

Changes in Expressive Movement with Actor Training

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Abstract

The theatre has been recognized for centuries as a catalyst for social and political change. More recently, the transformative potential of the acting process has been underscored by proponents of drama therapy and by research in the social sciences. This paper describes differences in physical expression (quantified using motion capture) between actors and controls on a series of open-ended improvisational tasks. The results are consistent with the viewpoint that theatrical experience affects behaviour by increasing awareness of communicative options.

Introduction

Theatrical performance is a complex, multifaceted form of creative expression. The unique potential of the theatre to affect the audience has been recognized since at least ancient Greece, and is at least partially responsible for a longstanding love-hate relationship with political and religious authorities. More recently, the rise of drama therapy, agiprop, and other “applied theatrics”, as well as cognitive studies of the role of rehearsal in atheletic performance, have drawn performance creativity into the mainstream of the social sciences. An emerging theme in such research is the short term and long term impact of theatrical experience on various facets of the behavior and expression.

In the area of personality theory for example, changes in self concept have been attributed to role rehearsal in a conventional theatrical context (Hannah et al., 1994). Hitchcock and Bates (1991) describe acting as a controlled dissociative state with unique potential for resolving role conflicts and for clarifying the dynamics of social interactions. In the context of drama therapy, Valente and Fontana (1991) observe that acting draws clients into a richer tapestry of relationships than they would be likely to encounter in everyday life. When appropriately selected, theatrical scenarios can heighten self awareness and freedom of choice, promoting empowerment through challenges to personal limitations.

Such experiences are not limited to the clinical arena. There is already tentative evidence that actor training is associated with temperamental changes, factors including heightened self-consciousness and sensitivity to nonverbal cues, coupled with a more outgoing, independent attitude (Hammond and Edelman, 1991). Theatre programmes are also demonstrating their “catalytic potential” in the area of childhood education, where they have been harnessed to address deficits in concentration and problem-solving, as well as more general issues of motivation/interest level and degree of cooperativeness (Bidwell, 1990; Schoon, 1997).

¹ This article was developed from material appearing the author's Ph.D. thesis (commercially unpublished), cited in the References section.

Actor Training and Physical Expression: Theatre of course has long been recognized as a life-changing process by theatre makers themselves. Here however, the focus is typically not on temperament or scholastic ability per se, but on psychophysical growth, especially the communicative potential of the body in motion (Hawkins, 1991)². To date, the topic of somatic awareness as a tool for creative expression is rarely addressed by conventional psychometric or scholastic tests, yet sophistication of nonverbal response may ultimately prove to be a key factor in understanding the ancillary social and cognitive benefits associated with the acting process. (Eriksson, 1995).

In light of this, a doctoral project was initiated under the aegis of the *xHCA* programme at the University of Malta to investigate changes in personality (primarily nonverbal expression) with theatrical experience³. Motion capture equipment was chosen as the most suitable means of documentation for several reasons: (1) Subtleties of physical behavior are more suited to objective documentation rather than self-reports; (2) Kinematic recordings reduce the bias from reliance on assessments by expert witnesses; and (3) Digitizing the results introduces the possibility of generating summary profiles (for use in feedback or analysis), or even quantifying group differences with respect to specific aspects of presentation.

Objective

To compare the physical presentation of actors and controls during a series of open-ended (improvisational) tasks, and to characterize the differences using motion capture equipment. As a working hypothesis, it was anticipated that the participants with a background in the theatre would spontaneously utilize a greater expressive “domain”, as defined based on key themes in the performance literature (postural adjustments, tempo, use of space, etc.)

Participants

A total of 50 unpaid volunteers between the ages of 18 and 35 were recruited for this study (25 actors and 25 controls). There were no significant differences between the groups with respect to age, sex, height, weight, or arm length. The actors recruited all had a background in amateur or professional theatre, with an average of 8 year's experience (1 to 17 years). 21 were currently rehearsing at least once per week; 6 also had a background in dance, and 1 in martial arts. None of the controls reported any theatrical experience, although 1 had been a cheerleader, and 2 had a martial arts background.

Equipment

² Relevant here are performance anxiety and expressive range, observational learning and behavioural repertoire, and the procedures for eliminating stereotypical response (Grotowski, 1968).

³ *xHCA*, which stands for “Questioning Human Creativity as Acting”, is a unique interdisciplinary venue for performance research, which brings together specialists from a range of disciplines to study the work of the actor from a multidisciplinary perspective. It has been largely subsumed by the E-MAPS (European Masters in Performer Studies) programme.

The kinematic data was recorded using a V-Scope 100 system from Eshed Electronics. The device (an ultrasonic monitor with supplementary IR tracking and thermistor adjustment) is capable of generating simultaneous 3DOF recordings of two markers affixed to the body of a single participant within a circumscribed performance space. Signals were emitted from small plastic buttons sewn into a set of specially designed Velcro bands worn over the right hand and shoulder respectively. During the recording sessions, these signals were picked up by receivers positioned at ceiling level, and were shunted to a PC outside the recording area for processing by proprietary software. Sampling was conducted at 22 Hz throughout the investigation. The basic configuration is shown in Figure 1.

Procedure

Participants were recorded on an individual basis with only the experimenter in attendance. Sessions began with a short written introduction to the study and to the concept of expressive movement (physical improvisation). It was explained that while the behavior of the right hand was the focus of the recording, any action during the session was acceptable, provided that two rules were followed: (1) Feet were to remain at rest in the same position above the floor marker (no traveling), and (2) due to line-of-sight limitations, the right hand was to remain palm downwards throughout the improvisation.

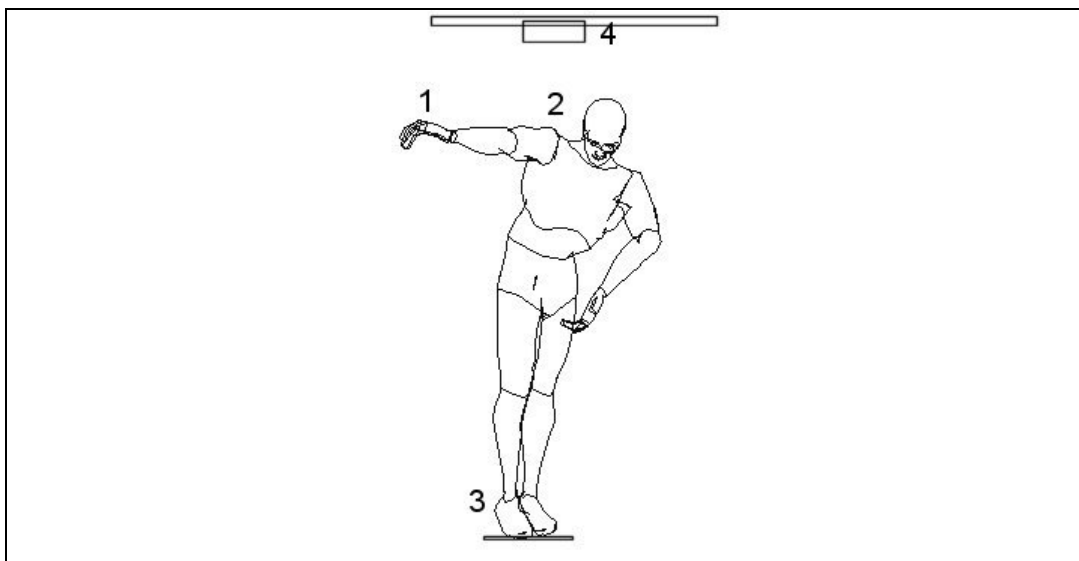


Figure 1 Motion trackers are secured to flexible bands above the right hand (1) and right shoulder (2). The participant stands above a fixed floor marker (3) and the movement of trackers is recorded by ceiling based equipment (4).

The Velcro anchor bands for the emitters were then fitted as tightly as possible over 1 layer of street clothing, and the participant was guided to stand comfortably above a reference grid.

A card with a single open-ended movement theme (to be explained below) was presented to the participant, who was asked to respond immediately through the medium of physical action. Sampling began as soon as the card had been read and returned, and continued for 1 minute, at which point the

participant was asked to stop the improvisation. The next card (theme) was presented, and the procedure was repeated. The order of the trials was randomized with the exception of the warm-up exercise (first card).

Movement themes: A total of 13 open ended physical tasks were utilized for this experiment. The content, drawn primarily from the work of the choreographer and movement theorist Rudolf Laban, was intended to elicit contrasts of positioning, tempo, and forcefulness (Appendix A). In addition, the wording was sufficiently flexible to accommodate a variety of movement styles including concrete gesture (“*pushing heavy furniture*”), abstract form (“*slowly and flexibly*”), and emotional response (“*violent*”).

Analysis

The data files were processed to eliminate artifacts (primarily from occlusions), and then analyzed with respect to four basic behavioral measures. The description of these markers and the rationale for their selection are as follows:

i) Relative movement of shoulder and hand (“Posture-Gesture Ratio”)

Writers from Laban to Grotowski have noted that in comparison with hand movements, spontaneous shifts of posture tend to be constrained within a fairly narrow range circumscribed by cultural expectations, personal habits, and temperament. This tendency is only exacerbated by the stress of performance, which can lead to a relatively stiff overall presentation, coupled with an exaggerated use of the hands (Grotowski, 1968; Lamb and Watson, 1979).

While movement of the right hand was specifically mentioned in the recording instructions, other physical action was not proscribed, and it was hypothesized that the “somatically aware” volunteers (the performers) would spontaneously incorporate more postural shifts and other activities extending beyond hand gesture. To capture this difference, and bearing in mind the limitations of the recording equipment, a simple “posture-gesture ratio” was derived by calculating the average range-of-motion of the shoulder tracker, dividing this by the corresponding value for the hand tracker, and averaging over the 13 trials.

ii) Tempo variability

An appreciation for the expressive impact of tempo is a recurring theme in the performance literature (Gordon, 1987; Barba & Savarese, 1993). From Stanislavsky onwards, tempo has been recognized as a fundamental aspect of presentation, inextricably linked to the externalization of psychological states. In the context of physical improvisation, awareness of tempo would presumably be reflected foremost in a richer variety of movements and phrases, in contrast to reliance on simple, repetitive gestures.

The first step in quantifying tempo variations was to derive velocity profiles from the raw hand tracker data. Velocity was converted to speed, and the data for each DOF of hand movement was processed to yield a “coefficient of

variability” (technically standard deviation over mean). Averaging these values provided a single variability estimate for each trial and, from there, for each participant.

iii) *Fluidity in trunk-limb positioning*

Moving on to spatial awareness, it seemed reasonable to expect the actors to take more advantage of the total available reach space, one aspect of which would be flexibility in trunk-limb positioning. To quantify this behavior, arm length was divided into 10 equal intervals or “bins”. Profiles of inter-tracker (shoulder/hand) distance were analyzed to determine the number of bins with more than minimal activity during each trial. Tallying these bins and averaging over the 13 trials then provided a single fluidity measure.

iv) *Overall use of available space*

In daily life, hand gestures typically fall within a limited zone to the left or right of stance, at an elevation between chest and waist level. Yet this represents only a fraction of the movement potential afforded by the *kinesphere*, the overall zone of reach-space centered on the body and extending above the head and below the knees, as well as behind the torso.

To quantify awareness of this potential, a breakdown of the movement profiles was conducted based on a 27-zone system outlined by Bartenieff & Lewis (1980). In the first step, reach-space was partitioned into bins defined by low/medium/high (vertical), left/middle/right (transverse) and forward/middle/back (coronal)⁴. Profiles of arm movement were analyzed to determine the total number of bins traversed by the hand during each trial. Finally, the results for all 13 trials were averaged to give a single indicator of spatial usage (ave. #bins out of 27) for each participant (Figure 2).

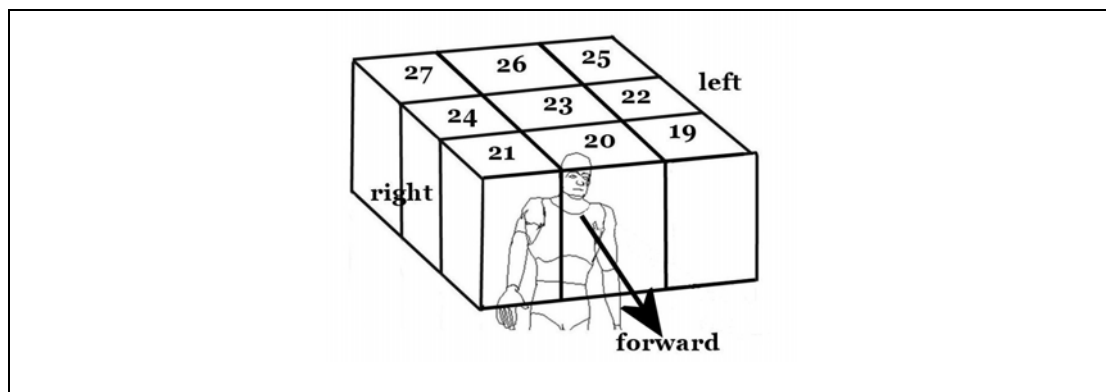


Figure 2 Partial overlay of 27-box partitioning scheme, used for quantifying the utilization of reach space. The image shows the highest vertical layer of 9 boxes.

Results

⁴ Boundary points were calculated using biometric data including height and leg length.

Summary values for the four indices of expressive range are shown in Tables 1, 2, 3, and 4.⁵

Table 1 Relative Movement of Shoulder and Hand

Ratio of Volume (Shoulder Activity) to Volume (Hand Activity) ⁶ (Averaged for 13 Trials)	Actors 6.73% Controls 2.78%
Significance	t-test for independent groups with unequal variance, $t=-2.64$ $p=0.006$ (one-tail) Significant at .05 level

Table 2 Tempo Variability

Coefficient of Variability (Speed) ⁷ (Averaged for 13 Trials)	Actors = 1.11 Controls = 0.979
Significance	t-test for independent groups with equal variance, $t=-3.57$ $p=.001$ (one-tail) Significant at .05 level

Table 3 Changes in Trunk-Limb Positioning

Active Shoulder-Hand Intervals (Max. 10) (Averaged for 13 Trials)	Actors = 6.4 Controls = 5.7
Significance	t-test for independent groups with equal variance $t = 2.58$ $p = .007$ (one-tail) Significant at .05 level

Table 4 Overall Use of Available Space

Active Zones of Reach Space (Max. 27) (Averaged for 13 Trials)	Actors = 8.3 Controls = 7.1
Significance	t-test for independent groups with equal variance $t = 2.19$ $p = .012$ (one-tailed) Significant at .05 level

Discussion

Significant between-group differences were noted on all indices. Further, the directionality supported the hypothesis that a theatrical background heightens awareness of communicative options, at least with respect to certain types of physical behavior:

- i) Range of motion at the shoulder relative to hand was clearly more pronounced for actors than controls, suggesting a greater mobility of posture.
- ii) The speed profiles were more variable for the actors, suggesting less reliance on repetitive actions.

⁵ The results in Tables 2 and 4 were calculated from the hand tracker recordings (actors=25, controls=25). The indices in Tables 1 and 3 were inter-tracker comparisons. The greater sensitivity to occlusions (hand passing over the shoulder) reduced the number of available profiles (actors=21, controls=20).

⁶ Defined separately for the shoulder and hand as the volume of an ellipsoid with axes set to $SD(x,y,z)$.

⁷ $SD(\text{speed})/AVE(\text{speed})$, calculated separately for each orthogonal component and then averaged.

- iii) In terms of available reach-space, the actors took a more fluid approach to separation of shoulder and hand.
- iv) They also utilized more of the kinesphere for their hand movements.

Looking at the results as a whole, and drawing an analogy with the visual arts, one could say that the palette of the actors was broader than that of the controls. While expressive range does not equate in and of itself with either sophistication or artistic merit, the results are congruent with the notion of performance as a transformative process. Specifically, the theatre affords unique opportunities to expand beyond everyday persona and to engage in a variety of "extra-daily" behaviors (Barba & Savarese, 1993). It would not be surprising for such experiences to be reflected in a more sophisticated approach to physical expression, and thus amenable to objective analysis.

In reviewing this study, it is acknowledged that the potential for generalization is circumscribed by the relatively small number of participants, their heterogeneous backgrounds, and the subjective approach to the selection of variables. A first step towards validation is presented in Appendix B, but is no replacement for feedback from choreographers, directors, and other movement theorists regarding the relevance and accessibility of the data. Larger sample sizes would help to establish the robustness of the contrasts, and the inclusion of additional groups would be useful for addressing rudimentary questions about the etiology of the differences observed⁸.

In terms of applications for subsequent projects, I see two natural extensions of the objective profiling concept, one research-based and one pedagogical:

- i) *creativity research*: At *xHCA*, the work of the performer is viewed as a single instance of creative production. Yet the ephemeral nature of physical expression has always limited it as a subject of investigation. Objective assessment of key behavioral markers opens up possibilities for integrating performance studies with more general issues in creativity research such as the relationship between skills building and production (Weisberg, 1993); the role of intrinsic versus extrinsic reward (Collins & Amabile, 1999); and the impact of thinking style on productivity (Torrance & Rockstein, 1988).
- ii) *individualized instruction*: The procedure illustrated here would be easily adapted to the longitudinal study of an individual participant over a series of recording sessions. In the context of a master class for example, an analysis of this type could form one component of an interactive learning environment (Denny, [hypertext 1](#)). Such a venue would ideally provide seasoned performers with new insights into their own movement habits and untapped expressive potential. At the same time, directors and educators would have an opportunity to evaluate the efficacy of relaxation training, guided imagery, observational modeling, and other issues of relevance to curriculum design.

⁸ The contribution of stage fright for example could be at least partially controlled by comparing actors to professional musicians or others comfortable with performance in front of an audience.

Conclusion

This study has identified specific contrasts in nonverbal behavior (approach to physical improvisation) as a function of acting experience. The results are consistent with the hypothesis that a background in theatrical performance enhances somatic awareness with respect to key aspects of nonverbal presentation. Given the importance of body language as social behavior, these findings may ultimately prove relevant to understanding subtle psychological and scholastic gains stemming from interpersonal communication (Dupont, 1992; Erikson, 1995).

The use of motion capture equipment in the performance context has become ubiquitous in recent years, with for example the seamless integration of computer-generated characters in motion pictures and video games. Application of this technology as a tool for the assessment of creative movement is less common, and there is no denying that it places unique demands on both researchers and participants alike. Yet the ability to generate performance records and to subject them to statistical analysis is a powerful tool for documenting changes in expressive technique. Assuming validation and related issues are successfully addressed, this procedure may ultimately find a permanent niche in multidisciplinary settings such as *xHCA*, as an adjunct to conventional performance assessment based on structured observation by choreographer or movement analyst. (Novack, 1988).

Appendix A

Improvised Tasks Presented to Eliciting Expressive Movement

	Hand Movement	Quality of Imagery	Use of Space	Timing	Weight (Force)
1	1 minute warm-up				
2	Like punches in boxing	Concrete	Direct	Quick	Strong
3	Floating like a cloud	Concrete	Indirect	Slow	Light
4	Pushing heavy furniture using one's fist	Concrete	Direct	Slow	Strong
5	Flicking insects off another person's clothing	Concrete	Direct	Quick	Light
6	Flowing smoothly	Abstract	-	-	-
7	Jerky (abrupt)	Abstract	-	-	-
8	Quick, drawing straight lines	Abstract	Direct	Quick	-
9	Slow and flexible	Abstract	Indirect	Slow	-
10	Quick, flexible, and strong	Abstract	Indirect	Quick	Strong
11	Slow and light, and drawing direct lines	Abstract	Direct	Slow	Light
12	Violently emotional	Emotional	-	-	-
13	Expressing elegance	Emotional	-	-	-

Appendix B

An Investigation of Validity

On completion of the recordings, the internal consistency of the results was investigated by using a subset of the actors and controls to predict the group affiliation of the remaining participants. In this procedure, a “training set” of 13 actors and 12 controls was randomly selected from the recorded data. A statistical procedure (linear discriminant analysis) was used to derive a formula maximizing between-group differences with respect to the four previously outlined measures of expressive awareness. This formula was then applied to the remaining “testing set” of 12 actors and 13 controls, to evaluate its robustness in discriminating between the groups.

The calculations were performed with a freeware statistical package (lindisc.exe). The size of the sample (50) was sufficient for the number of variables (4). The data was checked for normality and equality of variance, and passed after a logarithmic transform of shoulder/hand ratio. Any missing data points were replaced with average values to maximize the number of samples. The results are shown in the following table.

Table 6 Identification of a Subset of Actors and Controls

	Actors	Controls
Identified as Actors	11 (Correctly Classified)	3 (Misclassified)
Identified as Controls	1 (Misclassified)	10 (Correctly Classified)
Success Ratio: $21/25 = 84\%$		

The contrast in the behaviour of a subset of actors and controls on the four expressive measures was thus sufficient to correctly identify the background of 84% of the remaining participants.

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Hypertext References

1. Denny, J. *Virtual Space Harmony: The Value of Rudolf Laban's Theory of Space Harmony as a Means to Navigate a Virtual Stage Environment (VSE)*. Institute for Studies in the Arts. <http://mythos.fa.asu.edu/batson.html> (accessed 2007)

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