TRACKMAN

IMPCaTT Research Study

IMPCaTT Research Study

by Liam Mucklow

A Technology Based Learning model for self guided instruction

Background: The introduction of technology to the art and science of golf instruction may fundamentally alter the requirements inherent to the position. Technology does not replace the need for coaching in golf, but necessitates the acquisition of an entire new body of knowledge by golf instructors.

The golf industry as a whole is undergoing a change. Better equipment and the aforementioned technology have made the game more accessible year round throughout the world. The lack of models or standardization of instruction using that technology has created a knowledge gap between what happens in that triangulation of instructor, student and technology. The fact that World Golf Coaches defined the difference between a golf teacher and a golf coach as lately as 2012, and that the areas of expertise required in golf coaching in programs throughout the world do not yet include the use of technology speaks to this lack. (World Golf Coaches.com).

New technologies such as Trackman create a demand for improved understanding of not only the analysis of research into coaching and performance but also a conceptual understanding of how this technology can and should affect the coaching process. The direct impact on instruction shows the need for a clear set of conceptual principles about the use of the technology based on the principles of adult education and the latest brain based learning. (Jensen, Eric, 2008) In his work on Neuro Learning for Golf (Hebron, Michael, 2007) Hebron suggests that utilizing Jensen's principles of brain based learning should include the how of learning, not just the what of learning. Simply put, improving a student's individual learning potential enhances their performance potential. The environment that this creates, and that Golf Lab adheres to, is a "learning-developing environment, as opposed to the traditional teaching and fixing to get it right approach". Cognitive science studies on long-term learning have found that words are less powerful than personal visualizations and feels for making progress. So using Trackman to draw on what golfers already know and understand from their past experiences – then helping that individual to invent their personal golf swing while improving their prediction, mind body connection, problem solving, creativity and deduction skills is a worthwhile study. Using one focus of inquiry to generate another, and asking the student to reflect on what is wrong with their swing is a brain compatible approach to improvement. Connections and relationships to data points are then determined by the instructor, displayed on the monitor, and poor outcomes are no longer seen as failures but as useful feedback for future improvement.

A questioning, critical approach to utilizing Trackman technology is imperative and through this project we hope to construct a framework with which to delimit, describe and analyze the coaching process, coaching behaviour and coaching practice while using Trackman technology.

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Methodology: Operating on the principles of adult education and brain based learning we anticipate that this project will support the suggestion that a teaching model for Trackman that is based on increasing the predictive capacity of the student and limiting the data presented will improve the clients ability to predict their Swing Direction and Launch Direction which will ultimately show a statistical correlation (2 points of data) between predictive capacity and actual values. If this is the case we further suggest that this may be a better way for golfers to practice their game using a launch monitor. A students predictive capacity is deemed important because it allows the player to better identify on course misses and more accurately make corrections in real time without the technology present i.e. if you train this way you can better identify misses. In this way we will maximize the efficiency of improvement with Trackmans accurate and easy to use equipment. Discoveries from this and future investigations will contribute to a model of facilitating accelerated improvement in the game of golf.

Process: The study will follow 30 subjects over a 16 week time period. The subjects will sign a contract that outlines their responsibilities as part of the study (Appendix 1). The next step will be to use Trackman Fundamentals to ensure the student has the proper conceptual understanding of key terminology that is vital for completion of their training protocols. Upon successful completion of the Trackman Fundamentals Training the student will complete a 10 shot test with their 7 iron.

The Golf Lab Professional will then use the IMPCaTT model, (Appendix 2), to determine the ideal Swing Direction and Launch Direction for that individuals preferred shot shape based on the Angle of Attack and Swing Plane measures. The student will be shown the down the line hit screen, over head carry view, and *only* Carry/Total and Side/Side Total. From this display the student will be asked to predict both their Swing Direction and Launch Direction. This data will be recorded as Predicted Values, Actual Values and Variance. Variance will be calculated independently for each variable and used as comparison reference after the final test upon completion of the training protocols.

RH Straight Launch Direction of 0.0 will create a Straight Shot*

*assuming Center Contact

Swing plane angle in degrees \ Angle of Attack in degrees	-7.0	-6.5	-6.0	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0	2.5
40	-8.3	-7.7	-7.2	-6.6	-6.0	-5.4	-4.8	-4.2	-3.6	-3.0	-2.4	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.4	3.0
40.1	-8.3	-7.7	-7.1	-6.5	-5.9	-5.3	-4.8	-4.2	-3.6	-3.0	-2.4	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.4	3.0
40.2	-8.3	-7.7	-7.1	-6.5	-5.9	-5.3	-4.7	-4.1	-3.6	-3.0	-2.4	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.4	3.0
40.3	-8.3	-7.7	-7.1	-6.5	-5.9	-5.3	-4.7	-4.1	-3.5	-2.9	-2.4	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.4	2.9
40.4	-8.2	-7.6	-7.0	-6.5	-5.9	-5.3	-4.7	-4.1	-3.5	-2.9	-2.3	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.3	2.9
40.5	-8.2	-7.6	-7.0	-6.4	-5.9	-5.3	-4.7	-4.1	-3.5	-2.9	-2.3	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.3	2.9
40.6	-8.2	-7.6	-7.0	-6.4	-5.8	-5.3	-4.7	-4.1	-3.5	-2.9	-2.3	-1.8	-1.2	-0.6	0.0	0.6	1.2	1.8	2.3	2.9
40.7	-8.1	-7.6	-7.0	-6.4	-5.8	-5.2	-4.7	-4.1	-3.5	-2.9	-2.3	-1.7	-1.2	-0.6	0.0	0.6	1.2	1.7	2.3	2.9
40.8	-8.1	-7.5	-7.0	-6.4	-5.8	-5.2	-4.6	-4.1	-3.5	-2.9	-2.3	-1.7	-1.2	-0.6	0.0	0.6	1.2	1.7	2.3	2.9
40.9	-8.1	-7.5	-6.9	-6.3	-5.8	-5.2	-4.6	-4.0	-3.5	-2.9	-2.3	-1.7	-1.2	-0.6	0.0	0.6	1.2	1.7	2.3	2.9
41	-8.1	-7.5	-6.9	-6.3	-5.8	-5.2	-4.6	-4.0	-3.5	-2.9	-2.3	-1.7	-1.2	-0.6	0.0	0.6	1.2	1.7	2.3	2.9
41.1	-8.0	-7.5	-6.9	-6.3	-5.7	-5.2	-4.6	-4.0	-3.4	-2.9	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.9
41.2	-8.0	-7.4	-6.9	-6.3	-5.7	-5.1	-4.6	-4.0	-3.4	-2.9	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.9
41.3	-8.0	-7.4	-6.8	-6.3	-5.7	-5.1	-4.6	-4.0	-3.4	-2.8	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.8
41.4	-7.9	-7.4	-6.8	-6.2	-5.7	-5.1	-4.5	-4.0	-3.4	-2.8	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.8
41.5	-7.9	-7.3	-6.8	-6.2	-5.7	-5.1	-4.5	-4.0	-3.4	-2.8	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.8
41.6	-7.9	-7.3	-6.8	-6.2	-5.6	-5.1	-4.5	-3.9	-3.4	-2.8	-2.3	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.3	2.8
41.7	-7.9	-7.3	-6.7	-6.2	-5.6	-5.1	-4.5	-3.9	-3.4	-2.8	-2.2	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.2	2.8
41.8	-7.8	-7.3	-6.7	-6.2	-5.6	-5.0	-4.5	-3.9	-3.4	-2.8	-2.2	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.2	2.8
41.9	-7.8	-7.2	-6.7	-6.1	-5.6	-5.0	-4.5	-3.9	-3.3	-2.8	-2.2	-1.7	-1.1	-0.6	0.0	0.6	1.1	1.7	2.2	2.8

Ideal values will be determined by the Average Angle of Attack, and the Average Swing Plane of the subject during their first 10 shots. The Launch Direction remains constant based on the desired shot shape of the subject. Straight shots start at 0.0, while shaped shots are prescribed to start 2.1 degrees from the target line on their respective side. All calculations are done to yield a curved shot that does not cross the target, assuming center impact.

After 90 shots (or 3 training sessions of at least 30 shots) the subject will retest in order to determine if there has been a Swing Plane shift, or change in Angle of Attack.
Between 12 to 16 weeks, depending upon training times, a final 10 Shot Predictive Test will be done.

All data will be stored within Trackman software and identified as part of the study. All participating Golf Lab staff will be trained on the study using a learning outcomes framework (Appendix 3) to ensure fidelity to the model.

Prediction: During the final blind test subjects predicted values will have less variance from the actual value, suggesting that the subjects have learned to better identify club delivery and ball launch.

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IMPCaTT Model (Improvement Measures & Predictive Capacity using **Trackman Technology) - a style of training that allows the golfer to more accurately identify their misses without becoming dependent on technology**

Results : At the conclusion of the training period each subject was put through the blind predictive test again and had their results put into table form. For full results from more golfers please see Appendix 4.

Calculation Methods:

V fr Predicted = Diff (Predicted and Actual)

V fr Ideal = Diff (Predicted and Ideal)

$$\text{Awareness Change} = \frac{((V\ fr.\ Predicted\ Start)-(V\ fr.\ Predicted\ End))}{V\ fr\ Predicted\ Start}$$

$$\text{Ideal Change} = \frac{((V\ fr.\ Ideal\ Start)-(V\ fr.\ Ideal\ End))}{}$$

bject #14

Entrance Test

	Swing Direction				Launch Direction			
Shot #	Predicted	Actual	V fr. Predicted	V fr. Ideal	Predicted	Actual	V fr. Predicted	V fr. Ideal
1	-2.0	-2.3	0.3	3.2	-1.0	-1.5	0.5	3.6
2	-2.0	-5.1	3.1	6	2.0	1.1	0.9	1
3	-4.0	-3.2	0.8	4.1	-3.0	-3.5	0.5	5.6
4	-3.0	-2.9	0.1	3.8	-2.0	1.2	3.2	0.9
5	-3.0	-4.5	1.5	5.4	4.0	2.4	1.6	0.3
6	-5.0	-3.0	2	3.9	-3.0	-2.3	0.7	4.4
7	-4.0	-1.1	2.9	2	-2.0	-0.6	1.4	2.7
8	-2.0	-3.6	1.6	4.5	-1.0	-0.4	0.6	2.5
9	-2.0	-4.8	2.8	5.7	0.0	-0.1	0.1	2.2
10	2.0	-4.3	2.3	5.2	4.0	2.9	1.1	0.8
	Start	-3.5	1.7	4.4	Start	-0.1	1.1	2.4

Ideal SD	0.9
Ideal LD	2.1

Swing Direction Awareness Change	37.93%
Launch Direction Awareness Change	6.60%
Swing Direction Variance from Ideal Change	76.48%
Launch Direction Variance from Ideal Change	5.42%

Exit Test

	Swing Direction				Launch Direction			
Shot #	Predicted	Actual	V fr. Predicted	V fr. Ideal	Predicted	Actual	V fr. Predicted	V fr. Ideal
1	1.0	-1.7	2.7	1.0	-3.0	-1.0	2.0	3.1
2	1.0	1.2	0.2	1.5	-2.0	-1.8	0.2	3.9
3	-1.0	-1.7	0.7	1.0	-3.0	-0.5	2.5	2.6
4	0.5	2.1	1.6	2.8	2.0	1.3	0.7	0.8
5	-2.0	-0.7	1.3	0.0	-3.0	-1.7	1.3	3.8
6	0.0	0.2	0.2	0.9	1.0	0.1	0.9	2.2
7	-1.0	-1.4	0.4	0.7	1.0	0.8	0.2	1.3
8	-1.0	0.4	1.4	1.1	2.0	1.3	0.7	0.8
9	-1.0	-1.8	0.8	1.1	1.0	0.3	0.7	1.8
10	1.0	-0.5	1.5	0.2	-1.0	-0.3	0.7	2.4
	End	-0.4	1.1	1.0	End	-0.2	1.0	2.3
	Ideal	-0.7			Ideal	2.1		
	Variance	0.3			Variance	2.3		

Ideal SD	-0.7
Ideal LD	2.1

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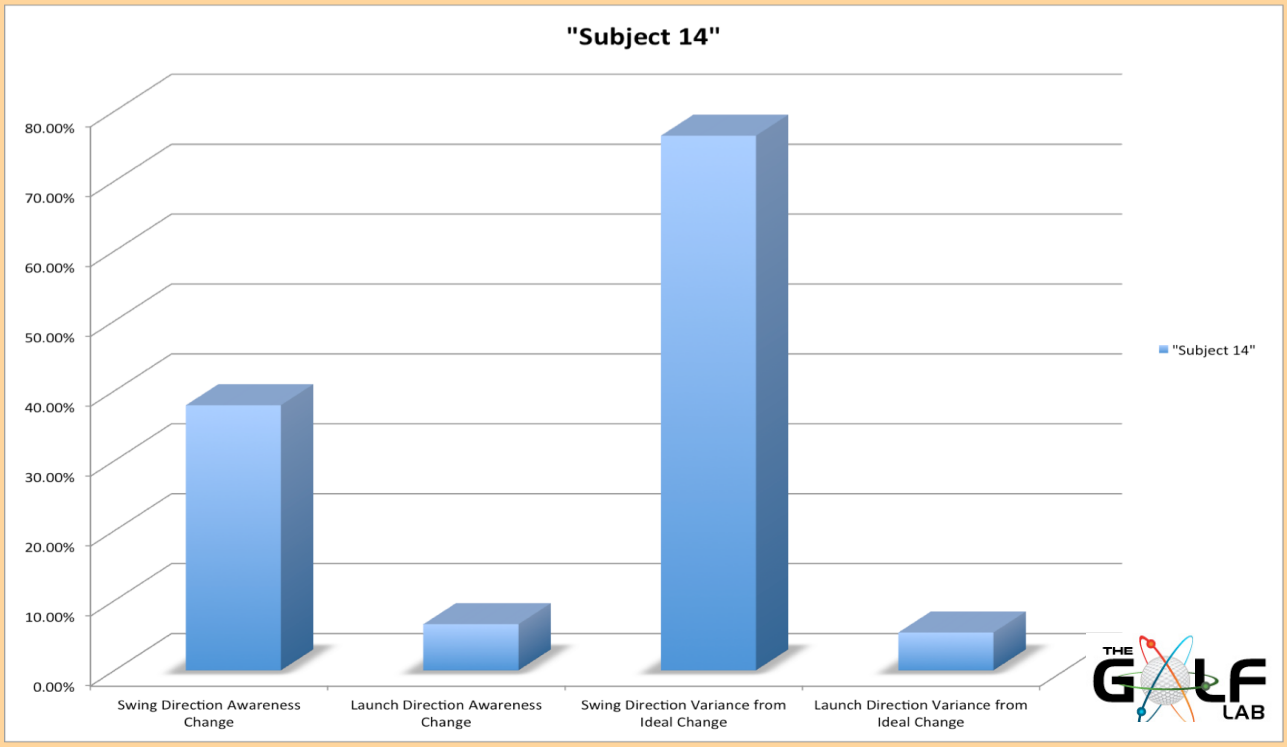
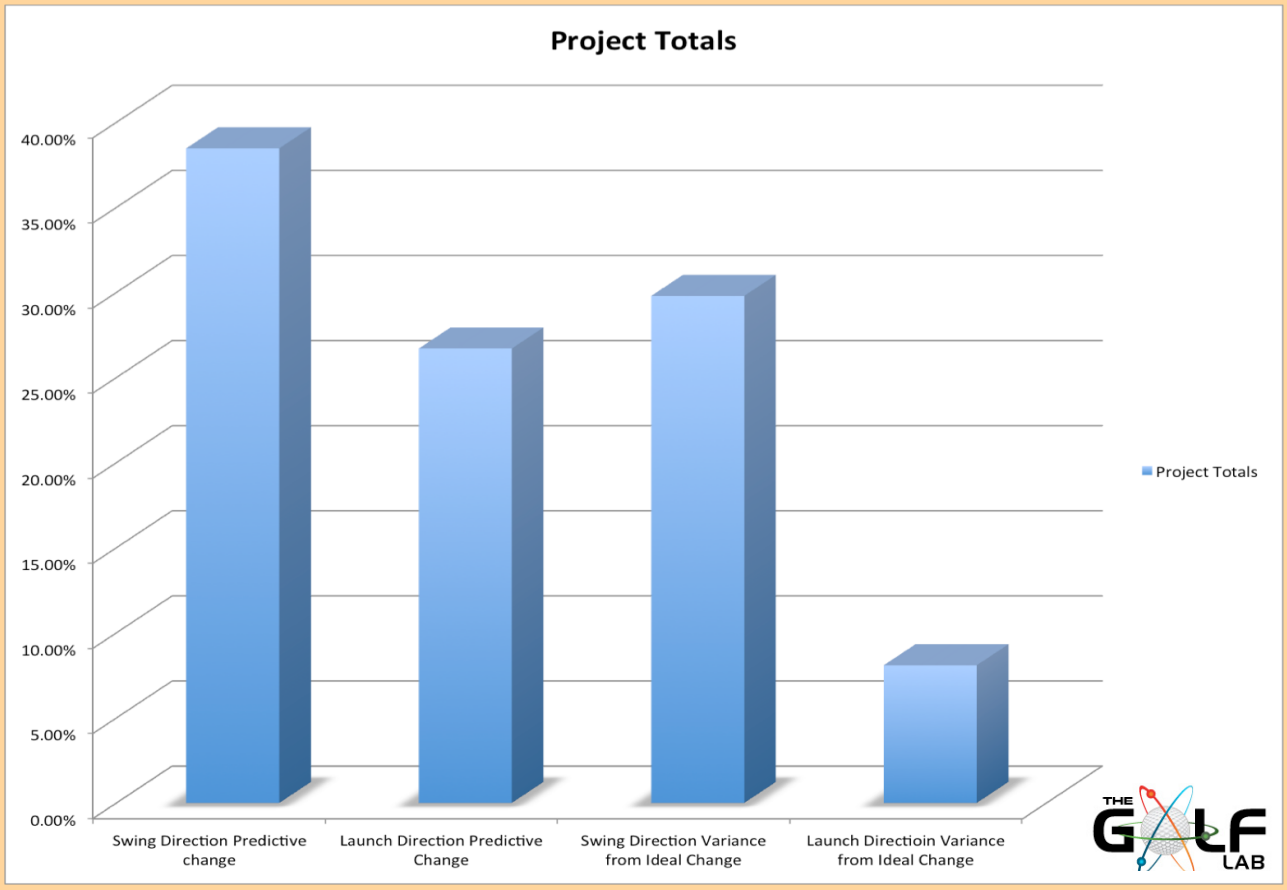
While the original protocol called only for the subjects predictive capacity to be analyzed we also expanded calculations to include *Variance from Ideal*. Many of the individuals we consulted with during the study requested that this value be tracked.

Each of the subjects then had their data put into graphical form. See Ex 2 below



The final table shown below in Ex 3 represents the averages of all participants of the study.



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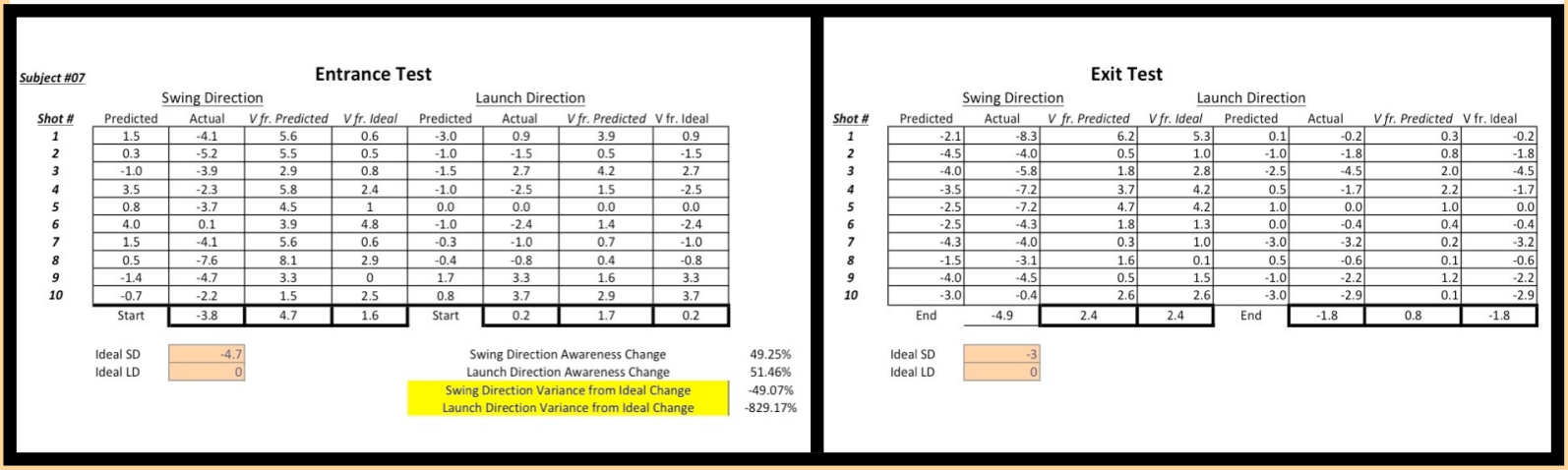
Analysis and Application : We feel that the final results strongly support the prediction made at the outset of this project. The average increase in Swing Direction(SD) Awareness was 38.47% and the average increase in Launch Direction(LD) Awareness was 26.70%.

The improvement in Swing Direction Awareness was more significant that in Launch Direction Awareness. We feel this is because Swing Direction was a new concept for virtually all subjects in the study. We feel the secondary calculation of Swing Direction Variance from Ideal(SDVI) strongly supports this model as a effective method for self guided learning. Not only were the subject more aware of their SD, but it was also significantly closer to the values needed to create their desired shot shape.

The category Launch Direction Variance from Ideal(LDVI) shows a much smaller improvement that, in our opinion, does represent statistically significant change. The reason for this was the results of a single subject shown below in Ex 4.



Subject #07

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	1.5	-4.1	5.6	0.6	-3.0	0.9	3.9	0.9
2	0.3	-5.2	5.5	0.5	-1.0	-1.5	0.5	-1.5
3	-1.0	-3.9	2.9	0.8	-1.5	2.7	4.2	2.7
4	3.5	-2.3	5.8	2.4	-1.0	-2.5	1.5	-2.5
5	0.8	-3.7	4.5	1	0.0	0.0	0.0	0.0
6	4.0	0.1	3.9	4.8	-1.0	-2.4	1.4	-2.4
7	1.5	-4.1	5.6	0.6	-0.3	-1.0	0.7	-1.0
8	0.5	-7.6	8.1	2.9	-0.4	-0.8	0.4	-0.8
9	-1.4	-4.7	3.3	0	1.7	3.3	1.6	3.3
10	-0.7	-2.2	1.5	2.5	0.8	3.7	2.9	3.7
	Start	-3.8	4.7	1.6	Start	0.2	1.7	0.2

Ideal SD	-4.7
Ideal LD	0

Swing Direction Awareness Change	49.25%
Launch Direction Awareness Change	51.46%
Swing Direction Variance from Ideal Change	-49.07%
Launch Direction Variance from Ideal Change	-829.17%

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	-2.1	-8.3	6.2	5.3	0.1	-0.2	0.3	-0.2
2	-4.5	-4.0	0.5	1.0	-1.0	-1.8	0.8	-1.8
3	-4.0	-5.8	1.8	2.8	-2.5	-4.5	2.0	-4.5
4	-3.5	-7.2	3.7	4.2	0.5	-1.7	2.2	-1.7
5	-2.5	-7.2	4.7	4.2	1.0	0.0	1.0	0.0
6	-2.5	-4.3	1.8	1.3	0.0	-0.4	0.4	-0.4
7	-4.3	-4.0	0.3	1.0	-3.0	-3.2	0.2	-3.2
8	-1.5	-3.1	1.6	0.1	0.5	-0.6	0.1	-0.6
9	-4.0	-4.5	0.5	1.5	-1.0	-2.2	1.2	-2.2
10	-3.0	-0.4	2.6	2.6	-3.0	-2.9	0.1	-2.9
	End	-4.9	2.4	2.4	End	-1.8	0.8	-1.8

Ideal SD	-3
Ideal LD	0

Subject #07 was the only participant to show a strong negative correlation in the SDVI and LDVI categories. Interestingly enough both of their predictive values showed a strong positive correlation. It should also be noted that Subject #07 performed the minimum number of ball contacts of 360 within the learning model, and had over 3400 ball contacts where they had between 8-12 pieces of data displayed on the screen. This further supports our belief self guided learning can be impeded by presenting too much, and or irrelevant data. Interestingly enough Subject #07 also experienced an index drop of 1.6.

The number of ball contacts required per subject in this study was 30 per week. We feel confident that this is an effective minimum to induce positive change. We saw stronger improvement in subjects that increased the minimum up to 90 ball contacts per week. For subjects that went above 90 there was no further correlation to accelerated improvement.

Conclusions – We feel that the results of this study strongly support using a minimalist data presentation for students when training by themselves on Trackman. Moving forward we believe that further research can be done to quantify which values are most effective to be presented to induce positive change.

Moving Forward – We have already begun work refining exactly which values are being presented. We are currently working with 2 Club Delivery Parameters in the early Cognitive stages of learning. We the believe a progression to 1 Club Delivery and 1 Ball Launch Parameter, and finally 2 Ball Launch Parameters will further accelerate the self guided learning process.

IMPCaTT Research Study

Appendix 1

Study Name: The Golf Lab IMPCaTT Learning Model Development

Researchers: *Liam Mucklow*
liam@thegolflab.ca, 905-760-2522 ext 221

Purpose of the Research: *Create a standardized model for information delivery using Trackman for self guided learning*

What You Will Be Asked to Do in the Research: *Perform a minimum of 30 ball contacts per week in the prescribed manner of displaying on Swing Direction and Launch Direction. Training must be performed for 12 weeks of any 16 week timeframe in order to be included in results*

Risks and Discomforts: We do not foresee any risks or discomfort from your participation in the research. **Benefits of the Research and Benefits to You:**

Withdrawal from the Study: You can stop participating in the study at any time, for any reason, if you so decide. If you decide to stop participating, you will still be eligible to receive the promised pay for agreeing to be in the project. Your decision to stop participating, or to refuse to answer particular questions, will not affect your relationship with the researchers, York University, or any other group associated with this project. In the event you withdraw from the study, all associated data collected will be immediately destroyed wherever possible.

Confidentiality: All information you supply during the research will be held in confidence and unless you specifically indicate your consent, your name will not appear in any report or publication of the research. Your data will be safely stored in a password protected database. Confidentiality will be provided to the fullest extent possible by law.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact me

Legal Rights and Signatures:

I *(fill in your name here),* consent to participate in *(insert study name here)* conducted by *(insert investigator name here)*. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

Signature _____ _____**Date**

Participant

Signature _____ _____**Date**

Principal Investigator

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Appendix 2

PLEASE SEE FILE ATTACHED FOR FULL TABLES

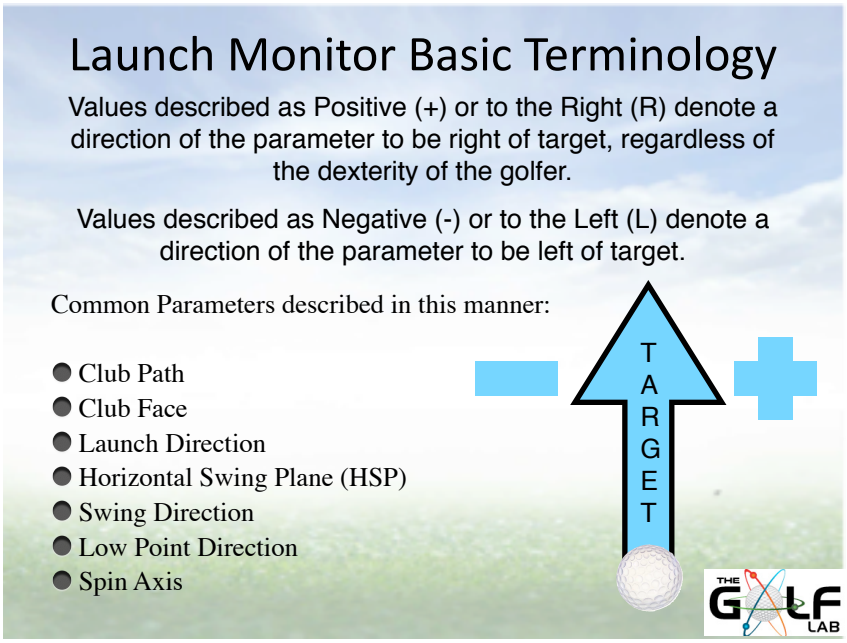
Chart Purpose- Determine Swing Direction needed to create preferred shot shape

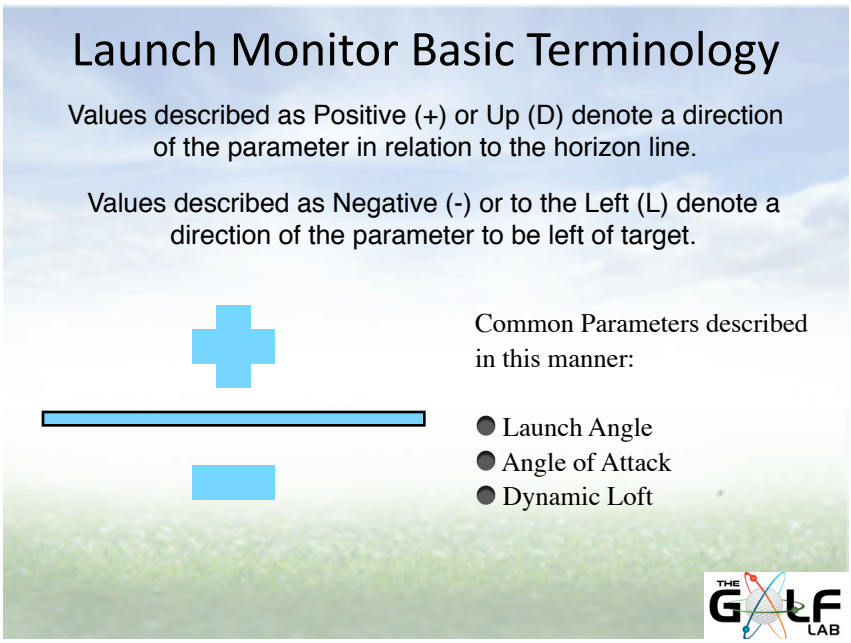
This chart is not designed to tell you how to create these events or how they did occur. It will not tell you how to measure yourself. With the help of a device like Trackman Pro you will be able maximize efficiency of improvement with provided feedback

We have omitted Club Static Loft and Spin Loft from this model as our primary objective is the development of a Learning Model Should we be successful in Phase 1 these values will be incorporated into formulas moving forward
Athletes will be trained using this model as the basis for data presentation during training sessions

Produced by: Dave Tutelman John Graham

Adapted for 7iron and Learning Model by: Liam Mucklow





Appendix 4

Below is the full data for subjects that agreed to have their results shared with the community.

Subject #16

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V. fr. Predicted	Launch Direction V fr. Ideal
1	-3.0	1.8	4.8	0.2	3.0	-2.1	5.1	2.1
2	0.0	2.2	2.2	0.2	0.0	0.0	0.0	0.0
3	1.0	-1.1	2.1	3.1	3.0	1.3	1.7	1.3
4	1.0	2.0	1	0.0	3.0	1.5	1.5	1.5
5	0.0	0.6	0.6	1.4	0.0	-1.1	1.1	1.1
6	1.0	1.9	0.9	0.1	2.0	1.2	0.8	1.2
7	-3.0	-0.2	2.8	2.2	-4.0	-3.6	0.4	3.6
8	-1.0	1.7	2.7	2.3	-3.0	-1.5	1.5	1.5
9	1.0	4.5	3.5	2.5	2.0	1.3	0.7	1.3
10	0.0	2.0	2	0.0	0.0	-0.3	0.3	0.3
	Start	1.5	2.3	1.2	Start	-0.3	1.3	1.4

Ideal SD	2
Ideal LD	0

Swing Direction Awareness Change	37.61%
Launch Direction Awareness Change	49.62%
Swing Direction Variance from Ideal Change	5.00%
Launch Direction Variance from Ideal Change	43.88%

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	2.0	0.1	1.9	1.9	2.0	2.7	0.7	2.7
2	0.0	0.1	0.1	1.9	0.0	-0.7	0.7	0.7
3	-0.5	1.1	1.6	0.9	0.0	-0.8	0.8	0.8
4	-0.5	2.9	3.4	0.9	1.0	-0.9	1.9	0.9
5	0.0	1.0	1.0	1.0	0.0	-0.8	0.8	0.8
6	-0.5	1.6	2.1	0.4	0.5	0.1	0.4	0.1
7	0.0	2.3	2.3	0.3	0.0	0.4	0.4	0.4
8	0.0	1.1	1.1	0.9	0.0	-0.1	0.1	0.1
9	1.0	0.6	0.4	1.4	1.5	1.0	0.5	1.0
10	0.0	0.2	0.2	1.8	0.0	-0.3	0.3	0.3
	End	1.1	1.4	1.1	End	0.1	0.7	0.8

Ideal SD	2
Ideal LD	0

Subject #07

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	1.5	-4.1	5.6	0.6	-3.0	0.9	3.9	0.9
2	0.3	-5.2	5.5	0.5	-1.0	-1.5	0.5	-1.5
3	-1.0	-3.9	2.9	0.8	-1.5	2.7	4.2	2.7
4	3.5	-2.3	5.8	2.4	-1.0	-2.5	1.5	-2.5
5	0.8	-3.7	4.5	1	0.0	0.0	0.0	0.0
6	4.0	0.1	3.9	4.8	-1.0	-2.4	1.4	-2.4
7	1.5	-4.1	5.6	0.6	-0.3	-1.0	0.7	-1.0
8	0.5	-7.6	8.1	2.9	-0.4	-0.8	0.4	-0.8
9	-1.4	-4.7	3.3	0	1.7	3.3	1.6	3.3
10	-0.7	-2.2	1.5	2.5	0.8	3.7	2.9	3.7
	Start	-3.8	4.7	1.6	Start	0.2	1.7	0.2

Ideal SD	-4.7
Ideal LD	0

Swing Direction Awareness Change	49.25%
Launch Direction Awareness Change	51.46%
Swing Direction Variance from Ideal Change	-49.07%
Launch Direction Variance from Ideal Change	-829.17%

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	-2.1	-8.3	6.2	5.3	0.1	-0.2	0.3	-0.2
2	-4.5	-4.0	0.5	1.0	-1.0	-1.8	0.8	-1.8
3	-4.0	-5.8	1.8	2.8	-2.5	-4.5	2.0	-4.5
4	-3.5	-7.2	3.7	4.2	0.5	-1.7	2.2	-1.7
5	-2.5	-7.2	4.7	4.2	1.0	0.0	1.0	0.0
6	-2.5	-4.3	1.8	1.3	0.0	-0.4	0.4	-0.4
7	-4.3	-4.0	0.3	1.0	-3.0	-3.2	0.2	-3.2
8	-1.5	-3.1	1.6	0.1	0.5	-0.6	0.1	-0.6
9	-4.0	-4.5	0.5	1.5	-1.0	-2.2	1.2	-2.2
10	-3.0	-0.4	2.6	2.6	-3.0	-2.9	0.1	-2.9
	End	-4.9	2.4	2.4	End	-1.8	0.8	-1.8

Ideal SD	-3
Ideal LD	0

Subject #14

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	-2.0	-2.3	0.3	3.2	-1.0	-1.5	0.5	3.6
2	-2.0	-5.1	3.1	6	2.0	1.1	0.9	1
3	-4.0	-3.2	0.8	4.1	-3.0	-3.5	0.5	5.6
4	-3.0	-2.9	0.1	3.8	-2.0	1.2	3.2	0.9
5	-3.0	-4.5	1.5	5.4	4.0	2.4	1.6	0.3
6	-5.0	-3.0	2	3.9	-3.0	-2.3	0.7	4.4
7	-4.0	-1.1	2.9	2	-2.0	-0.6	1.4	2.7
8	-2.0	-3.6	1.6	4.5	-1.0	-0.4	0.6	2.5
9	-2.0	-4.8	2.8	5.7	0.0	-0.1	0.1	2.2
10	2.0	-4.3	2.3	5.2	4.0	2.9	1.1	0.8
	Start	-3.5	1.7	4.4	Start	-0.1	1.1	2.4

Ideal SD	0.9
Ideal LD	2.1

Swing Direction Awareness Change	37.93%
Launch Direction Awareness Change	6.60%
Swing Direction Variance from Ideal Change	76.48%
Launch Direction Variance from Ideal Change	5.42%

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	1.0	-1.7	2.7	1.0	-3.0	-1.0	2.0	3.1
2	1.0	1.2	0.2	1.5	-2.0	-1.8	0.2	3.9
3	-1.0	-1.7	0.7	1.0	-3.0	-0.5	2.5	2.6
4	0.5	2.1	1.6	2.8	2.0	1.3	0.7	0.8
5	-2.0	-0.7	1.3	0.0	-3.0	-1.7	1.3	3.8
6	0.0	0.2	0.2	0.9	1.0	0.1	0.9	2.2
7	-1.0	-1.4	0.4	0.7	1.0	0.8	0.2	1.3
8	-1.0	0.4	1.4	1.1	2.0	1.3	0.7	0.8
9	-1.0	-1.8	0.8	1.1	1.0	0.3	0.7	1.8
10	1.0	-0.5	1.5	0.2	-1.0	-0.3	0.7	2.4
	End	-0.4	1.1	1.0	End	-0.2	1.0	2.3
	Ideal	-0.7			Ideal	2.1		
	Variance	0.3			Variance	2.3		

Ideal SD	-0.7
Ideal LD	2.1

Subject #13

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	0.0	-9.3	9.3	7.1	-3.0	-3.3	0.3	-3.3
2	-6.0	-7.3	1.3	5.1	0.0	-3.9	3.9	-3.9
3	-0.5	-6.3	5.8	4.1	-3.0	-4.4	1.4	-4.4
4	-10.0	-9.1	0.9	6.9	-3.0	-3.3	0.3	-3.3
5	-5.0	-7.8	2.8	5.6	4.0	-4.4	8.4	-4.4
6	-10.0	-3.5	6.5	1.3	-4.0	-3.6	0.4	-3.6
7	-5.0	-2.1	2.9	0.1	-4.0	-2.3	1.7	-2.3
8	-5.0	-4.9	0.1	2.7	0.0	-3.6	3.6	-3.6
9	-10.0	-6.6	3.4	4.4	-3.0	-2.3	0.7	-2.3
10	-15.0	-4.8	11.2	2.6	0.9	-4.3	5.2	-4.3
	Start	-6.2	4.4	4.0	Start	-3.5	2.6	-3.5

Ideal SD	-2.2
Ideal LD	0.0

Swing Direction Awareness Change	35.07%
Launch Direction Awareness Change	5.65%
Swing Direction Variance from Ideal Change	40.10%
Launch Direction Variance from Ideal Change	-5.65%

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	-4.0	-2.4	1.6	0.5	4.0	4.7	0.7	4.7
2	-2.0	-2.5	0.5	0.4	2.0	0.7	1.3	0.7
3	-3.0	1.0	4	3.9	4.0	3.5	0.5	3.5
4	-4.0	-1.2	2.8	1.7	4.0	6.1	2.1	6.1
5	-3.0	-3.2	0.2	0.3	3.0	1.5	1.5	1.5
6	-3.0	1.1	4.1	4	4.0	3.9	0.1	3.9
7	-3.0	0.2	3.2	3.1	3.0	2.9	0.1	2.9
8	-4.0	2.1	6.1	5	4.0	5.8	1.8	5.8
9	-4.0	-0.8	3.2	2.1	4.0	4.6	0.6	4.6
10	-3.0	0.0	3	2.9	2.0	3.7	1.7	3.7
	End	-0.6	2.9	2.4	End	3.7	1.0	3.7

Ideal SD	-2.9
Ideal LD	0.0

Subject #22

Entrance Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	-3.0	-5.4	2.4	3.4	3.0	2.5	0.5	0.4
2	1.0	-5.1	6.1	3.1	1.0	1.1	0.1	1.0
3	0.0	-6.4	6.4	4.4	0.0	1.0	1.0	1.1
4	-2.0	-5.9	3.9	3.9	6.0	9.3	3.3	7.2
5	1.0	-8.2	7.2	6.2	2.0	-1.1	3.1	3.2
6	1.0	-7.3	6.3	5.3	-2.0	-0.4	1.6	2.5
7	1.0	-6.9	7.9	4.9	-2.0	0.0	2.0	2.1
8	6.0	-7.9	13.9	5.9	-2.0	-4.9	2.9	7.0
9	6.0	-7.2	13.2	5.2	2.0	2.6	0.6	0.5
10	1.0	-5.9	6.9	3.9	1.0	0.6	0.4	1.7
	Start	-6.6	7.4	4.6	Start	1.1	1.6	2.7

Ideal SD	-2.0

Exit Test

Shot #	Swing Direction Predicted	Swing Direction Actual	Swing Direction V fr. Predicted	Swing Direction V fr. Ideal	Launch Direction Predicted	Launch Direction Actual	Launch Direction V fr. Predicted	Launch Direction V fr. Ideal
1	2.0	-3.3	5.3	1.3	2.0	1.1	0.9	1
2	2.0	-4.4	6.4	2.4	1.0	1.6	0.6	0.5
3	-2.0	-4.7	6.7	2.7	-2.0	-1.9	0.1	4
4	-2.0	-4.7	6.7	2.7	2.0	0.4	1.6	1.7
5	0.7	-4.2	4.9	2.2	4.0	0.4	3.6	1.7
6	-1.0	-1.0	0	1	-2.0	-1.2	0.8	3.3
7	-1.5	-5.1	3.6	3.1	1.5	0.0	1.5	2.1
8	-1.0	-6.0	5	4	-2.0	-1.2	0.8	3.3
9	4.0	-6.9	2.9	4.9	n/a	n/a	n/a	
10	2.0	-6.6	8.6	4.6	n/a	n/a	n/a	
	End	-4.7	5.0	2.9	End	-0.1	1.2	2.2

Ideal SD	-2.0