order to keep his balance!) The latest craze in the movies supports the counterargument. By

having an object (stars) coming at the viewer on the visual screen, the sense of motion is induced. So, which sense contributes to which? In fact, they are interactive. To say that one is more significant, or is more independent, is to misconceptualize.

Let me further this concept of dependence and independence of the senses. Perhaps one would wish to argue that vestibulation is not an independent sense because it is always associated with other senses. However, I have already demonstrated that the sense can be experienced daily in its pure form. Just because one does not attend to a particular sensation continually (one does not continually feel the clothes touching the skin), does not mean that the sense does not exist. Secondly, and more significantly, this argument of dependence can be better applied to the relation between olfaction (smell) and gustation (taste), long considered separate. However, it is common experience that by blocking the sense of smell, taste is diminished. This is indeed an example of a dependence of one sense upon another--in an asymmetric way. Holding the nose affects taste, but holding the tongue does nothing (except, perhaps, to make the scientist look a little strange!). And yet, we consider these two senses as separate (because we are taught this from our youth). The common experience of their relatedness is not used to say that one is not a true sense, but instead is understood to mean that there is an important reason for the connection. Likewise, the fact that vestibulation is intimately related to vision, kinesthesia and audition, should direct us to pay more, not less, attention to its unique characteristics.

Finally, as a member of the class of senses, vestibulation possesses the characteristics of localization, quantification, memory (we remember vestibular images) and sub-modalities (linear and rotary motion).

### **Further Evidence**

Now that I have hopefully entertained the significant arguments against my thesis, I would like to briefly describe how this discovery was made, as this process provides further evidence of the separateness and supremacy of vestibulation.

My observations began with my study of the relationship of language to the senses--how well language could describe an image from a particular sensory modality. I developed the concept of "linguistic access", which I define as the ability of language to abstract the qualities of a sense from the sense itself. For example, with vision, there exists many words that are abstractions from visual experience. All the various shapes, patterns, colors, reflective qualities, and of course localization and intensity are linguistic abstractions from the sense itself. On the other hand, the sense that developed earlier evolutionarily have much less "linguistic access". For example, with the exception of a few words, such as sweet, sour, bitter, pungent, and salty, it is very difficult to describe the taste of a substance except to say that it tastes like itself. As an example of the difference in linguistic access between vision and gustation in describing an apple, I would visually describe the apple as being red, shiny and round, with a thin brown cylindrical thing coming out of an indentation in the top. A crude description, granted, but infinitely more sophisticated than describing the taste of an apple. Other than saying that it is sweet, and moist, and crisp (which are really borrowed from the taste of touch), the only other way of describing the taste is to say that it tastes like an apple (or that it tastes a little like a pear).

Though this concept of linguistic access needs refinement, it does indicate a further argument for including vestibulation in the class of separate senses. There is such a range of linguistic access between the senses that to exclude vestibulation on the basis of its "vagueness" is fallacious. In an attempt to quantify the linguistic access of vestibulation, I have collected the following terms from everyday linguistic usage, some of which are purely vestibular, while a few have a kinesthetic component (denoted V-K):

- 1)I fell asleep
- 2)I fell in love
- 3)I dropped off to sleep
- 4)I dropped out of school
- 5)I dropped in to visit

- 6)The deal fell through
- 7)My plans are up in the air
- 8)Let me settle down (V-K)
- 9)I am cracking up (V-K)
- 10)I am going in circles
- 11)He is off his rocker (V-K)
- 12)He is off-balance (V-K)
- 13)I'm spaced-out, man!
- 14)I am high, man
- 15)I am feeling low
- 16)I am deep in a depression
- 17)His spirits have lifted
- 18)He is out of his mind
- 19)The gravity of the situation
- 20)I am upset (uptight) (V-K)

Given that some of these examples are better than others, one cannot deny that there is something here (especially if one were to show that this occurs in other languages too). It was this observation that led me to wonder about the significance of the vestibular sense, and its importance. Its profound effect on vision, kinesthesia and audition, the ability to experience it in a pure form, its relation to psychological states, and its sharing all the characteristics possessed by the other senses all are reasons to consider it a separate, and supreme sense in its own right.

### Applications

As the ultimate test of any scientific model is in its application, I will briefly describe how knowledge of this sense can be applied to psychology, the arts and the neurosciences.

### Psychology

From the list of common linguistic expressions, the relationship of the vestibular sense to psychological states can be observed. Indeed, from this observation, one might suggest that every sense has a special relationship to the emotional (affective) system; to coin another term, I do indeed suggest that each sense not only has a "linguistic access", but also an "affective access". I suggest that the vestibular sense reins supreme over the other senses in its affective access (again, what is stronger than a baby's, or even an adult's fear of falling?). As stages of development may be characterized by the mastery of a particular sense, the participation of the vestibular sense in development may fill in some of the conceptual gaps that exist in the psychological models of infancy. I can't help but note that in classic psychoanalysis, the analysand is made to lie down--it is well accepted that this "fosters regression". Knowledge of the vestibular sense provides the specific mechanism for this phenomenon. As a particular visual image may stir the memory, so might a vestibular image (position w.r.t. gravity) foster other memories.

### The Arts

I have long been trying to characterize the various art forms according to which sensory systems they depend upon, and would like to briefly expand upon the observation of the movie effect cited earlier. The relationship between the visual and vestibular senses, again, being reciprocal, the larger the size of the screen on which the objects are coming toward the viewer, the larger the ability to instill a sense of motion. This can explain why seeing a movie on a small screen or TV is not quite as "moving" an experience.

If the central visual field is moving, while the peripheral field is stable, will this have a greater or lesser effect on vestibulation than the converse (central field stable, peripheral field moving)? A survey of the literature has suggested that it is the peripheral visual field that is more involved with the sense of

motion, which is consistent with the observation, that the larger screens have a stronger effect--the larger screen takes up more of the peripheral field.

This ties in to Sergei Eisenstein's montage theory. Briefly, this states that it is the sudden change of image in a film, the fact that two disparate images follow each other (montage) that causes the psychological effect. Indeed, if our organisms are designed to maintain a vestibular and visual stability (in nature, the visual and vestibular environment only changes rapidly in the most extreme of circumstances), then each time a change of visual image occurs (even a change in camera angle), this can be interpreted by the nervous system as a change in the organism's position in space, with some arousal being caused. As an example, the types of movies, or even TV commercials in which the images change rapidly--such as a different view each second--are quite captivating, due to the arousal that accompanies each change.

Movies can sustain interest without any dialogue, and often without plot. A sequence of changing visual images on a big screen, constantly arousing the organism due to the effect on vestibulation, is all that is needed.

The recent innovation in which the audience is surrounded by a series of speakers, even above, enhances this effect by using the auditory senses to also trigger the sense of motion.

This also explains the problem that the modern playwright has, raised in a TV and movie generation, to write for the stage. As the audience's peripheral field, and even the central field never moves (the only things that move are the actors and the curtains), to write for the stage requires a whole different technique.

### Neurosciences

All that was said in the previous two sections applies. However, there is one more important point, which was mentioned in the beginning of this paper. If one grants these arguments even a small measure of validity, then the same arguments can be applied to other sensory phenomena. Is it proper to consider under the sense of "touch", the senses of pressure, pain, temperature, two-point-discrimination, and vibration? What are the logistics of grouping some together, others apart?

The sense of kinesthesia is another separate sense.

Is the sense of the "insides", the viscera, separate?

Would it be helpful to consider the emotions a sense? Very often, "feelings" are described by using other sensory modalities--i.e., love is the sense of inner warmth, relaxation, stability, etc. what qualities of the emotions are truly separate?

What about the "sense of reality"? The "sense of time"?

Finally, is there a three-dimensional sense? This sense can be evoked by a disparity in the visual or auditory stimulation of the two sides of the body. Though vision and audition "contribute" to the three-dimensional sense, perhaps this is a separate sense in itself.

Clearly, these questions need exploration. The answers may fill in many of the gaps we currently have when trying to develop a unified theory of brain organization. Without a clear and distinct sensory "alphabet", our conceptual "words" and the "grammar" of our models will retain the limitations propagated since Aristotle.

FIGURE 1: ORIENTATION AND STIMULATION OF THE VESTIBULAR SYSTEM (PURE X, Y & Z; NOT INCLUDING COMBINATIONS)

