Symmetry and Dance

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DANCE APPRECIATION

A dance is an aesthetic entity existing in the four dimensions of space-time. Different styles of dance have different degrees of concern for the spatio-temporal symmetry of the movements. For example, the communication of a variety of emotional feelings to the viewer has been suggested as a major aim of American Modern Dance (Mazo, 1977,166), and Classical Ballet evolved through a dramatic form with the purpose of narrating a story. However, other styles of dance appear to be concerned solely with the manipulation of abstract patterns in space-time, for example Ballroom Dancing, Scottish Country Dancing, and ballets such as those by George Balanchine.

PERCEPTION

The aesthetic appreciation of a dance is complicated by some curious differences in the human perception of symmetry in space and time.

Time by itself is of only one dimension, so the symmetries possible of a pattern in time are only translation and reflection. If one considers an arbitrary pattern in time, e.g. the rhythm in Figure 1,

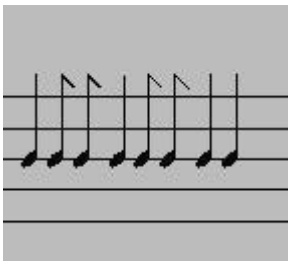

Figure 1
An arbitrary rhythm
tum tiddy tum tiddy tum tum

and then considers the results of appending a translated copy to itself (i.e. repeating it), as in Figure 2, the human ear perceives the repetition easily.

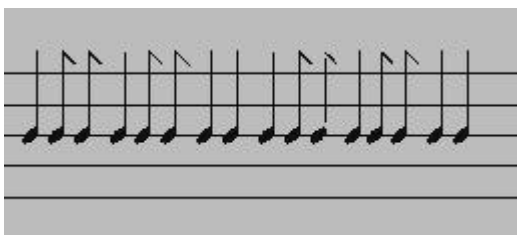

Figure 2

The rhythm repeated
tum tiddy tum tiddy tum tum tum tiddy tum tiddy tum tum

If however, the pattern is reflected and appended to itself (i.e. repeated backwards), as in Figure 3, the human ear has difficulty in appreciating the symmetry.

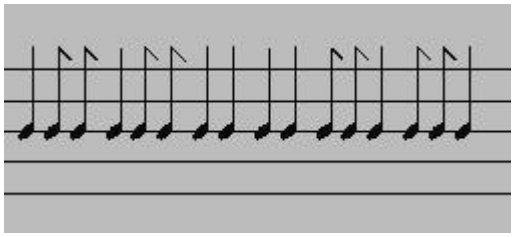

Figure 3
The rhythm followed by its reflection.
tum tiddy tum tiddy tum tum tum tum tiddy tum tiddy tum

The human eye has the opposite facility. This may be seen in Figures 4 and 5, which show a random pattern of dots in a square replicated four times in the four quadrants of the Figures. (Julesz, 1971, 57).

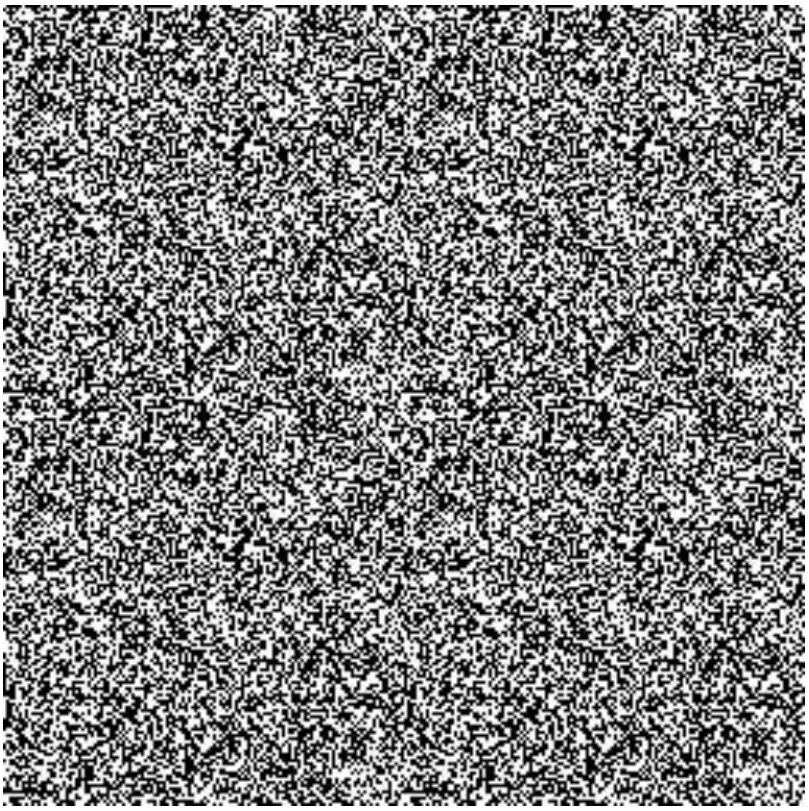

Figure 4
A random pattern translated into the other 3 quadrants.

In Figure 4, the replication is by translation. The human eye only with difficulty perceives the translation symmetry.

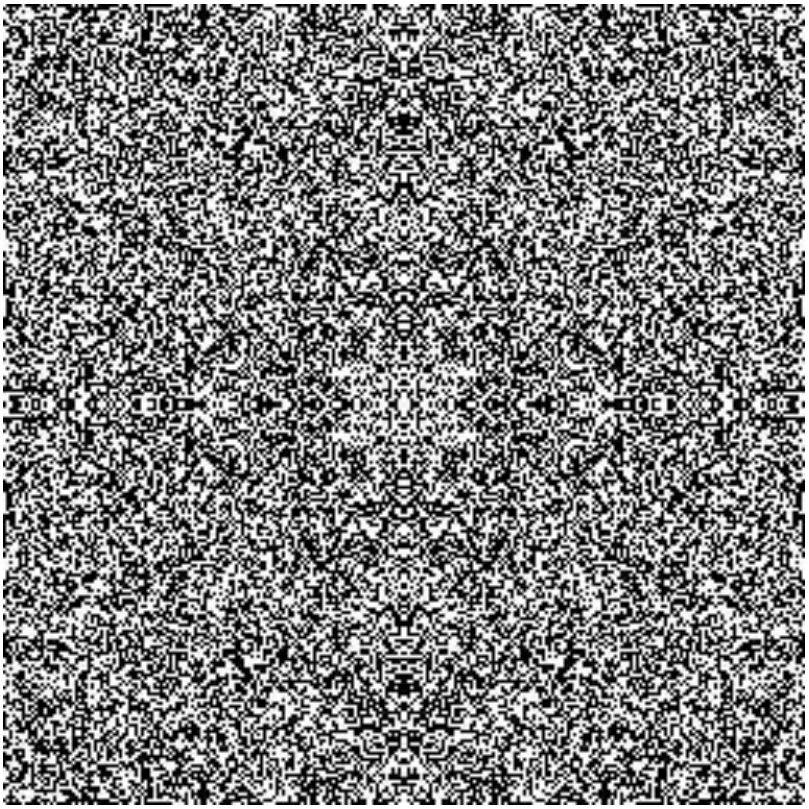

Figure 5
A random pattern reflected into the other 3 quadrants.

In Figure 5, the replication is by reflection. The human eye easily perceives the reflection symmetry.

This difference in the ease of human perception of different types of symmetry in space and time is a great complicating factor for any intending choreographer.

WIDDERSHINS

Although the human form has approximate left-right reflection symmetry across the sagittal plane, human culture associates different meanings to movements done on the right and on the left.

Most people are more adept at performing complex movements using their right arm or leg than using their left. Many professional ballet dancers are more adept at turning to the right than to the left. However, the tour de force of 32 "fouettes en tournant", in the coda of the “Black Swan” Pas de Deux from Petipa's "Swan Lake", while rotating to the right, is normally done on the left leg.

The convention in Ballroom dancing is to progress anti-clockwise (viewed from above) around the dancefloor. This was clearly already evident in the the early 19th Century, when the Viennese Waltz first became popular.

However, in Scottish Country Dancing, circling clockwise, (to the left) is normal ('Deasil). Circling anti-clockwise (to the right) is called 'Widdershins', meaning 'the witches way'. It has

been suggested that the name Widdershins is perhaps a hangover from sun worship (Milligan, 1976, 11).

This connection is at best ambiguous. The direction of rotation of a shadow of a stick in the northern hemisphere is Deasil (clockwise). Sundials were invented based on this concept, When clocks were invented there, it is reasonable to assume that the direction of motion of the hands would be chosen to be the same as that of the shadow of the gnomon of a sundial. But of course, the direction of motion of a shadow of a stick in the northern hemisphere is not caused by the sun rotating clockwise (as viewed from above the north pole) around the earth, but by the earth rotating on its axis in the opposite direction: namely anticlockwise (as viewed from above the north pole). But it is unlikely that this was a consideration in sun worship before Copernicus published his theories. The direction of motion of the shadow of a stick on the ground is the same as that of a projection of the sun onto a plane below one's feet. If we instead project the motion of the sun onto a plane above our head, the sun does indeed appear to move anticlockwise. Maybe the ancients used this projection. But it seems more likely that they would use the motion of a shadow, in which case perhaps the Witches who danced Widdershins were actually part of a pre-Christian rebellian against sun-worship.

Another possibility is that it has something to do with the men wearing swords on their left hip. This was the normal position for a scabbard, as it enabled the sword to be drawn more easily with the right hand than if the sword were worn on the right hip. Thus in an Allemande, the lady would normally be on the man's right to avoid tripping over the scabbard, and it would be reasonable to progress anticlockwise around a room, putting the man inside the circle, to avoid hitting the legs of the audience with the scabbard also.

Another possibility is that, in Ballroom Dancing, circling anti-clockwise around the floor is typically performed paradoxically by the couples doing figures that turn clockwise. Doing these, it is easy to negotiate turning 1/4 of a turn to the left at a corner of the room by underturning one of the figures. To turn to the left while doing figures that turn to the left requires the dancers to overturn a figure, and this requires much greater skill. Figures turning to the right are called 'natural' in Ballroom Dancing, whereas turns to the left are called 'reverse' (Moore, 1951, 48).

Perhaps doing 'natural turns' was considered 'natural', because the turning direction was the same as that of the shadow of a sundial gnomon (in the Northern Hemisphere), and the anticlockwise progression around the floor was a consequence of inexperienced dancers doing these turns.

Or perhaps it was the other way around. Perhaps figures turning to the right were called 'natural' because they enabled inexperienced dancers to progress around the floor Widdershins. Either way, for most of the 19th century, it was considered a 'faux pas' (false step) to do a reverse turn on the ballroom floor because it interfered with the progression of the rest of the couples anti-clockwise around the room.

REPETITION

The ability to recognize an acoustic sequence when repeated in time but not when reflected carries over into dance. Many Classical Ballets, particularly those from the 19th Century, have sequences of steps repeated three or four times. Usually the fourth repetition is modified as an introduction to the next sequence.

Repetition is very important in learning dance and other movements. Studies have shown that coordination and efficiency improve with repetition, even after millions of previous repetitions, (Schmidt, 1975, 45).

Because of the approximate left-right symmetry of the human body, left-right symmetry in dance has a special significance.

A symmetric shape of a human figure has been equated with an emotional feeling of security and repose. As such, it is an anathema to dance: it has been suggested that too much left-right symmetry in a dance is inclined to put an audience to sleep. In order to stimulate and excite an audience, the shapes and movements in a dance should be unsymmetrical (Humphrey, 1959, 51).

Symmetry plays a large part in dance teaching because pupils find it easiest to copy and learn movements while standing behind the teacher. This teaching situation has the problem that the teacher cannot then watch the progress of the pupils. This problem can be rectified by having the teacher face a large wall mirror. Thus many dance studios have mirrors not only for the pupils to see and assess their own movements, but also for a teacher to see the pupils while demonstrating facing away from the class.

Dance teachers working in studios without mirrors frequently demonstrate facing their class, but performing the actions with left-right reversed. This way, the pupils see a mirror image of what they are to copy. The success of this teaching method presumably depends on the familiarity that the pupils have with coordinating their own movements while using a mirror. It also leads to dance teachers who are very adept at performing left-right reversals of movement sequences. This task is much harder than one might suppose; for example few people can do mirror writing with their non-dominant hand.

Another facility developed particularly by teachers of Ballroom Dancing, is that of doing a simultaneous left-right and front-back reversal of a movement sequence. This enables them to derive the lady's part from the man's when a couple is in closed ballroom hold.

DANCE NOTATION

Although only a small proportion of dancers know how to write down dances on paper using notation, most major dance companies in the world now depend on notated scores for the maintenance of their repertoires. Many dance notations have been devised over the centuries (Guest, 1986, vi). All have the problem of reducing a four dimensional manifold to two dimensions. The basic method of compressing the dimensionality is by quantization. This process also limits the detail representable, control of which is then given by the number of symbols used. Any process for reducing the dimensionality must also lose some direct representation of the symmetries inherent in the higher dimension domain. Many notations have extra symbols for representing commonly used symmetry operations.

The two notations in most common use are Benesh notation (Brown, 1986, 79) and Labanotation (Brown, 1984, 9). Examples of these are shown in Figures 6 and 7. These notations are very different in the ways they treat space and time. Benesh quantizes time and Laban quantizes space. Both retain the left-right symmetry of the human form, mapping left-right movements of the body on the left-right dimension of the paper.

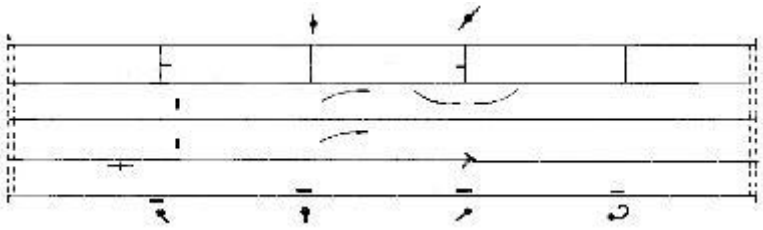

Figure 6
A Fouette-en-Tournant in Benesh notation

The figure is initially standing facing downstage left on a bent left leg, the right leg extended in front. The right leg is swung to the side and then brought in rapidly as the figure rise on point, and then pirouettes.

Benesh uses notional orthogonal projection of the figure onto a frame on a music-like stave. Each frame is embellished with signs representing detail about positions and movements of the various parts of the body. The frames may be viewed as a series of snapshots of the figure in time. Thus each frame has an analogue representation of left-right and up-down movement. It also has an analogue representation of forward-back movement using the foreshortening of fixed length limbs, and a simple binary symbol to show if the foreshortening is due to the limb being in front of or behind the coronal plane.

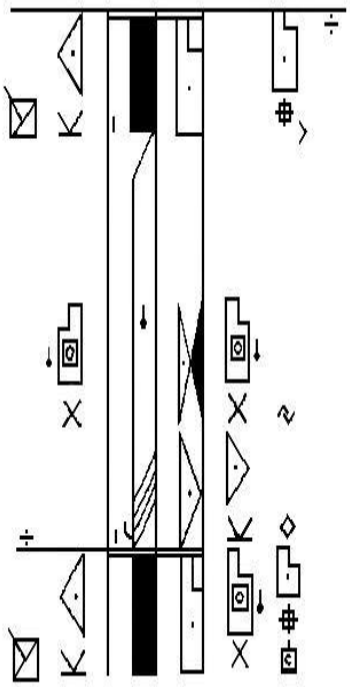

Figure 7
A Fouette-en-Tournant in Labanotation.

Laban notation has time running continuously up the page. The vertical length and positioning of a symbol represent when and for how long the action occurs. Different columns of the vertical stave represent different parts of the body. Additional signs can be added to represent additional detail. The primary division of space is divided into 27

directions: high, centre, low; forward, centre, back; and left, centre, right, thus referencing polyhedron with 48 faces : an icosatetrahedron:

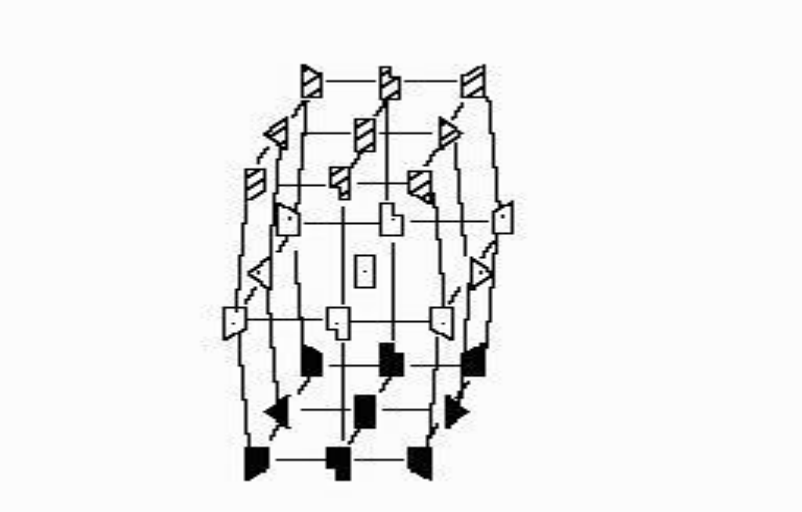

Figure 8
The icosatetrahedral division of space by Labanotation.

Both Benesh and Laban notations have special symbols for copies and repeats of a movement, and for copies and repeats with left-right reversed, and front-back reversed.

DIMENSIONALITY

The mindset of people in various disciplines might be characterised by the dominant dimensionality of thought needed to perform their work. Thus for example, computer programmers typically need to think in one dimensional character strings. Engineers and architects are inclined to reduce everything to two dimensional drawings. Sculptors and surgeons need to think in three dimensions. Four dimensions are the domain of, amongst others, physicists and dancers. One can scarcely conceive of two disciplines in which the participants are further apart in terms of ability to communicate with one another in terms of their working paradigms.

It is tempting to imagine that the study of symmetry might be an element where they can find common ground.