INFLUENCE OF BRAIN TYPES ON GOLF SWING COORDINATION

Alfred Finch[1], Jon Niednagel[2], Laura Finch[1] and Gideon Ariel[3]

Indiana State University, Terre Haute, Indiana, USA[1]
Brain Type Institute, Thornfield, Missouri, USA[2]
Ariel Dynamics, San Diego, California, USA[3]

Video analysis was used to evaluate an individual's segmental coordination during a golf swing and the person's brain type was classified using a brain typing inventory with 16 categories. Fifteen subjects with markers placed on selected joints, performed 5 golf swings that were videotaped from an antero-posterior axis along the frontal plane at 60 Hz. Three participants having a brain type on each end of the personality spectrum were selected for film analysis. The golf swing coordinate data were analyzed using an Ariel APAS. The time and maximal angular velocities were calculated for selected joints. The order of joint sequencing was determined for the brain types. Subjects who were brain type A (BCIL/INTJ) were fine motor skilled using a multiple joint, core to hand sequencing and those of brain type B/C (FEAR/ESFP) were gross motor skilled and their golf swing went from hand to core.

KEY WORDS: brain types, golf swing, motor skill coordination, fine and gross motor control

INTRODUCTION: The Brain Type Institute founded by Jon Niednagel has been successfully involved in the brain typing of professional athletes classifying personality characteristics to identify individuals who may be effective as leaders in business or athletes in sport. A Brain Typing Inventory personality questionnaire developed at the Brain Type Institute (BTI) and based on Jung-Myers topologies (Briggs & Myers, 2001), was administered for the purpose of brain typing, and the responses on the 20 question brain type identified the individual's personality characteristics and classified their brain type out of the 16 possible brain types on a continuum. Niednagel (2004) had conducted research on brain typing and brain activity (EEG), and most recently he has examined the influence of genetic code on the association of brain types and the neural control or wiring demonstrated by an individual. The purpose of this study was to examine the segmental sequencing used in a complex sport skill such as a golf swing performed by novices and the influence of the participants' brain type associated with the polar ends of the brain type continuum. Espenschades and Eckert (1967) defined effective motor coordination as when one moves efficiently and the sequence and timing of his motions are well controlled. An analysis of the segmental coordination of proximal-to-distal sequential segmental patterns was conducted by Putnam (1991).

METHODS: Participants in this study were 15 university students (age 23.5 ± 1.2 yr, height 1.65 ± .11 m, body mass 83.3 ± 11.5 kg). Each subject was evaluated by an expert in personality/brain typing using a modified Jung-Myers personality questionnaire (Niednagel, 2010) after informed consent was obtained. The brain typing process evaluated an individual's preferences on four personality dimensions. The four dimensions used by the Jung-Myers questionnaire were extraversion/introversion, sensing/intuition, thinking/feeling, and judging/perceiving while the Brain Type Institute's dimensions were front/back, conceptual, animate, and left/right side orientation. Each individual's brain type was classified into one of the available 16 personality types. Twenty-one body surface markers located according to the procedures cited by Plagenhoef (1971) were attached to each participant on the distal phalange of the third ray for both feet, the navicular bone of both feet, patella of both lower extremities, head of the femur of both legs, acromion processes of both shoulders, lateral epicondyles of both elbows, ulnar styloid processes of both wrists, navicular bone of the left hand, chin, temple, golf club grip, club head heel and toe, and the ball. The participants selected were inexperienced golfers who had played no more than 5 total games in order to examine the motor coordination pattern utilized by novice golfers. After a brief 5 minute warm-up period of light jogging, stretching and 10 practice swings, participants were recorded indoors on a Mondo playing surface with court shoes in a large multi-purpose gymnasium while performing 5 golf swings using a 5 iron provided to each subject to strike a practice plastic golf ball. Video images were collected with a consumer grade Panasonic PV65 3CCD video camera with a framing rate of 60 Hz with a .002 s shutter speed from an antero-posterior axis while moving along the frontal plane. Ideally, a framing rate of 100-200 frames per second would be desirable to record this movement. Kinematic timing and coordination variables including maximal angular velocities of the shoulder, elbow, and wrist were determined. The most typical golf swing for each of the 6 subjects was selected for video temporal analysis and following analysis, their brain types (3-group A, 1-group B, 2-group C) were identified. The x, y data point coordinates were transformed using a 2D DLT into real distances using a calibration cube, and the coordinates were smoothed using a Butterworth 2nd order digital filter with a 8 Hz frequency cut-off selected from visual inspection of the power spectral analyses of the angular kinematic variables to include 95% of the movement phenomena. In order to use two dimensional kinematic analysis techniques, the timing sequencing of the shoulder, elbow, and wrist joints using the maximal angular velocities about the z axis was determined and the corresponding times were identified using the Ariel APASview module for the analysis of the joint coordination. Golf club head velocities at ball contact were determined applying the Ariel APAS impact/relax smoothing module to the interval including 2 frames prior to and including contact and then the corresponding times were also determined.

RESULTS and DISCUSSION: A data table of the maximal joint velocities for the shoulder, elbow, and wrist joints, and time of occurrence was created. Then the order of the time sequence of maximal joint angular velocities prior to contact with the golf ball was determined using a timeline. To effectively integrate a golfer's core and whole body into a swing, the kinetic link or summation of velocity principle must be utilized (Kreighbaum & Barthels, 1995). This requires the club/hands to be drawn back during the takeaway and backswing and then the trunk/core is rotated or coiled. Typical initiation of the downswing would begin with the hips, then followed by the trunk, shoulder, elbow, wrist, and club movements. Presented in Table 1 are the maximal joint velocities, time of occurrence, with the order of the maximal joint velocity sequencing shown. Spearman rho correlations were performed on the brain type and the ranked order of the occurrence of the maximal joint's velocity and a significant correlation (r_s) of -.815 (p=.047) was found to exist between the shoulder joint order and the brain type A (BCIL/INTJ). Non-significant correlations of $r_{s} =$ .211 (p=.688) between brain type A and elbow utilization order and a relationship between brain type A and the wrist order of $r_{s} =$ .527 (p=.283) were found. The beginning of the downswing was initiated with maximal shoulder velocities exhibited in 2 of the 6 participants (A1 & A3). Also, 3 of the 6 participants (C1, C2 & A2) initiated their swing with movement of their hands followed by elbow or shoulder action and this represented a distal to proximal segmental sequencing. The initiation of the golf swing movement with the shoulders occurred in 2 of the 3 subjects in group A. But only one subject (A1) in group A demonstrated the "ideal" or "kinetic link" sequencing beginning with the trunk / shoulders and finishing with the wrist action prior to contact as the last joint that provided impetus to the final ball release velocity.
Both subjects in group C began the swinging movement with wrist action and then used the joints more proximal to the trunk later in the movement. This improper timing in the golf swing technique did not effectively provide summation of velocity from one part of the body to the other. A unique sequencing characteristic was exhibited by subject B and subject C2 where a near simultaneous biphasic or second wrist peak action occurred just prior to ball contact. This resulted in the participants needing to sequentially coordinate fewer segments in the golf swing movement and essentially simplifying the coordination of the swinging skill. Typically coordination research has focused on qualitative analysis of inter-segmental sequencing and timing parameters (Hudson & Hill, 1991). However, they discussed a need for objective measurement of the segmental sequencing and timing, and a later study conducted by Finch, Niednagel, Finch & Ariel (2012) reported an objective procedure used to quantify and classify free throw coordination.

Table 1: Maximal joint angular velocities, times and order of sequencing during a golf swing with 5 iron

Subject		Should Vel	Elbow Vel	Wrist Vel	Clubhead Vel
Subj B	Order	**3**	**1**	**2**	
	Time	-0.451 s	-0.534 s	-0.484 s	-0.017 s
	Variable	7.2 rad*s^{-1} (413 deg*s^{-1})	7.3 rad*s^{-1} (418 deg*s^{-1})	29.4 rad*s^{-1} (1684 deg*s^{-1})	27.4 m*s^{-1}
Subj C1	Order	**3**	**2**	**1**	
	Time	-0.367 s	-0.651 s	-0.734 s	-0.017 s
	Variable	1.8 rad*s^{-1} (107 deg*s^{-1})	11.2 rad*s^{-1} (642 deg*s^{-1})	27.5 rad*s^{-1} (1578 deg*s^{-1})	14.63 m*s^{-1}
Subj C2	Order	**2**	**3**	**1**	
	Time	-0.417 s	-0.050 s	-0.617 s	.017 s
	Variable	12.3 rad*s^{-1} (706 deg*s^{-1})	22.5 rad*s^{-1} (1288 deg*s^{-1})	33.8 rad*s^{-1} (1935 deg*s^{-1})	20.7 m*s^{-1}
Subj A1	Order	**1**	**2**	**3**	
	Time	-0.701 s	-0.501 s	-0.450s	0.501 s
	Variable	5.2 rad*s^{-1} (297 deg*s^{-1})	8.3 rad*s^{-1} (476 deg*s^{-1})	12.8 rad*s^{-1} (736 deg*s^{-1})	14.4 m*s^{-1}
Subj A2	Order	**2**	**3**	**1**	
	Time	-0.501s	-0.467s	-0.601 s	0.050 s
	Variable	4.0 rad*s^{-1} (228 deg*s^{-1})	6.7 rad*s^{-1} (383 deg*s^{-1})	15.6 rad*s^{-1} (894 deg*s^{-1})	30.4 m*s^{-1}
Subj A3	Order	**1**	**3**	**2**	
	Time	-0.551 s	-0.033 s	-0.067 s	0.032 s
	Variable	5.4 rad*s^{-1} (312 deg*s^{-1})	3.7 rad*s^{-1} (212 deg*s^{-1})	9.5 rad*s^{-1} (542 deg*s^{-1})	17.6 m*s^{-1}

The participants with brain type C (FEAR/ESFP) classification can be viewed as easy going, gross motor skilled individuals' whose sequencing of the golf swing mechanics illustrated that the participants initiated the movement from the wrist/elbow and completed the movement with a gross, shoulder/trunk action. Gross motor skill coordination strategies reflected in the temporal sequencing plots for individuals with a brain type of C (FEAR/ESFP) and fine motor controlled individuals with brain type A (BCIL/INTJ) are illustrated in Figure 1.

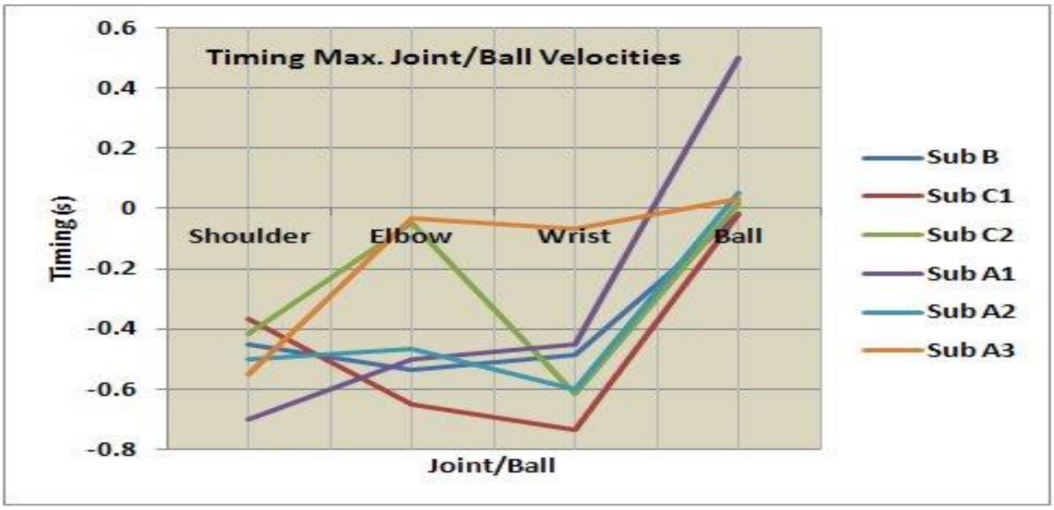

Figure 1: Maximal joint angular kinematic velocity sequencing for brain types B/C (FEAR/ESFP) gross motor control and brain types A (BCIL/INTJ) - fine motor control

Fine skilled individuals who initiated the golf swing movement from the shoulder/core sequentially coordinating down through upper extremity linkage to the club can be viewed as analytical with brain type A (BCIL/INTJ). An illustration of a brain type A (BCIL/INTJ) individual who adopted the fine motor control strategy of multiple sequencing is shown in Figure 2.

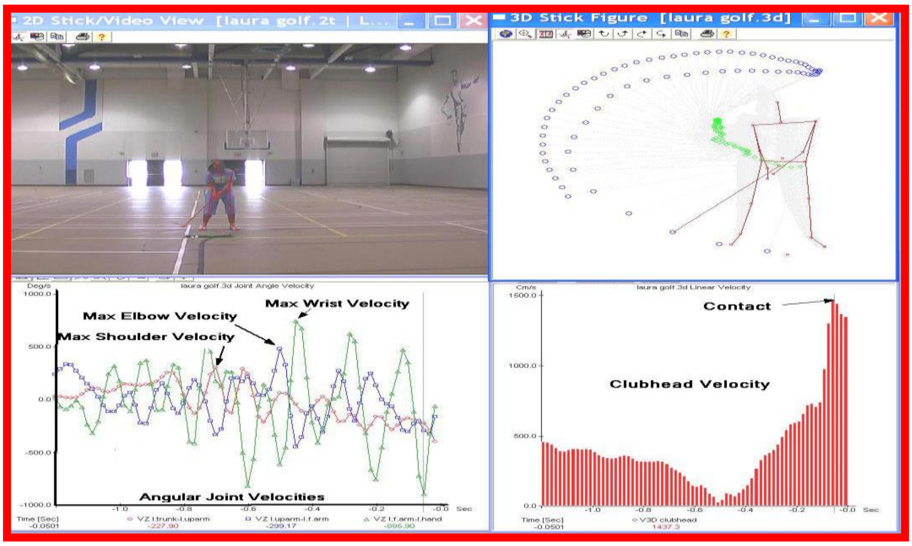

Figure 2: Angular kinematic sequencing for brain type A (BCIL/INTJ) - fine motor control

CONCLUSION: The objective evaluation of temporal sequencing of a golf swing suggests that this evaluative process may be a viable means to identify fine and gross motor control as related to brain type. This identification technique has the capability to classify whether an individual is neurally wired for fine or gross control of movement patterns. The influence of brain type on neural control could have the potential to provide objective evaluative tools that may be used in athletic scouting combines for athletic motor ability assessment. An increased sample size across the different brain types, who perform a variety of gross and fine motor based sport skills are still required to arrive at statistically significant conclusions the assessment of athletic motor ability and the influence of brain type on body coordination. Also, it may be necessary to develop different sport skill instructional strategies for fine and gross neutrally wired individuals because they utilize their segments in a different sequence pattern.

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