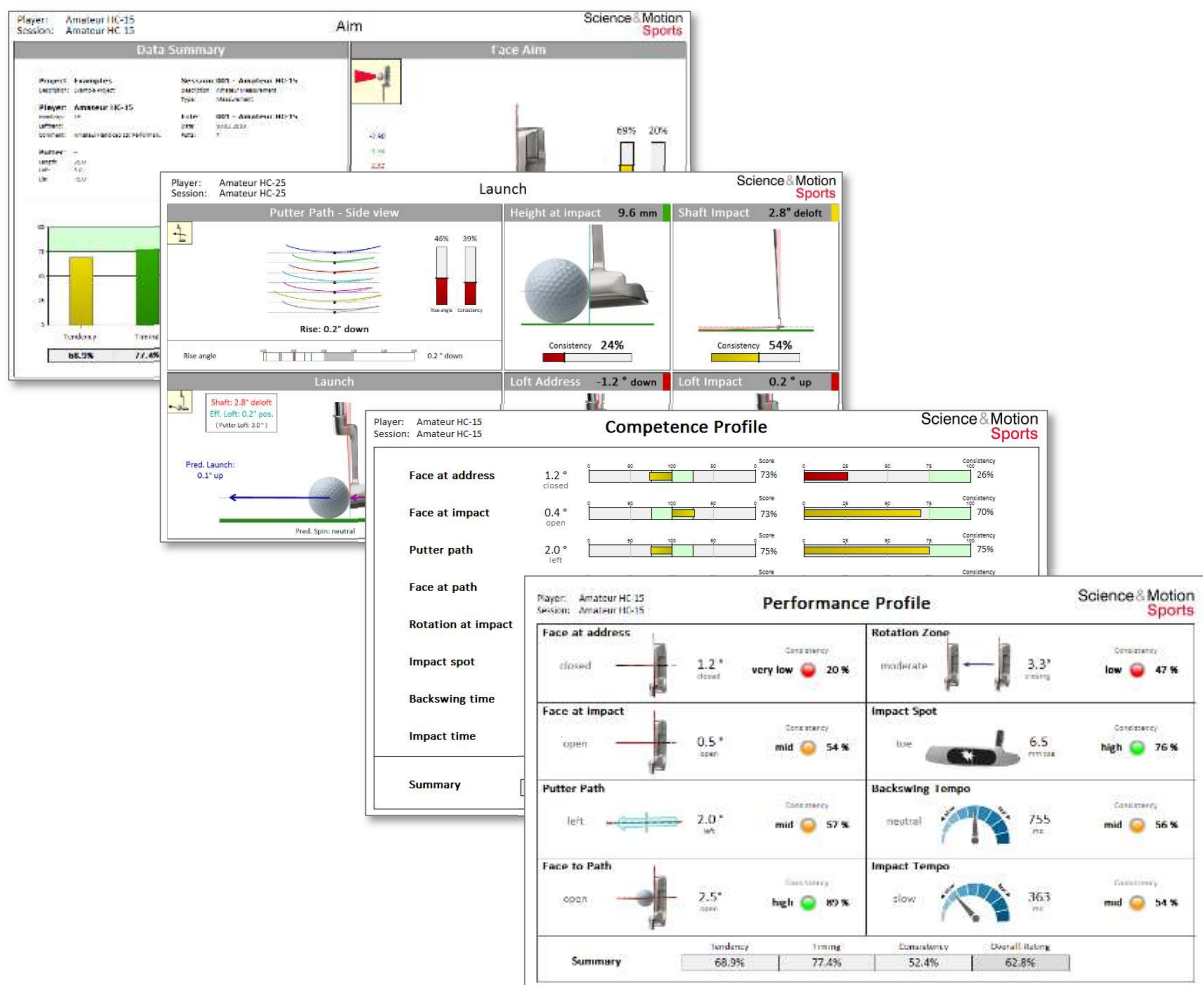


Science & Motion Sports

SAM PuttLab 7

Reports Manual



Reference

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SAM PuttLab 7 Reports Manual [02/2021]

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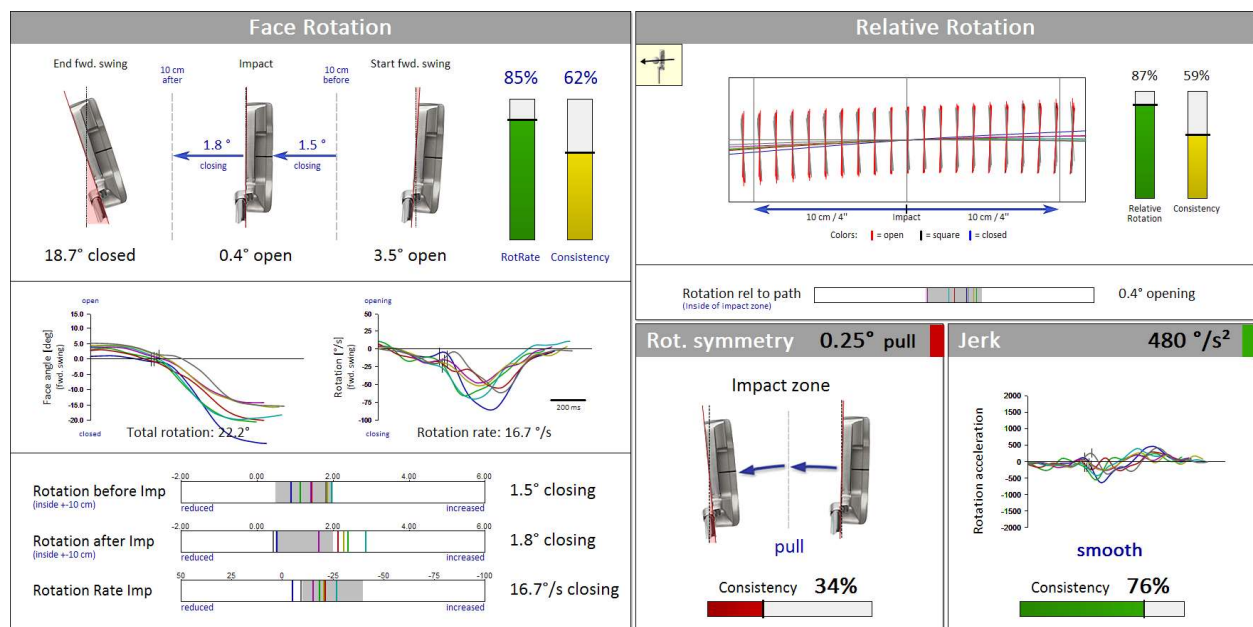
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1. SAM PuttLab Reports overview

1.1 What is a "Report"

<mailto:support@scienceandmotion.com>

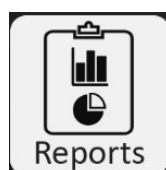
SAM PuttLab Reports display the putting data using images, graphics, numerical data, data bars, or Scoring bars. The Reports consist of an arrangement of different “Tiles”. A Tile is a defined data view in which the results are presented in easy to read graphics and numbers. The size of the tiles is full-screen (XL-Tile), half-screen (L Tile), quarter-screen (M-Tile) and one eights screen (S-Tile).



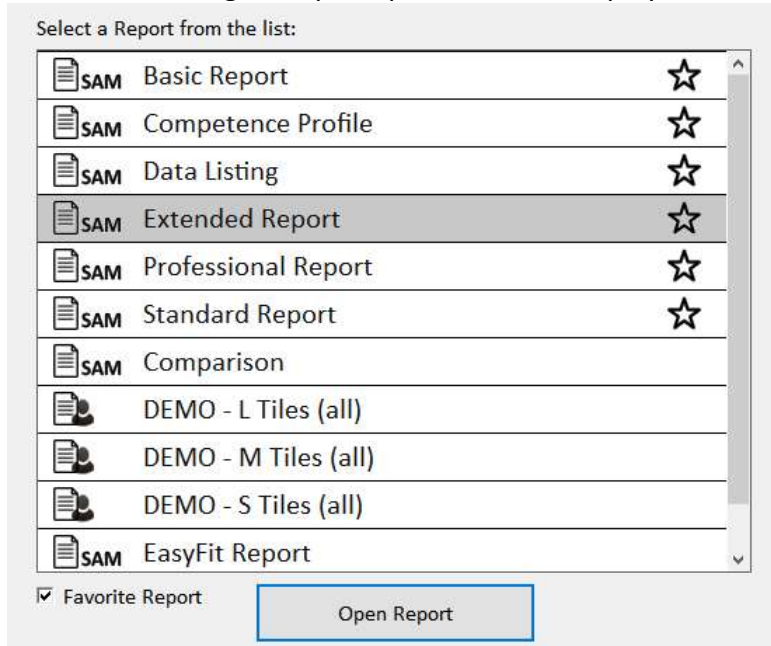
Many predefined Reports are delivered with SAM PuttLab (e.g. Extended Report). Own Report designs arranging Tiles on Report pages or modifying existing reports can be easily created and stored with the Report Builder (see 1.3).

SAM PuttLab **Reports** can contain up to 10 **Report Pages**, and on each **Report Page** different **Report Tiles** can be combined.

A Report can be selected by clicking on the “Reports” button on the main screen:



A Selection dialog will open up where a list displays all available reports:



There are two categories of Reports:

a) SAM Reports



These Reports are created by Science & Motion Sports and are part the original installation.

b) Custom Reports



These Reports are created using the "Report Builder". In the original installation there are some sample Reports available to give an overview about all existing tiles.

Reports can be set as "Favorites" by checking the "Favorite Report" checkbox:

☒ Favorite Report

Favorite Reports are listed on top of the list.

The list is sorted alphabetically.

Some specific sessions have a dedicated default Report.

These sessions are:

- Putter Selection
- Putting Optimizer
- Putter Fitting

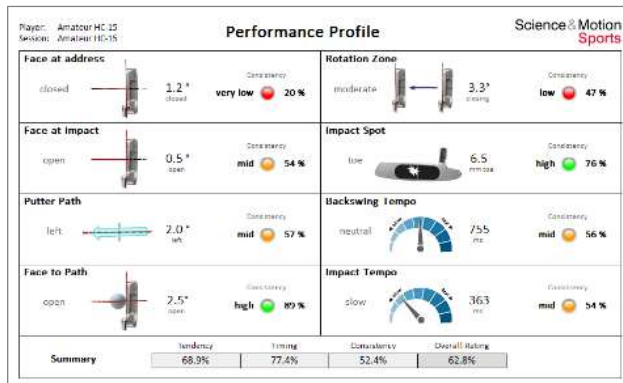
To open the default Report for a session just double-click on the corresponding session entry in the list:



1.2 Default Reports

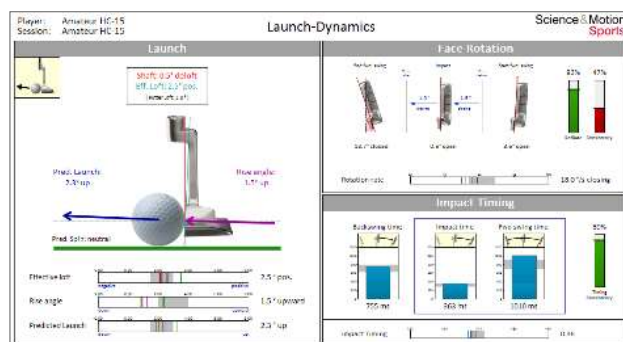
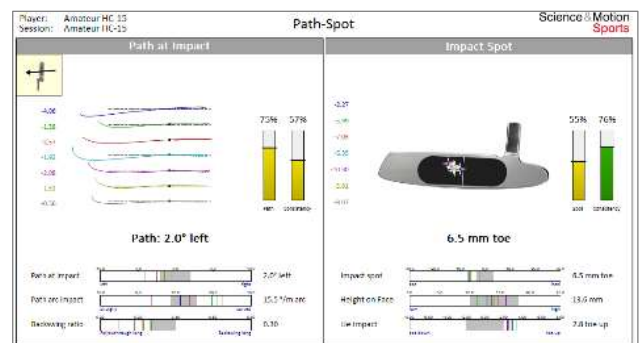
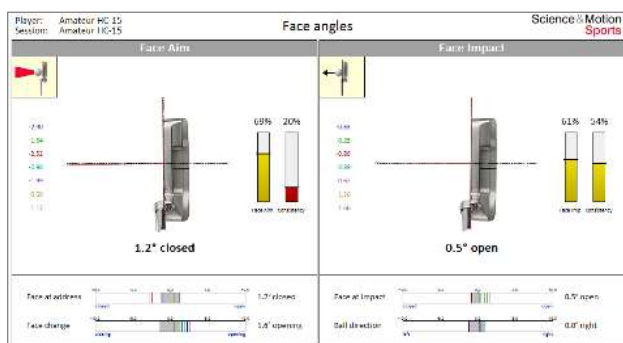
1.2.1 Performance Report (1 page)

Easy to understand overview on putt performance on one page with pictograms.



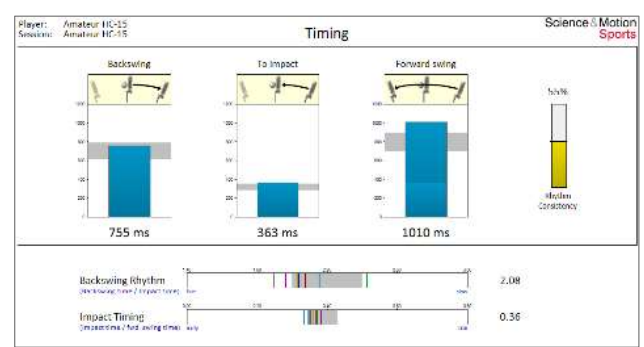
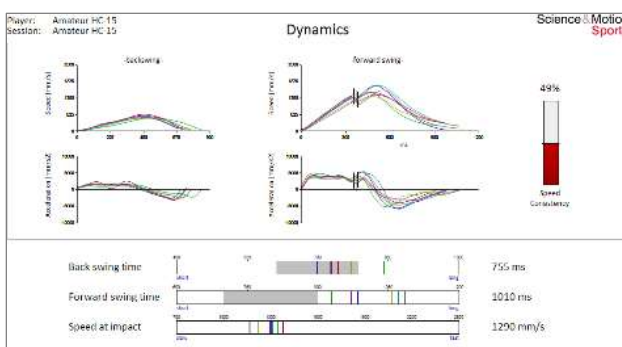
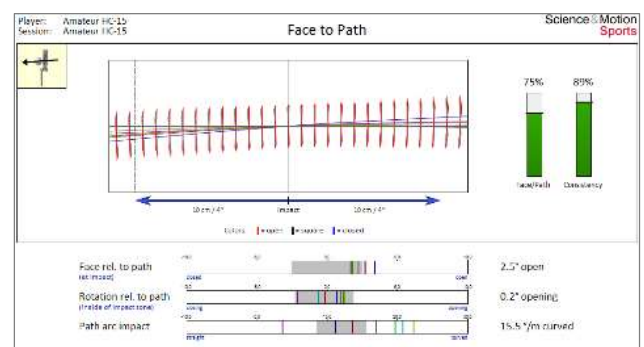
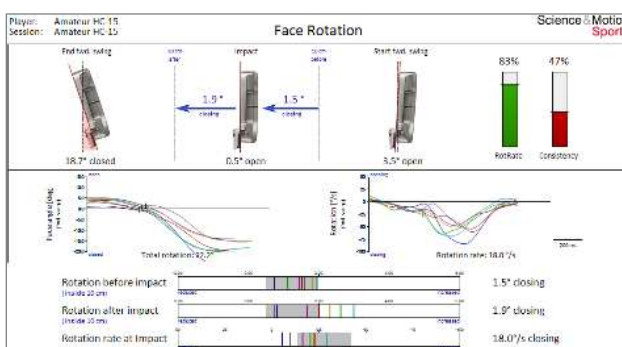
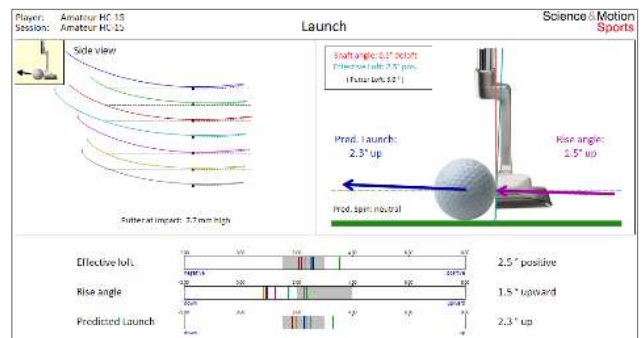
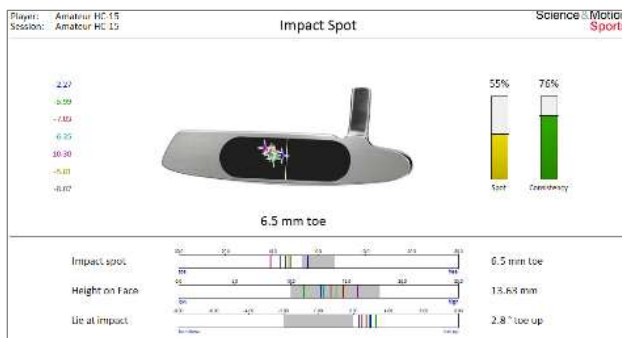
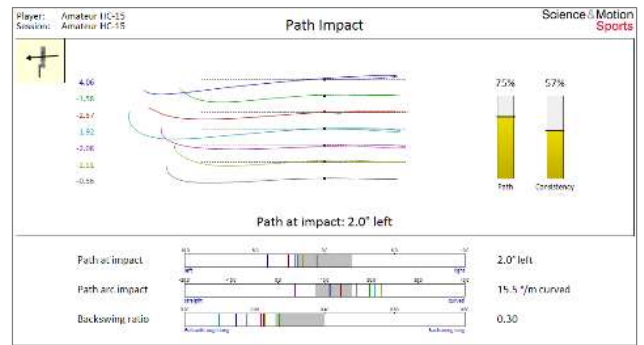
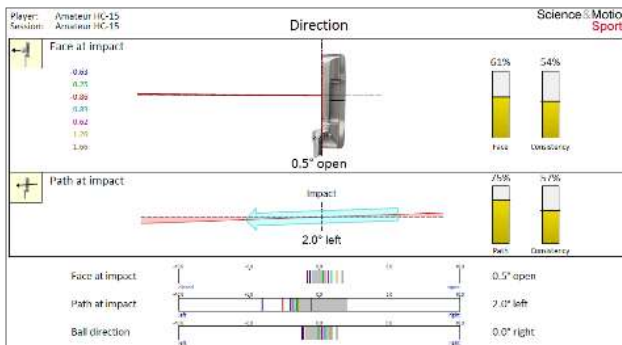
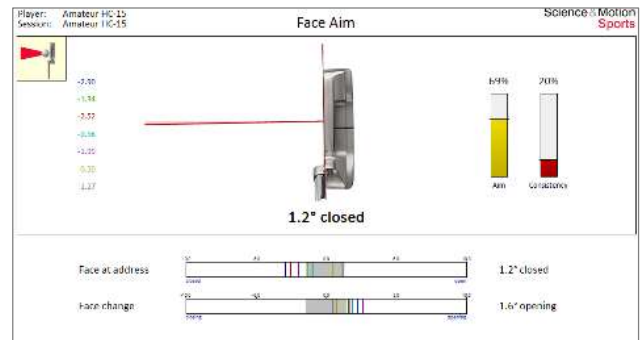
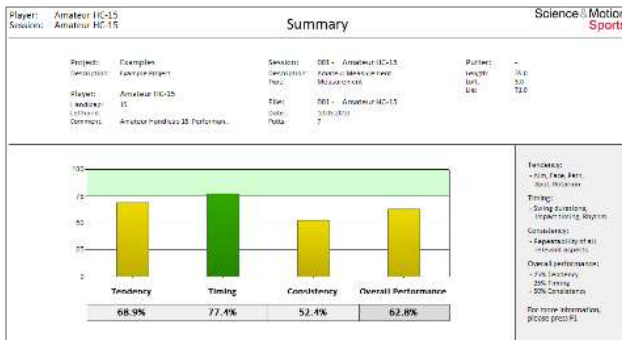
1.2.2 Basic Report (3 pages)

Easy to understand and basic information on performance, also to be handed out to the customer.



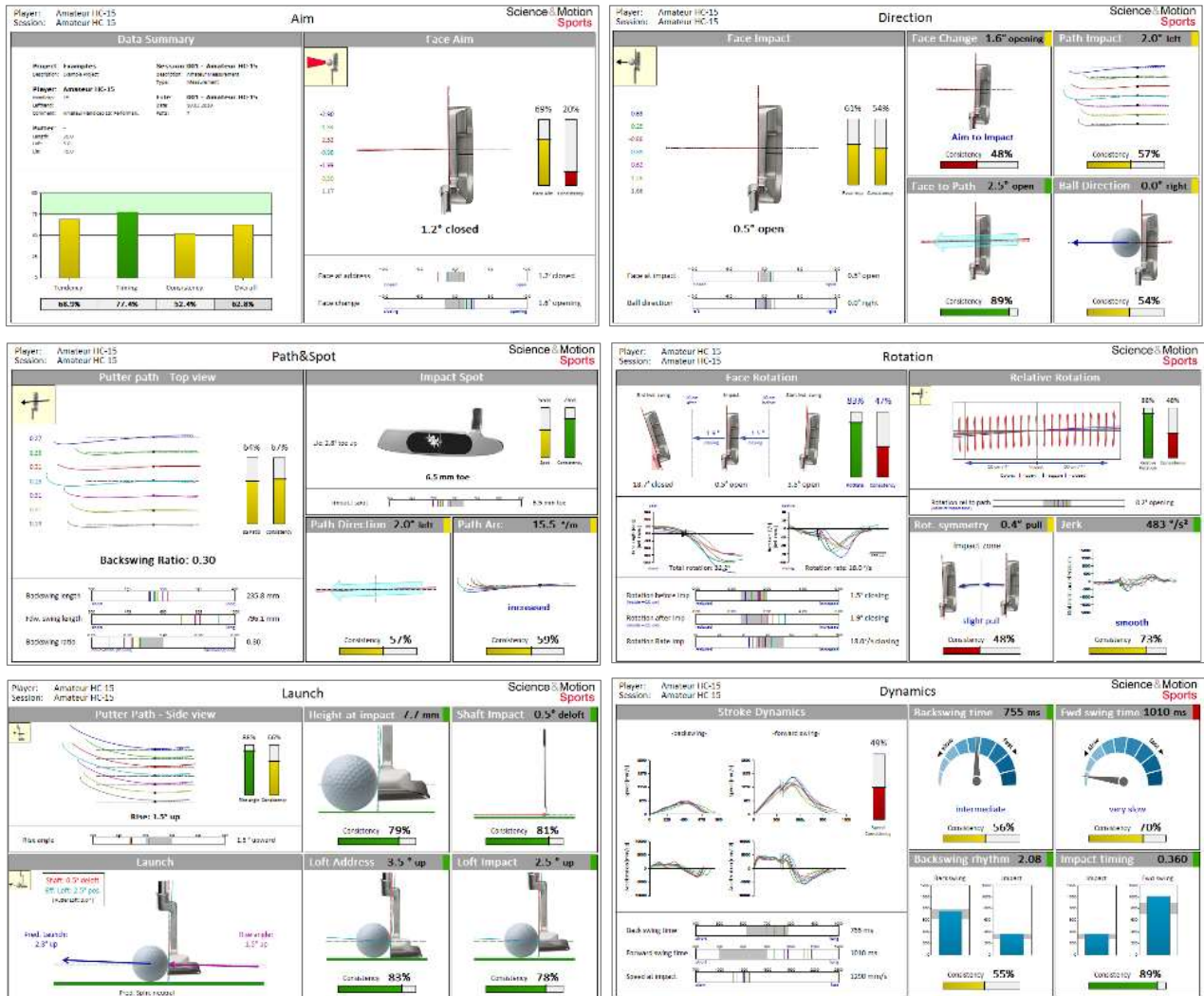
1.2.3 Extended Report (10 pages)

Expert report with comprehensive information.



1.2.4 Professional Report (6 pages)

Expert report with condensed information on 6 pages.



1.2.5 Compare Report (10 pages split screen, see Extended Report))

Report to directly compare two data sets (sessions, players, before/after) side-by-side. Same information as in the extended report.



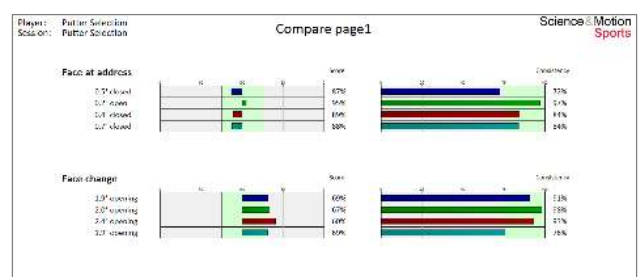
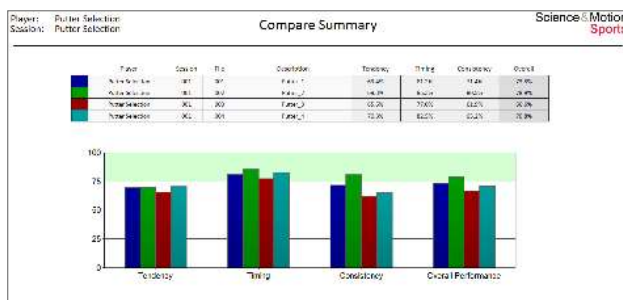
1.2.6 Competence Profile (1 page)

Overview on putting performance for technique and consistency. Very helpful as a first report after a measurement.



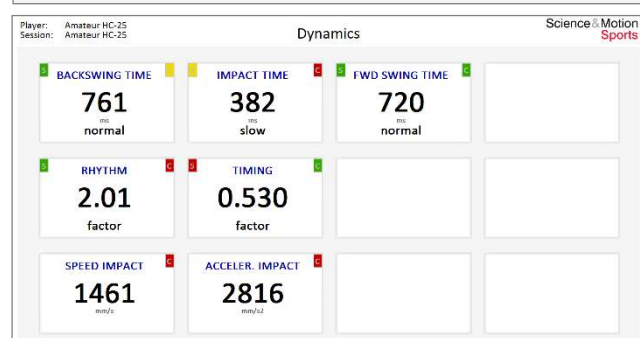
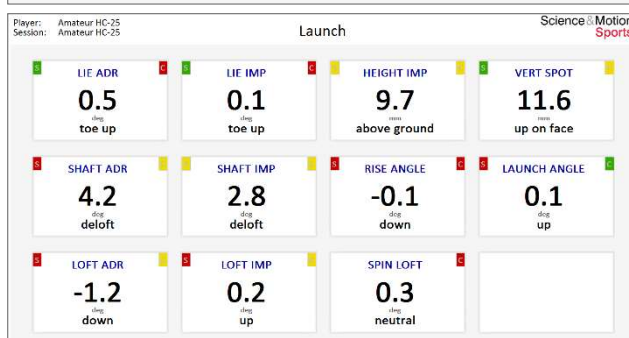
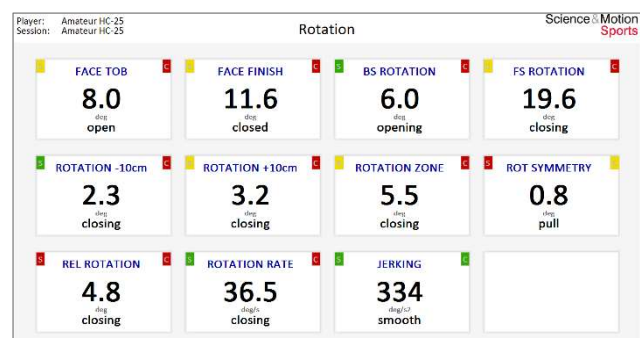
1.2.7 Multicompetence Profile (8 pages)

Direct comparison of up to eight data sets with competence profiles.



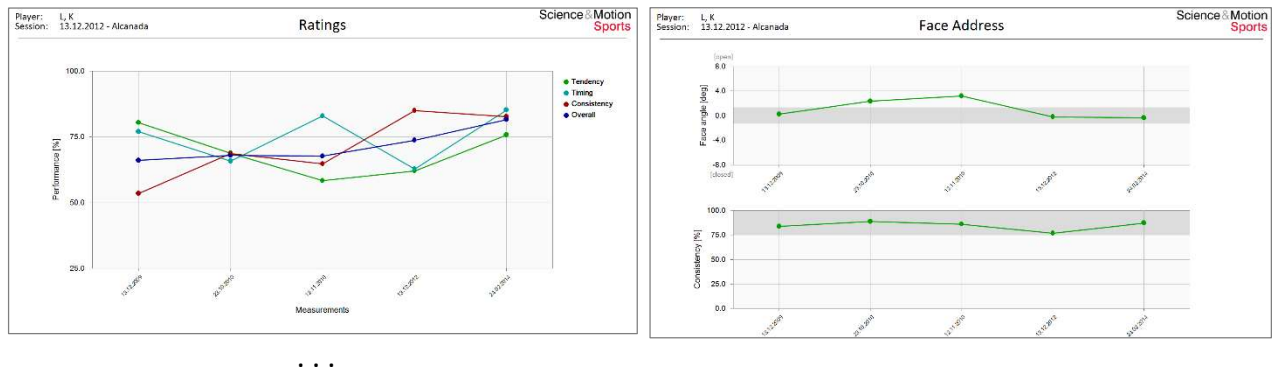
1.2.8 Data Listing (4 pages)

Data display of all relevant PuttLab parameters, including Score and consistency categories.



1.2.9 Player History (9 pages)

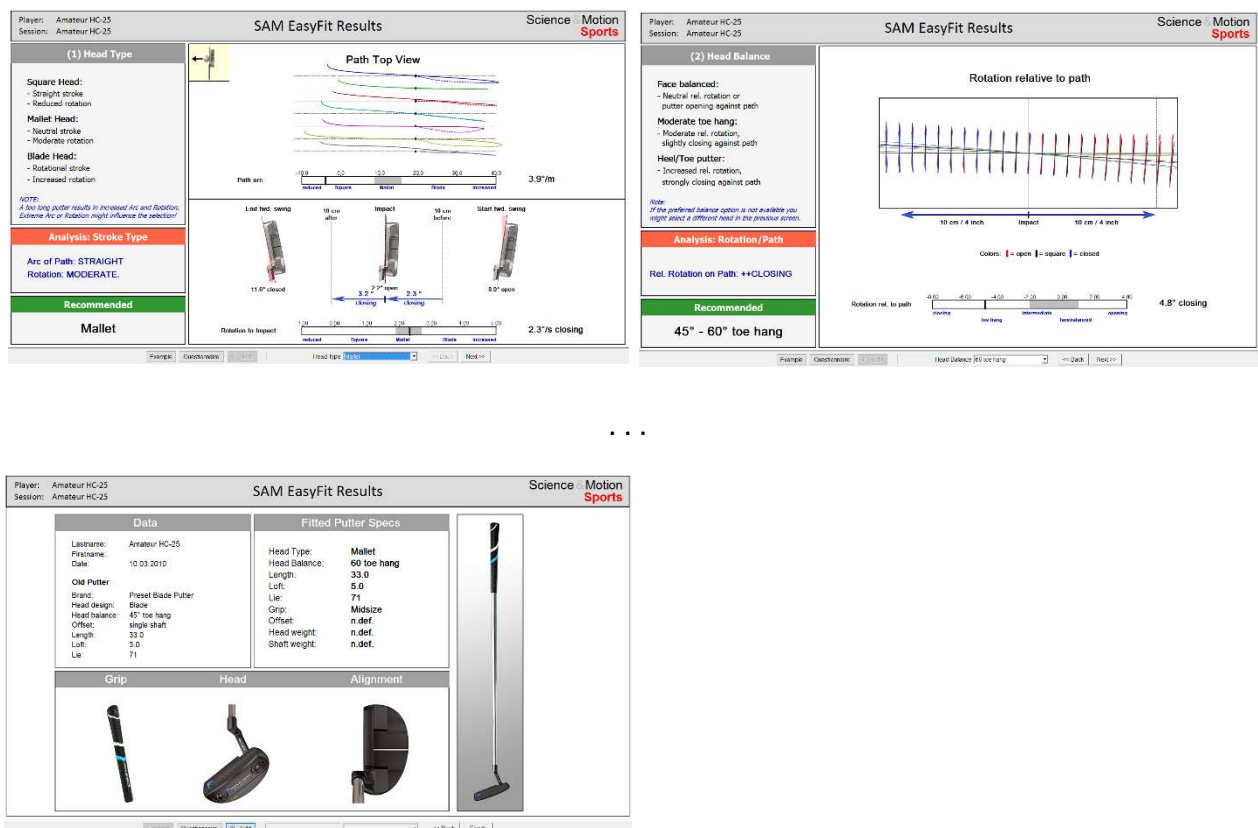
Performance charts of a player for Technique and Consistency over time.



1.2.10 EasyFit Protocol (6 pages)


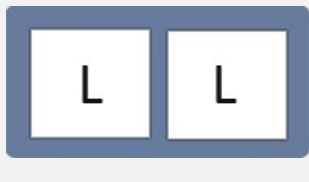
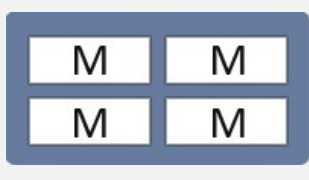
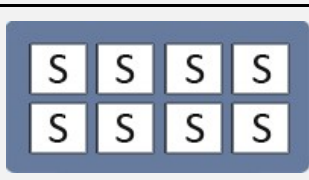
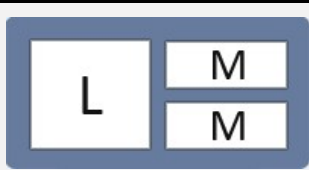
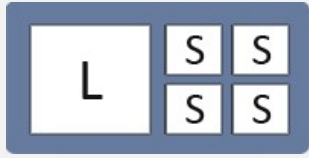
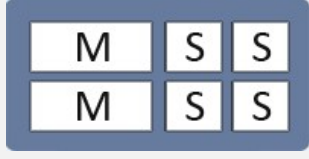
Post-hoc interactive EasyFit Fitting Protocol session for existing data sets.

Same reports as for the the EasyFit Measurement session.



1.3 Report Tiles

Report Pages are composed with Report Tiles of different sizes:

X Large (XL)	One XL-Tile fits on one page. The extra-large XL-Tiles are the most detailed representation of a result parameter. XL-Tiles are comparable with the old Screen report pages of previous PuttLab versions.	
Large (L)	2 L-Tiles fit onto one page. Large L-Tiles still show very detailed information and allow two see two main parameters on one page.	
Medium (M)	4 M-Tiles fit onto one page. Medium M-Tiles show less details than L but allow to see 4 different aspects on one page.	
Small (S)	8 S-Tiles fit onto one page. Small S-Tiles show less details than M but allow to see 8 different aspects on one page. This might be helpful during training.	
Mixed Tiles	<p>Besides the usage of equal sized Tiles on one page there are three more options for mixed designs a Report Page.</p> <p>Mixed designs allow to combine Tiles with more detailed information with Tiles containing less information and to cover multiple different parameters.</p>	  

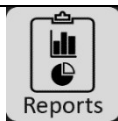
The PuttLab Software includes more than 80 existing tiles for all relevant putting parameters. Customized report designs can be created with the Report Builder.

1.4 Report Builder

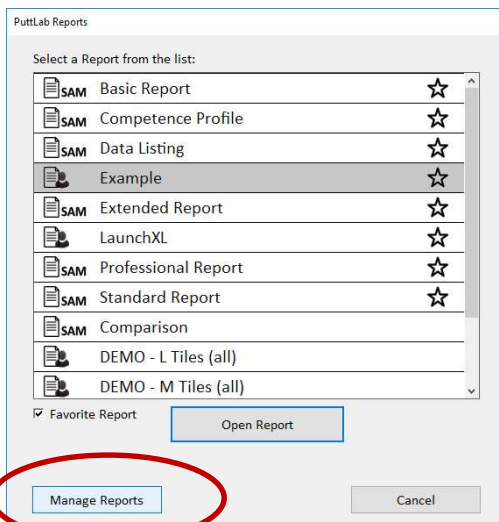
With the Report Builder it is possible to create customized Reports or to edit existing ones. The software allows to add or edit pages and to choose from a selection of more than 80 existing tiles for all relevant putting parameters. The Tiles are available in different sizes (see chapter 1.2 Report Tiles).

To learn how to create your own Report page, you can also watch our Tutorial Video on YouTube: <https://youtu.be/Zs9B-wX6vX4>

How to create your own Report Pages:



Click the Reports Button on the right side of the main screen to open the Report Builder.



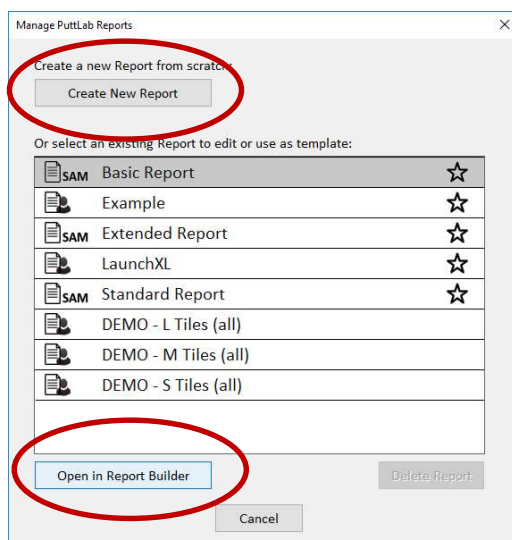
The PuttLab Reports window opens.

It contains a list with all available Reports.

You have two options:

1. Open an existing Screen Report.
2. Manage your Reports (add an existing Report or create a new Report in the Report Builder).

Click the Manage Reports button to create your own Report page.



The Manage Reports window opens.

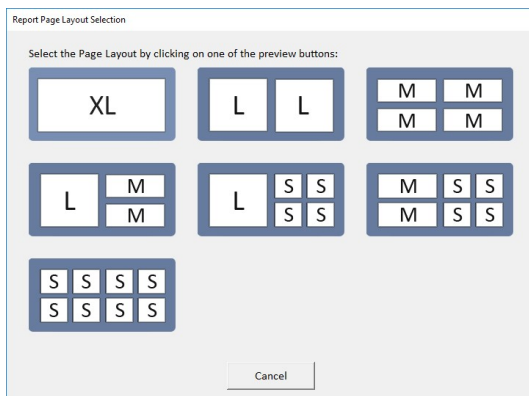
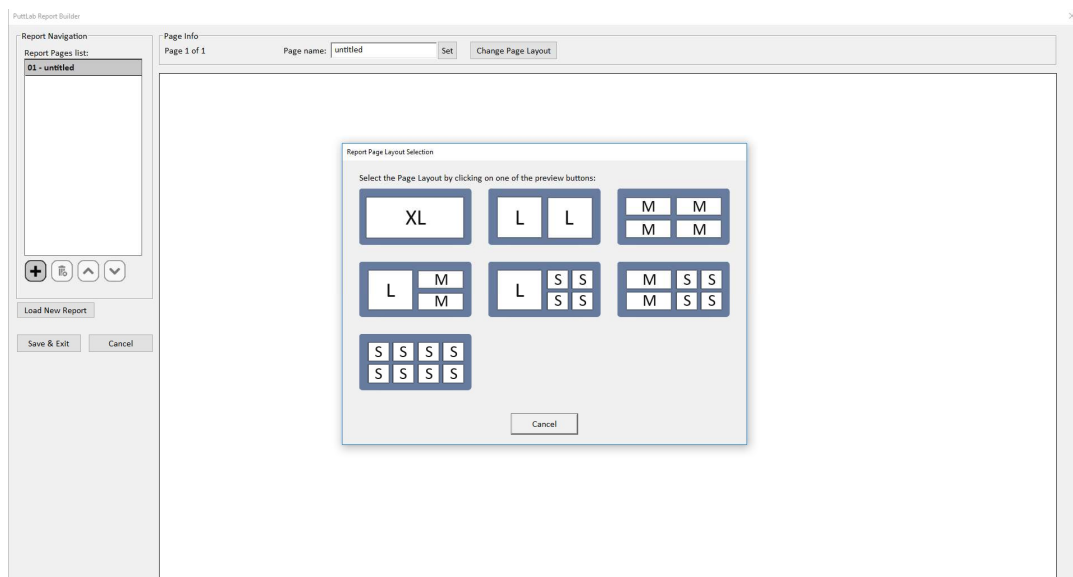
It contains a list with all available Reports, which can be customized.

You have two options:

1. Select an existing Report to add it.
2. Create a new Report.

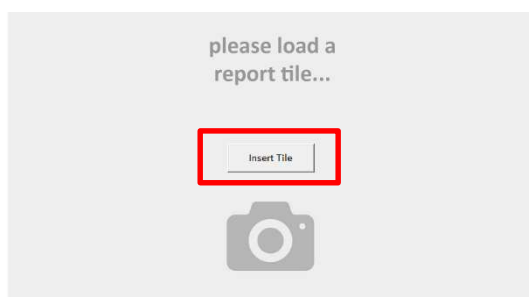
Click the Open in Report Builder button to create a new Report.

The Report Builder screen opens:



Choose the Layout of the first Report page by clicking one of the preview buttons in the Report Page Layout Selection window in the middle of the screen.

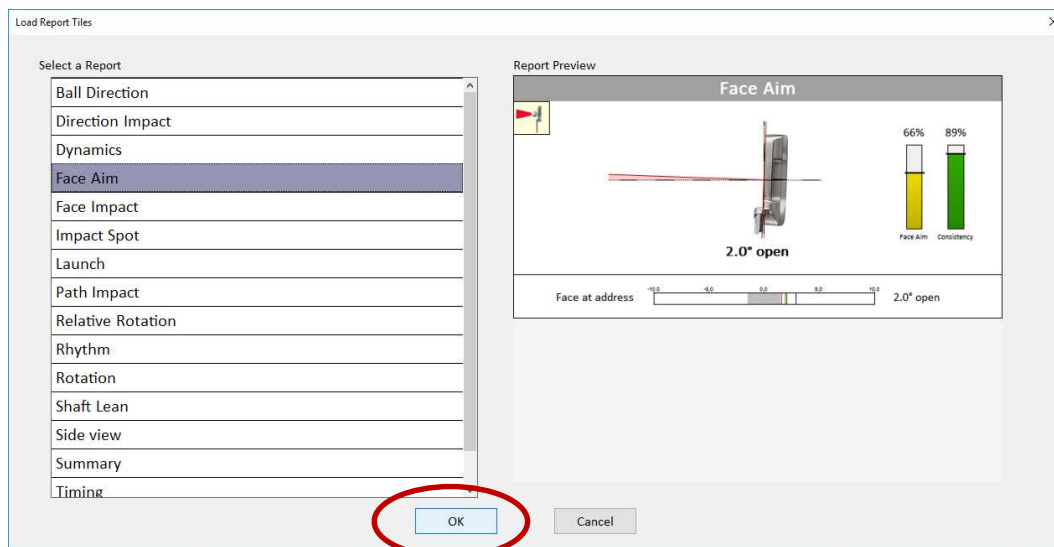
The chosen Layout will then be displayed in the Report Builder.



On every available space in your Layout you can see the Insert Tile button in the middle.

Click one of the Insert Tile buttons.

A list opens showing all available Tiles for the Tile size you have selected:



Select the Tile you want to use and add it to the Report Page by pressing the OK button. The preview image on the right will help you make a selection.

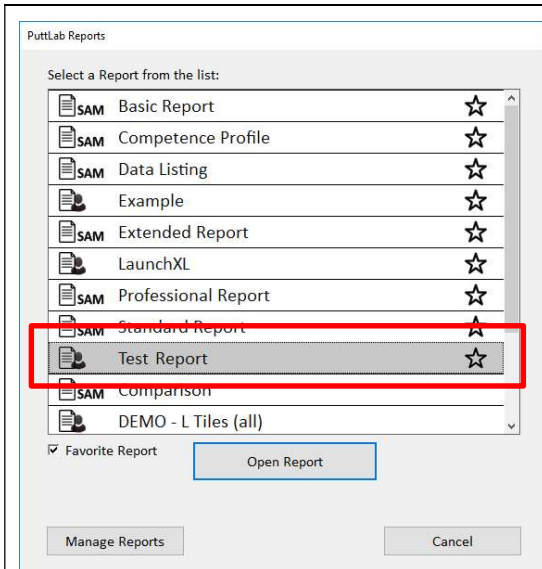
While you build a customized Report, you can immediately see how the result will look like:



Page name:

After you have composed your Report Page, you can give it a name.

Enter a title in the Page name field and press the Set button.



Now you can see the new Report page on the list on the left side.

If you want to change the name, enter a new name and press the Set button again.

Change Page Layout

You can change the Page Layout by clicking the corresponding button on the top.



Report Navigation

In the Report Navigation on the left side you can create the next / a new Report page by clicking the plus symbol:



Up to 10 pages can be designed and saved in one Report.

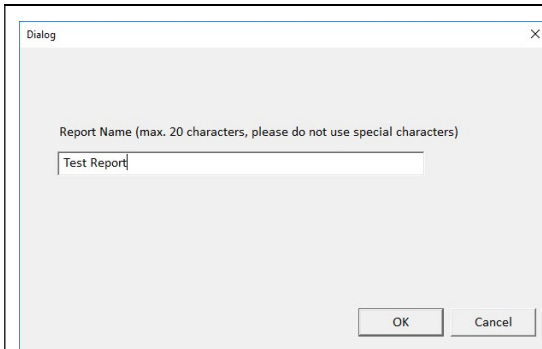
To delete a page click the trash can symbol:



Sort the Report Pages by clicking the up and down buttons:



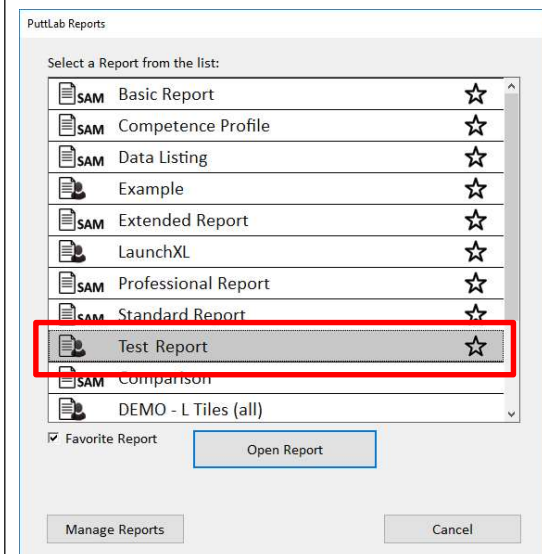
After you have composed your Report click on the Save & Exit button.



The Report Name dialog opens.

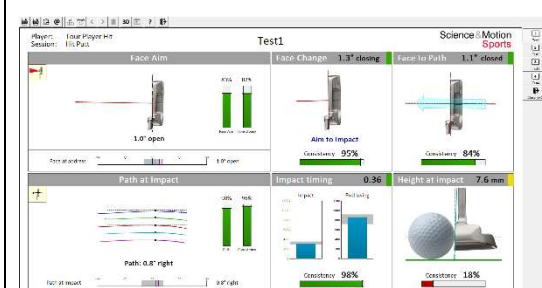
Enter a name for the Report and press OK.

After it has been saved, the Report Builder will close.



When you click the Reports button on your main screen again, you can now select your new customized Report from the list.

Click on Open Report.

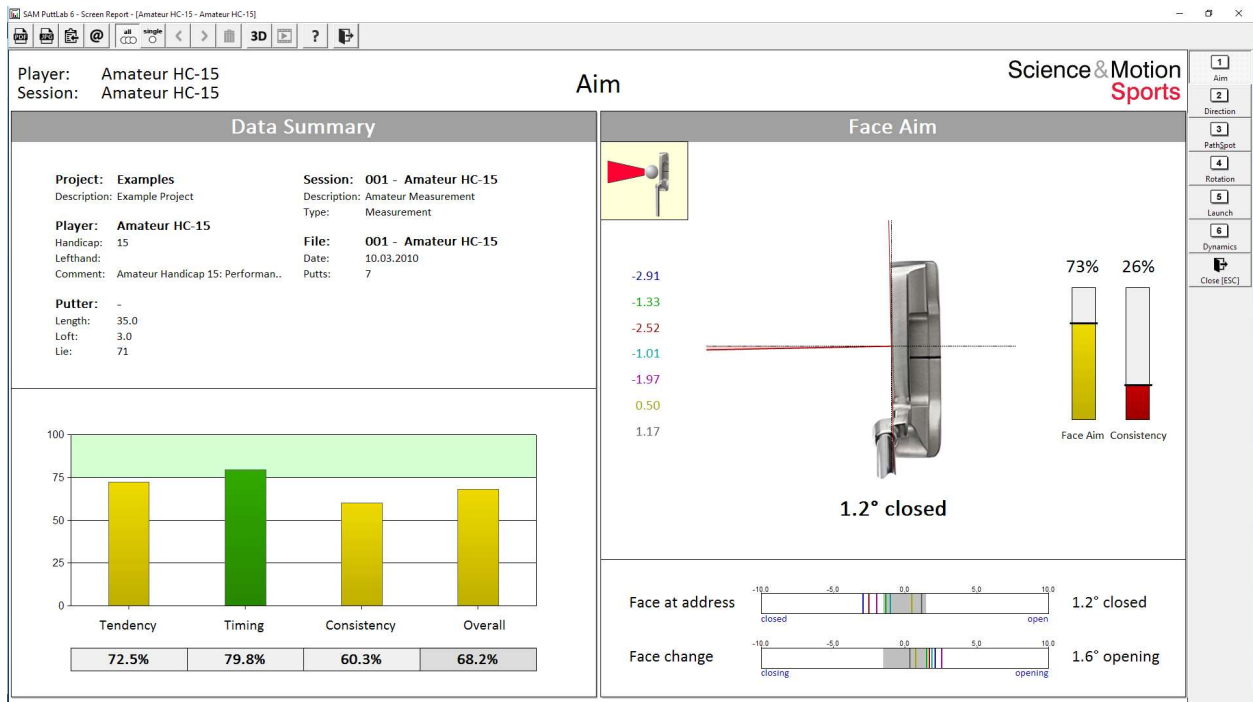


The Report will be displayed in the Report Screen.

The Reports can also be used in the Training mode.

You can learn more about the Report Screen in the next chapter of this Manual.






1.5 Report Screen



SAM PuttLab reports show the results for the currently selected dataset in a multi-page document with different graphical elements, data bars, numbers, or Scoring bars. A report page can show a composition of different Tiles in different sizes (see 1.3). The report elements are described more in detail in Chapter 2.

You can scroll through the different report pages via the toolbar at the right or by using the page up / page down keys.

The following functions can be executed via the toolbar at the top:

-  - Open or print the report as PDF document
-  - Save the report page as a JPG picture file
-  - Copy the report page to the clipboard
-  - Send the report as PDF via your email account
-  - Switch between all putts and single putt display, and corresponding scroll buttons



- Delete single Putts (only in single putt display mode)



- Display the putts in the 3D Module (or the 3D Putt add-on software)



- Play corresponding videos (if available)



- Close the report

Function keys

Function keys are available for direct access to important Report functions:

[F1] – Help on Reports

[F2] - Open or print the report as PDF document

[F3] - Save the report page as a JPG picture file

[F4] -

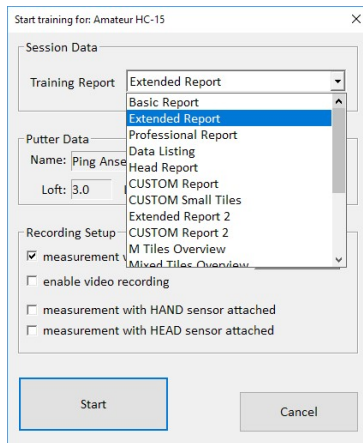
[F5] – Switch the Score bars on and off

[F6] – Switch the Consistency bars on and off

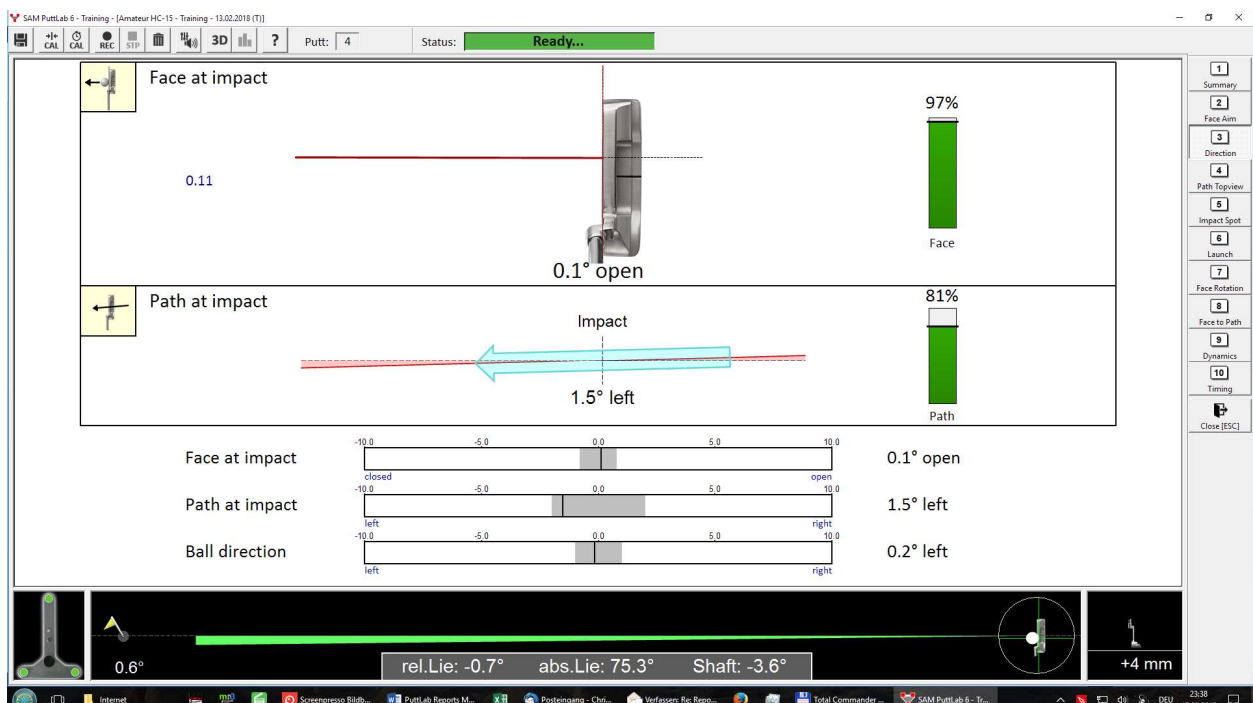
[F7] – Switch the numerical single data display on and off

1.6 Training Reports

Most of the Reports can also be used for training sessions. If starting a Training the training report needs to be selected from the dropdown list:



Then the Training Screen is displayed which is quite similar to the Report Screen, but the training report shows data for each single putt. There is no Consistency rating in the training report, as only one stroke is displayed at a time. The actual number of recorded putts is shown in the upper Toolbar. The report display is slightly reduced in size so that in the lower part live data can be displayed.



Customized training reports can also be designed in the Report Builder (see chapter 1.3).



Some of the reports which display specific data are not available during training, such as Comparison Reports or the Players History.

1.7 PDF Reports - printing

All Reports can be viewed and saved as a PDF.

Press the PDF button in the toolbar at the top of the report screen to create a PDF from the currently displayed report:



The PDF document will then be opened with the standard PDF viewer of your computer.



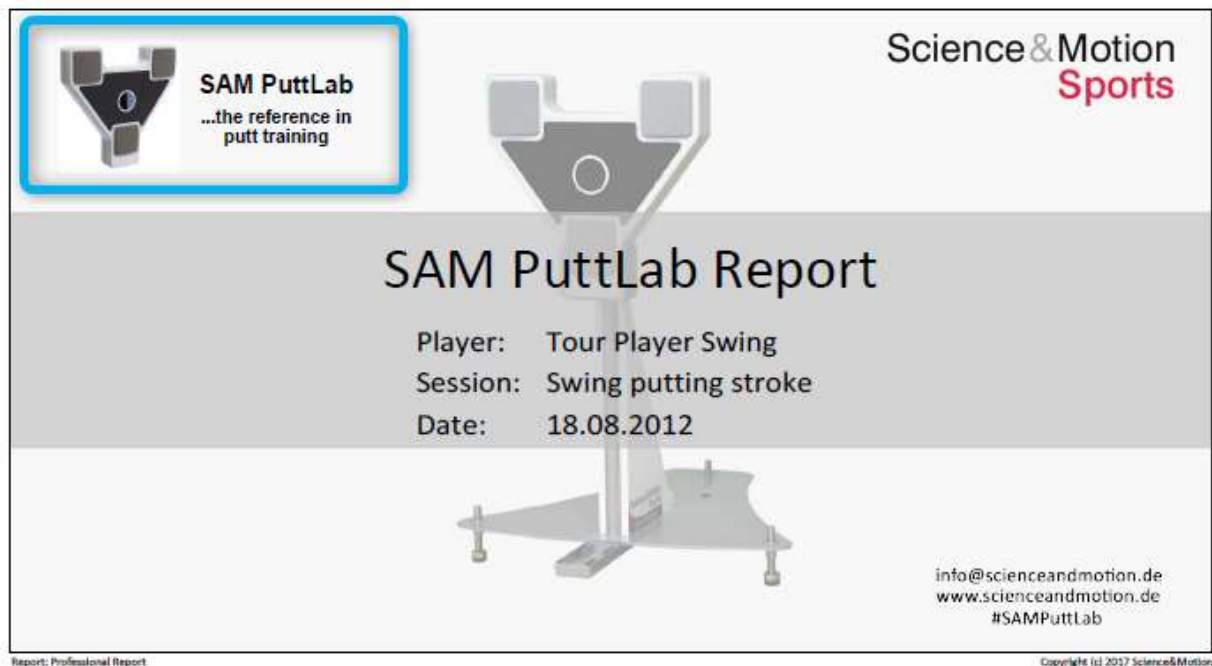
If you do not have a PDF viewer installed please download and install the Adobe Reader.

In the PDF viewer software you can use the print options to create printouts, or you can save the report as a PDF file to your local disc or cloud drives.

A cover page is added to the reports with some basic information on the dataset such as the player's name, the session name and the measurement date.

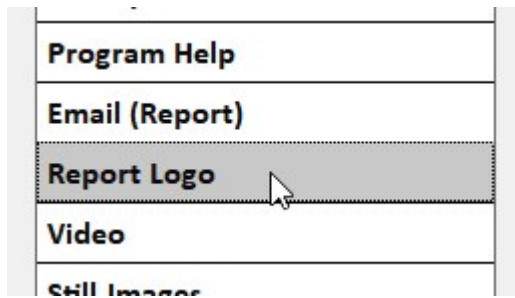
Adding a custom logo

To promote your location or business you can add a custom logo to the cover page
The standard cover page looks like this:

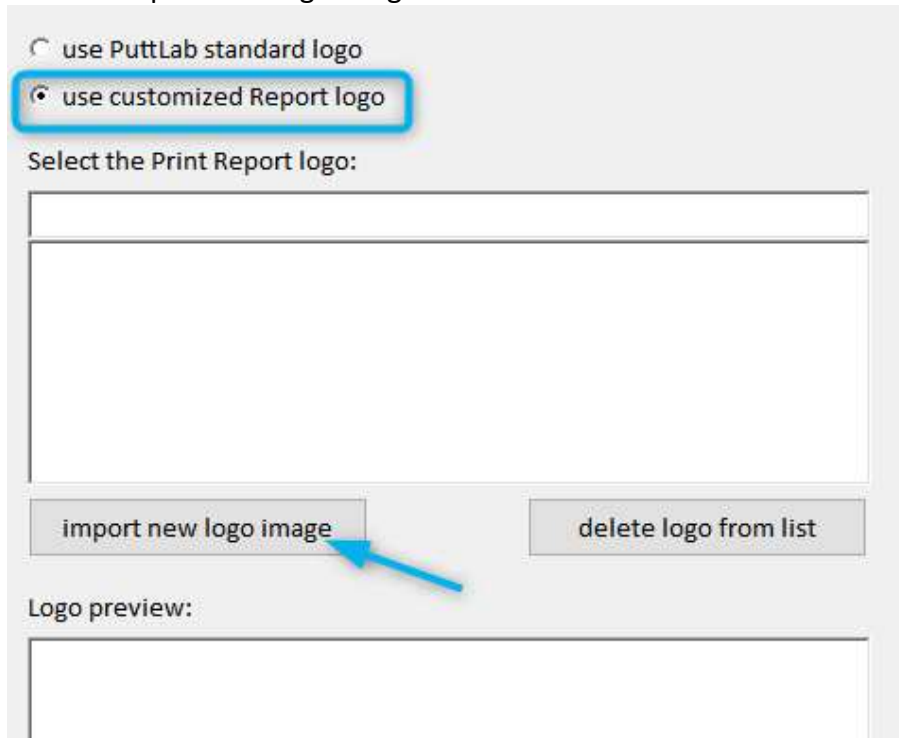


The area for the custom logo is the upper left corner, marked here with the blue box.

To add a custom logo open the program settings in the main screen and select the option "Report Logo".



In the settings window click on the option "use customized Report logo" and then press the button "Import new logo image":



Your custom logo should have a landscape format and a width/height ration of about 1.6 to fill the allocated space in an ideal way. After importing the logo file it should be available in the file list and you should be able to see it in the logo preview. Save the selection by pressing OK in the settings window

To check if the new logo is displayed in the right way open a Report and press the PDF button. The cover page should then show the logo in an adequate format and size:



There are two other options to export Report pages to graphics or to the clipboard:



This button will save the actual report page as a JPG picture file.

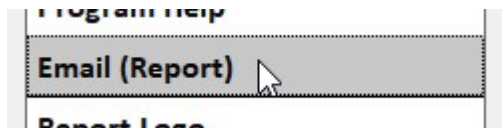


This button will copy the actual report page to the clipboard. You can paste it to any other software like Word or directly into an email.

1.8 Emailing Reports

Complete PDF Reports can directly be emailed using either the installed email client program or using the Email engine built in into the PuttLab software.

Before this option will be functional the Email settings have to be set in the general PuttLab settings. Open the program settings in the main screen and select "Email (Report)":



After the settings are finished you can send emails by pressing the email button in the top bar of the Report screen:



If the actual player's email is already available in the Player data this email will be used. If not you will see a prompt where you can enter any email address. Then just press the "Send" button.

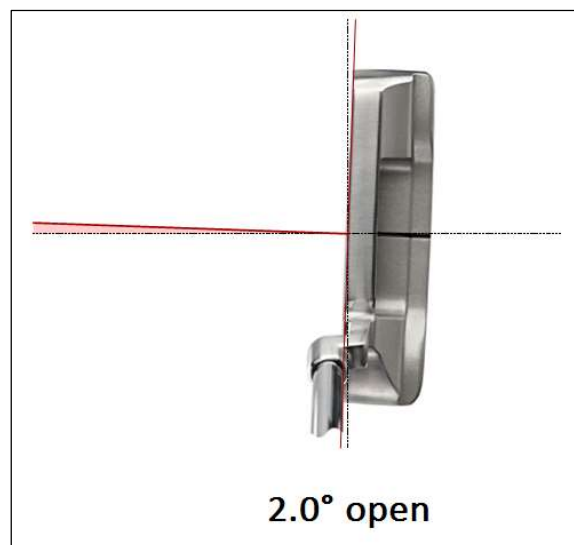
2. Report elements

SAM PuttLab reports display the results in a multi-page document with different graphical elements, data bars, numbers, or Rating / Scoring bars. A report page can display a composition of different Tiles in different sizes (see 1.3). In the following the different report elements are described in detail.

2.1 Data images

Reports include graphical displays of the results. This can be a data based image with additional numerical result display (e.g. Face angle). The data value represents the average value of the multiple putts. This face angle graph shows the EXACT true average data value (twisting of the putter face against the target direction) of 2.0 degrees. So you can also identify the deviation from optimum face angle by inspecting the picture itself. In this case the red triangle areas help to interpret the result.

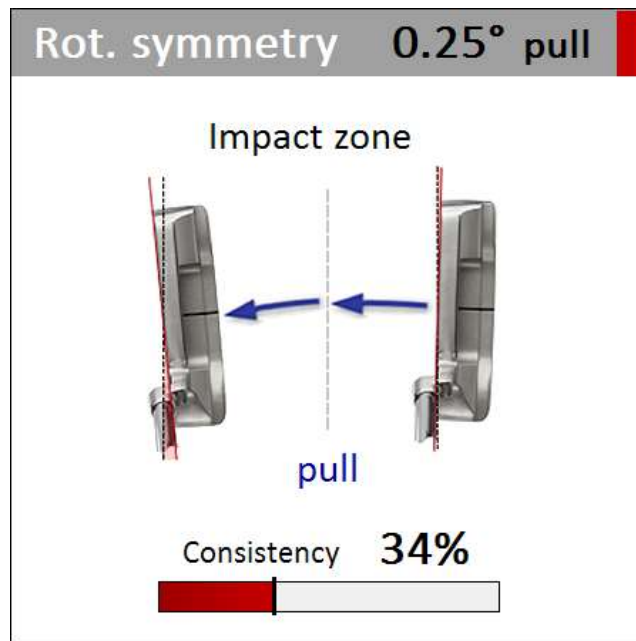
The average data value is the basis of calculating the corresponding **Score** rating (see 2.6).



- Graphical elements are often combined with Score and Consistency ratings (see 2.6) to allow to interpret the meaning of the average value. If in this case the putter face is open by 2 degrees at aim, it does not say much about the single putt data. If it were random data with a big variability it would show the inability to aim the putter, but it could also be a consistent deviation which would NOT be the inability to aim. Reason for consistent mis-aim could also be a problem of visual perception (seeing the hole on a wrong spot). Consequently, consistent and inconsistent data needs to be interpreted differently (see 2.6).

2.2 Pictograms

Reports images can also include *pictograms* which are predefined pictures that are selected corresponding to the category of the result. Pictograms classify the result and often also explain the meaning of result. Pictograms are normally only used in the small S-Tiles.



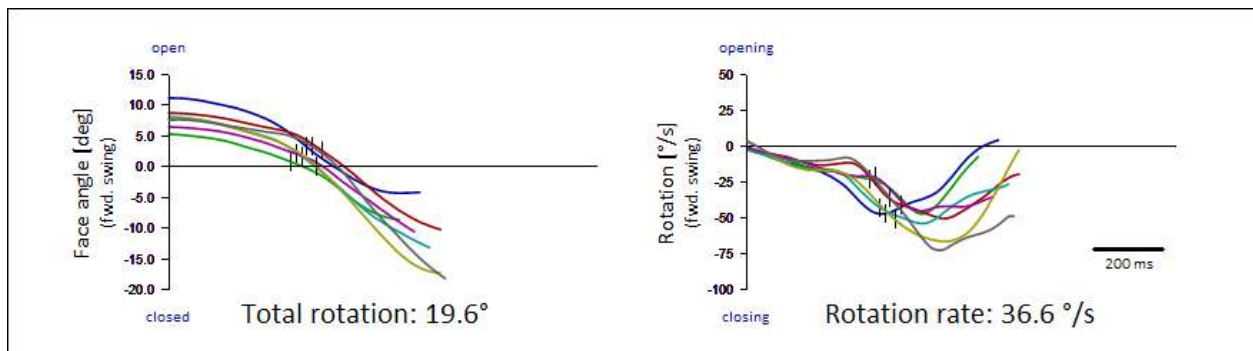
A pictogram is different to a data image as it does NOT exactly represent the data value itself. A pictogram is used for a specific category or *data range*. There are 5 data ranges used to select a pictogram, which also correspond to the Score for this parameter. If the Score is above 75%, you are in the normal (or neutral) range. If the Score is between 50% and 75% you are in the acceptable data range. If the Score is below 50% you are in the extreme data range.

Most pictograms contain additional wording to help to interpret the result. The categories for the parameter "Rotation symmetry" are "neutral", "slight push" or "slight pull", and "push" or "pull". In this case we see a pull stroke where the rotation is increased after impact by 0.25 degrees in the impact zone.

The average data value is the basis of calculating the corresponding **Score** rating (see 2.6).

2.3 Data curves

For some of the parameters the data is displayed with data curves. Curves are displayed for putter path, face rotation or speed and acceleration graphs. In the data curves the backswing is displayed with dotted lines (e.g. for path) and forward swing with a solid line.



The results for the different putts are displayed in different colors. The color for a specific putt will be the same for all views in this report. This allows comparing different parameters for the same putt.

The colors for the subsequent putts are that same as for the display of single data values (see 2.4). So the data value you see in the data list is correspond to the data curve you see in the graphs. The first putt is blue, the second green, and so on. Impact is indicated with a small vertical stripe.

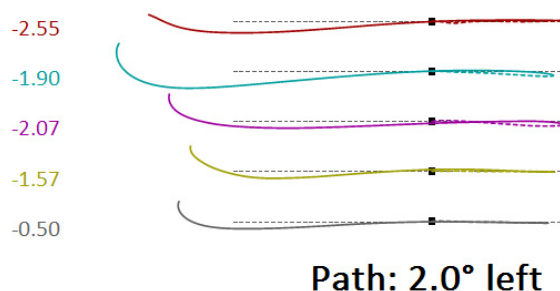
Data graphs are used if the course of the data over time is helping to understand details of performance better as if using typical data values only. However both representations of the data match together. Per definition the parameter is a data value at a specific position or a specific time, so all parameters are based on data curves (if they are not a combination of other parameters).

If we e.g. look at face angle (as in this graph) we see the face angle over time in the upper left graph. The data value at impact (the curve value exactly at the vertical stripe) is now exactly the same value as you will see for Face at Impact in the direction reports. If the stripe is exactly at the zero line then the face will be square. By inspecting the data curves you can now identify potential causes “why the” face at impact is not square which is important for training intervention. There might be problems in face rotation, but there might also be a problem that the face is already too much open at top of backswing.

In the right graph you see the amount of face rotation over time. The stripe is again impact. The data value shown in this graph (Rotation rate) corresponds to the average data value of the curve exactly at the stripe position (impact).

2.4 Single data values list

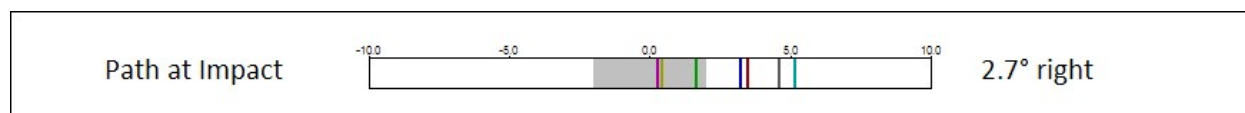
In the XL and L tiles single data values for each putt are displayed for the main parameter displayed in the report. The data for the first putt is at the top (blue) and the last putt is at the bottom. In this example the single data values for path direction are displayed. The same data values are also displayed in the bar graphs (see 2.5)



- The single data value display can be switched off and on with the function key [F7]

2.5 Single data values in bar graphs

In the XL and L tiles bar charts in the lower part of the report provide detailed information on each single putt. The numbers on top of the bars correspond to the data scale. The colored vertical stripes within the bars represent the different putts. The grey areas indicate the optimum data ranges as derived from the PGA Tour data sample.



The data value on the right side of the bars represent the average value for this parameter, and the vertical lines in the bar show the value for each putt. So you can inspect in detail both the average performance and the variability of your putts. The average is the basis of calculating the corresponding **Score** rating.

The spread of the single data values indicates the distribution for the single putts. The distribution of the data is the basis of calculating the corresponding **Consistency** rating. For high consistency of movement execution the stripes should be grouped very close together.

The grey area inside of the bar graphs represents the benchmark range and represents about 68 % of the Tour player's performance. For a high performance your results should be inside of this range but should also be grouped close together. The benchmark range data has been collected from about 100 European PGA Tour Players and shows their average performance and variability.

2.6 Score and Consistency rating

The **Score** rating shows the deviation from the optimum data value on a uniform scale. The raw data value is compared with a Tour data sample and then the Score rating is calculated. This allows to directly compare the performance in all parameters directly with each other. A Score of 100 % means that the performance is optimal. A Score rating of 75 % means that the performance is as good as for 68% of the Tour player's.

The **Consistency** rating shows the distribution of the data values of the single putts on a uniform scale. The raw data values are compared with the distribution of the tour data sample and then the consistency rating is calculated. This allows to directly compare the consistencies in all parameters directly with each other. A Consistency rating of 75 % means that the consistency is as good as for 68% of the Tour player's.

The Score and Consistency rating bars have 3 ranges, indicated by different colors:

- a) Green: 75% to 100%. This indicates a very good performance inside the Tour Pros benchmark range. High consistency shows that you execute the movement all the time the same and that your technique is well established.
- b) Yellow: 50% to 75%. This indicates a performance slightly below the Tour Pros benchmark range, which is still good performance for an amateur player.
- c) Red: 0% to 50%. This indicates a performance below the Tour Pros benchmark range. Low Score ratings indicate that this aspect of your technique is very much different from a Tour player's technique. Low Consistency ratings indicate that this aspect of your putting stroke varies all the time. High consistency represents high the skill level and is the most important factor for skilled players.

Comparison of Consistency rating and Tour Professional performance

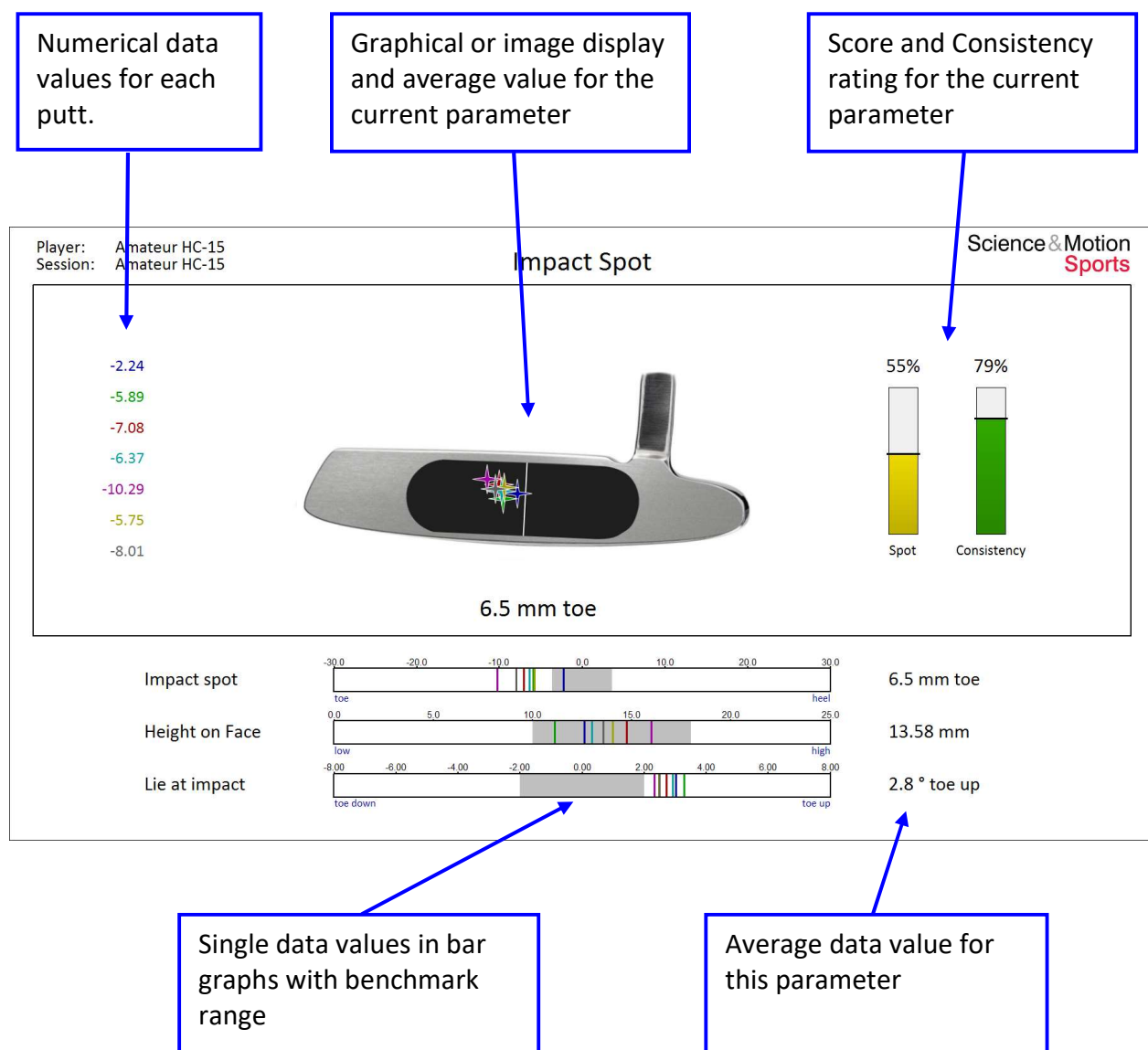
The Consistency ratings for single parameters directly correspond to the PGA Tour player's data. This table shows the Consistency rating for face a t impact and a corresponding virtual Tour player's ranking:

Face Impact Consistency	Virtual Tour player ranking
98%	1.
90%	9.
80%	59.
70%	88.
60%	100.

3. Report Tiles

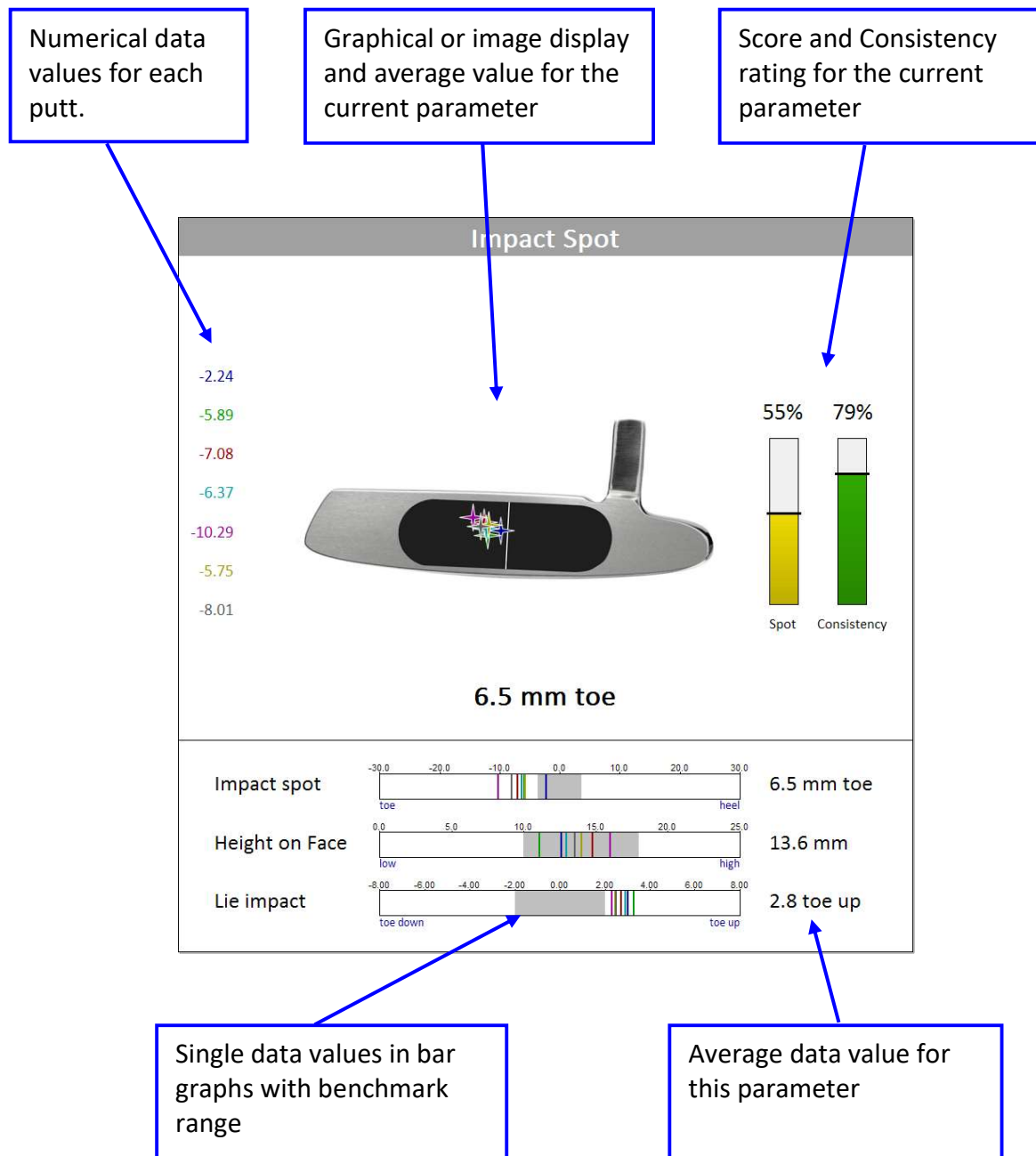
3.1 XL - Tiles

The XL-Tiles are the largest Tiles and fill a complete report page. The XL-Tiles contain comprehensive information on one specific putting aspect on very different levels, and can also display data on corresponding parameters.



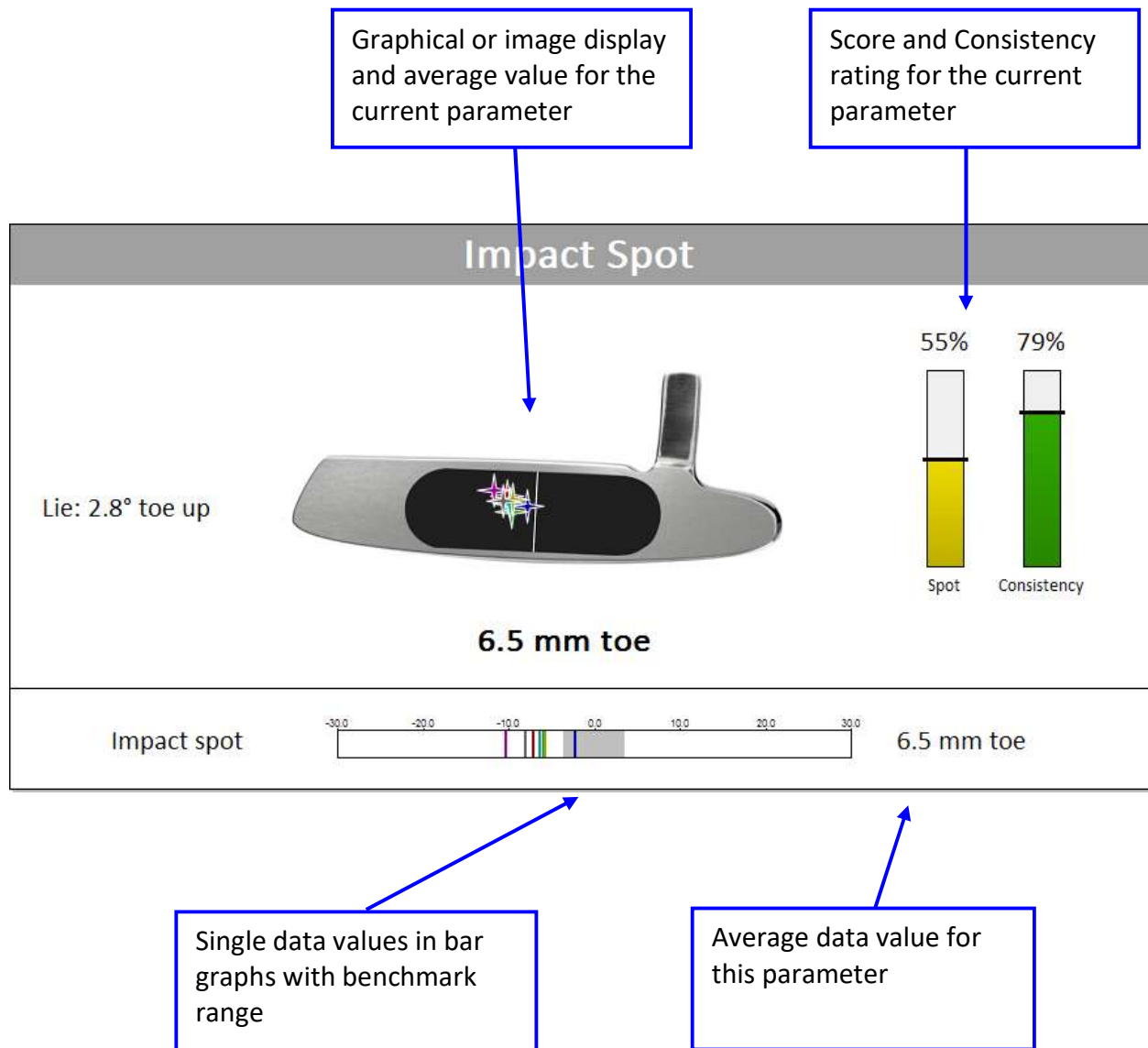
3.2 L - Tiles

The L-Tiles fill exactly half of a report page. The L-Tiles contain as much information as the XL-Tiles but the graphics are arranged more narrowly. L-Tiles can be combined with medium M-Tiles and small S-Tiles.



3.3 M-Tiles

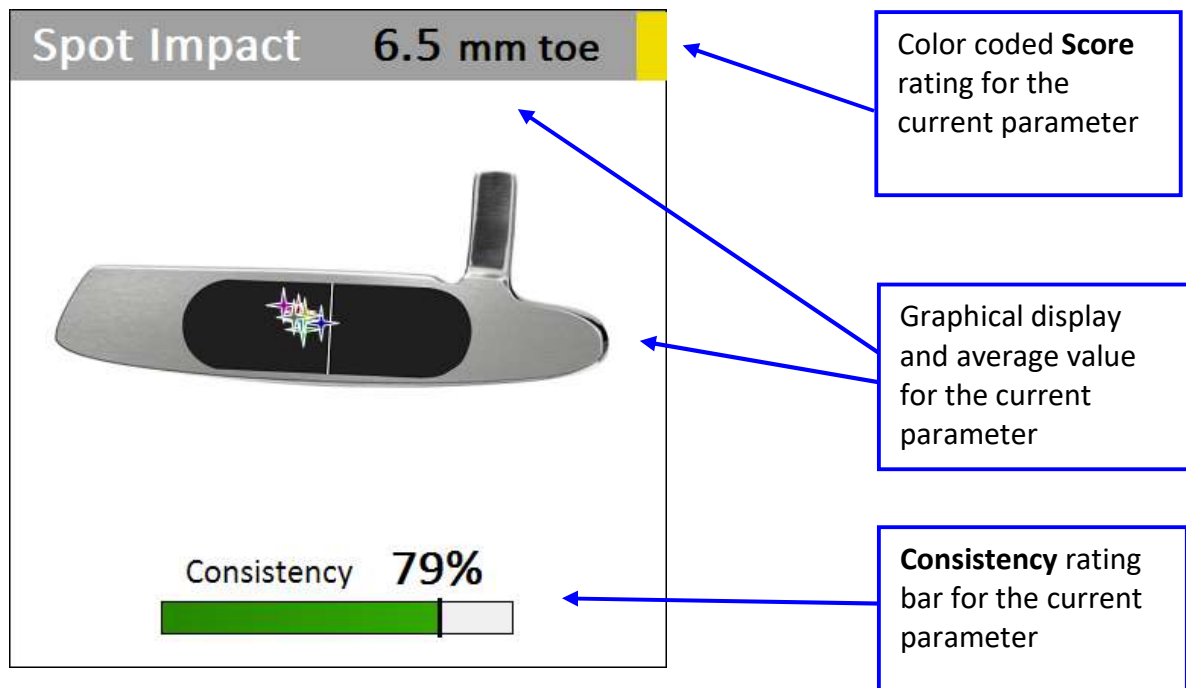
The M-Tiles fill exactly one quarter of a report page. The M-Tiles contain less information than the XL- and L-Tiles. The M-Tiles resemble the XL-Tiles but are more restricted to one parameter or one aspect and do not display single data values and data on corresponding parameters (only one result bar per Tile).



3.4 S-Tiles

S-Tiles display data on only one specific parameter.

The average data value is displayed in the header line. The image represents the average data value either in a data image (see 2.1) or a pictogram (2.2). The Score rating is here presented as a color coded rectangle at the upper right corner. The Consistency rating is displayed as a horizontal bar.



If using S-Tiles during training the consistency bar is blinded out, and instead the actual data value is displayed in the center of the tile:



4. XL-, L-, and M-Tiles

4.1 List of available report tiles

XL-Tile, L-Tiles and M-Tiles are displaying the same data in different levels of complexity (see 3.). The Tiles available to build custom reports are:

XL - Tile	L - Tile	M - Tile
Summary	Summary	Summary
Face Aim	Face Aim	Face Aim
Face Impact	Face Impact	Face Impact
Direction impact	Direction impact	Direction impact
Path impact	Path impact	Path impact
Top view	Top view	Top view
Impact Spot	Impact Spot	Impact Spot
Launch	Launch	Launch
Sideview	Sideview	Sideview
Shaft Lean	Shaft Lean	Shaft Lean
Rotation	Rotation	Rotation
Face on Path	Face on Path	Face on Path
Dynamics	Dynamics	Dynamics
Timing	Timing	Timing

Additional full screen Reports are:

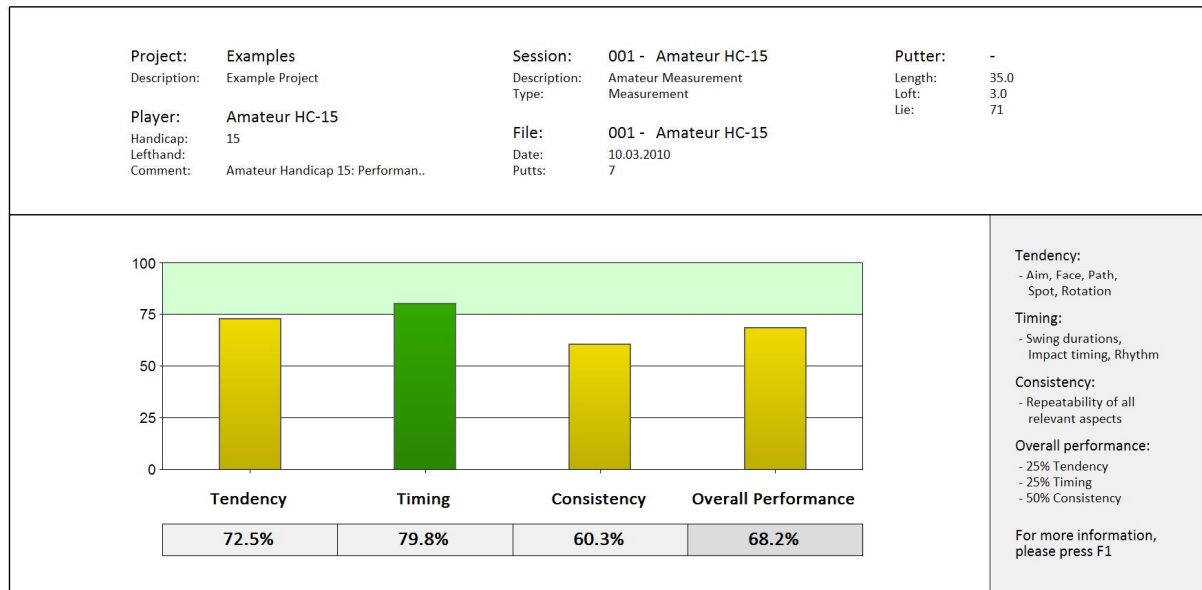
- Competence Profile
- Performance Profile
- Data Listing
- Easy Fit Report
- Comparison Report
- Line Chart History

4.2 Data Summary

Player: Amateur HC-15
Session: Amateur HC-15

Summary

Science & Motion
Sports



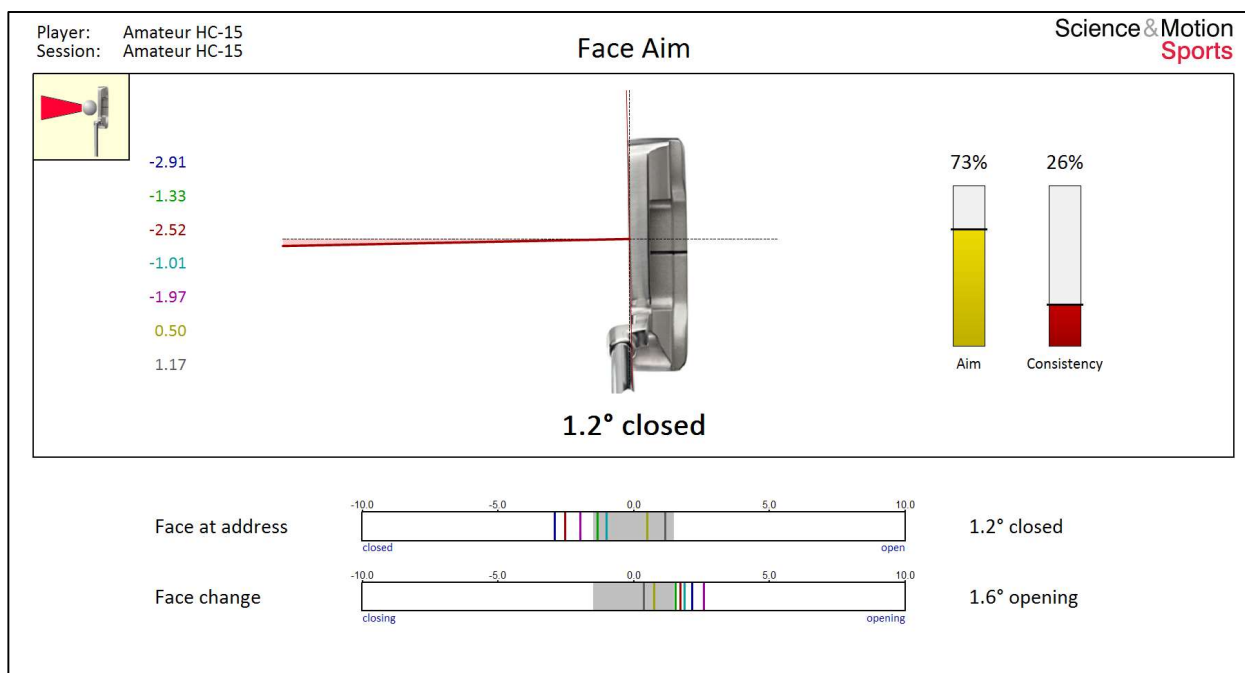
The report header displays information on the data set.

- **Project** – The name of the project and the description. The project name corresponds to a data directory which is found in the data directory of the PuttLab installation and contains all corresponding players and their data sets.
- **Player** – The name of the player and the corresponding biometric data.
- **Session** – The name of the session, the description and the date of the session. A session contains one or more data sets which belong together (i.e. in a putter selection process).
- **File** – The name of the file, the description, the date of the recording and the number of putts stored in this file. A file is a set of putts.
- **Putter** – Brand, length, loft and lie of the putter being used in this measurement.

In the lower part of the report an overview on the putting performance based on summary Ratings displayed with bars and numbers. Please see chapter 2.6 for more details on Ratings.

- **Tendencies** – Summarize Scores of the technical aspects: Face aim, Face impact, Path direction, Face to path, Impact spot and Face rotation.
- **Timing** – Summarizes Scores for timing aspects: Backswing symmetry, Backswing time, Impact time, Rhythm, Timing.
- **Consistency** – Summarizes Consistencies for: Face aim, Face impact, path direction, face to path, Path length, Impact spot, Face rotation, backswing time, Impact time, Impact speed.
- **Overall Performance** – Summarizes Tendencies (25%), Timing (25%) and Consistency (50%) into one overall Score.

4.3 Face angle at Aim



The graph shows the alignment of the **putter face at address**. The dotted line exactly represents the calibrated target direction. At 0 degrees the putter face is 100% square to the target. The average direction of the putter face alignment is represented by the thick red line. The area between the average alignment and the optimum target direction is filled in red color to indicate the amount of deviation.

The average putter face angle at address is shown beneath the putter head. In this example, the putter head is 1.2 degrees closed at address which means the face is slightly pointing to the left. The numbers for each single putt are displayed on the left side. The numbers display can be switched on and off with the F7 key.

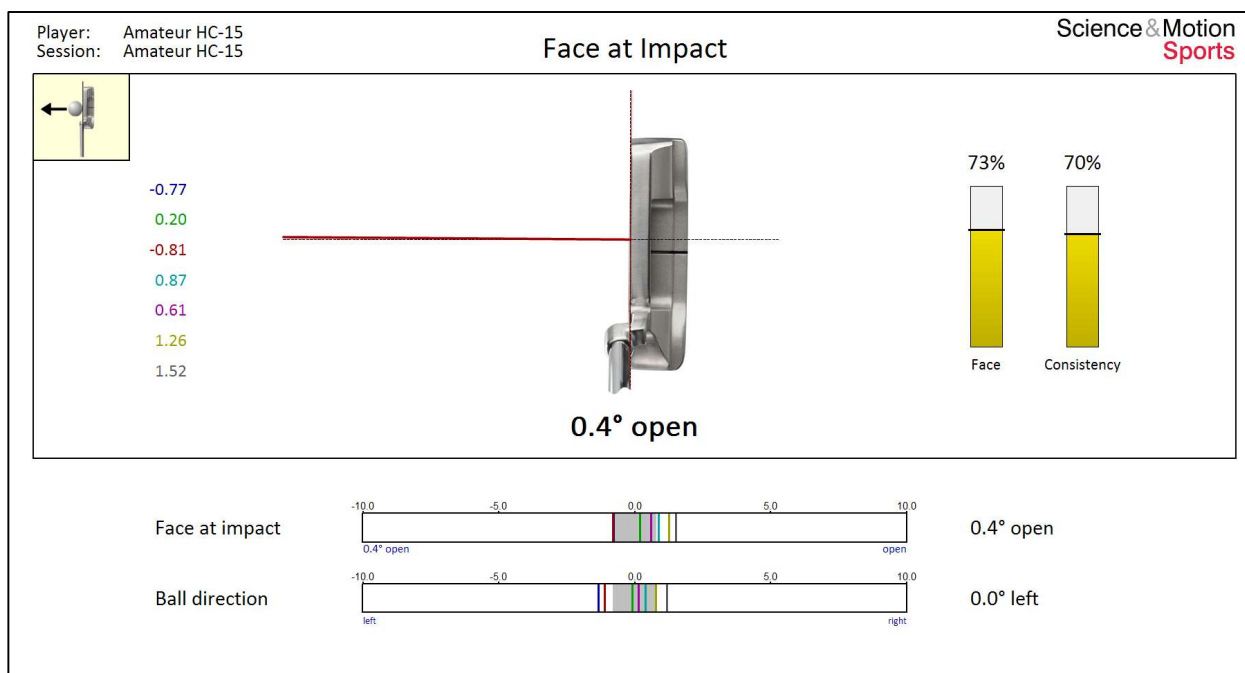
The two bars on the right side of the graph show the Score and Consistency rating for the different putts (see 2.6). The average Score for single aim angles is 73 % performance. The Consistency rating is 26 % which is poor performance. This means the putter is aligned very differently for the different putts.

The aiming bar charts provide information on each single putt with colored stripes (see 2.5). The number on the right side represents the average data value for this parameter.

The upper bar shows the data for face at address. For this player the data are grouped with a wide spread which indicates poor consistency of the aiming directions.

The parameter "face change" shows the change of putter face angle between address position and impact. This parameter provides additional information on the compensation of the putter face between aiming and impact and can explain sources of inconsistencies at impact. If face change is inconsistent you could work on a more smooth and regular movement inside of the backswing. If face change is consistent but face at impact is inconsistent, then you should work on a more consistent aim during setup.

4.4 Face angle at Impact



The graph shows the alignment of the **putter face at impact**. The display is exactly the same as for Face at Aim (see 5.3). The average value for the putter face angle at impact is shown beneath the putter head. The putter head is 0.4 degrees open at impact which is slightly pointing to the right. The face at impact determines ball direction to about 83%. Please note that a putter face which is more open / closed than 1 degree at impact results in missing a 4 meters putt to the right / left if the path is straight. The numbers for each single putt are displayed on the left side.

The two bars on the right side of the graph show the Score and Consistency rating for the different putts (see 2.6). The average Score for the single face angles results in 73 % performance. The Consistency rating is 70% which is ok for a HC 15 golfer.

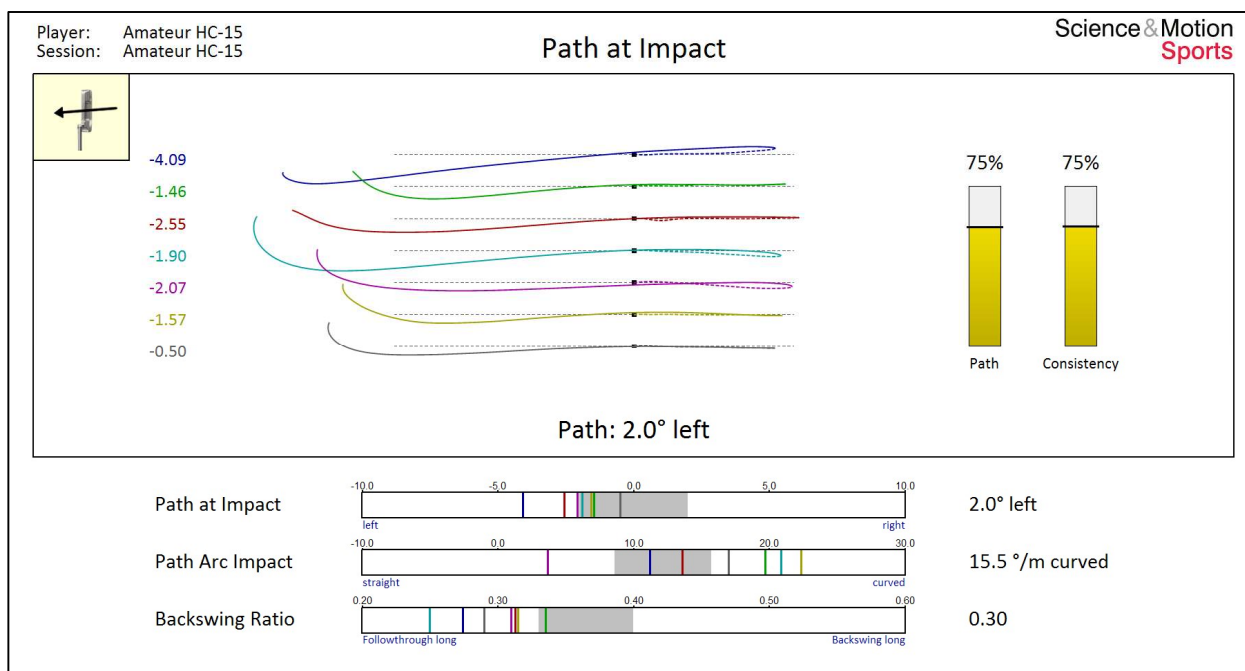
The bar charts provide information on each single putt with colored stripes (see 2.5). The number on the right side represents the average data value for this parameter.

The single data for **Face at Impact** show some spread and some of the data values are outside of the preferred range as indicated by the grey areas. As a result the Consistency is with 70% only in a mid-range.

The **Ball direction** is a calculation based on face and path direction at impact. Face angle is considered to contribute 83% and path direction contributes 17%. For this player the average Ball direction is perfect, but the single putts might still go left or right.

- Please note that the effect of errors in putter path direction on ball direction is about 5 times less than errors in putter face alignment at impact. This means that a 1 degree open putter face at impact has the same effect on ball direction as a putter path pointing 5 degrees to the right.

4.5 Path at Impact



The graph shows the putter path in a top view (see 5.7) and the direction of the **putter path at impact**. The average value for the putter path direction at impact is 2.0 degrees to the left. Deviations in putter path very often correlate to a misaimed body line.

The putter path direction at impact determines ball direction to about 17%. A path which is not pointing exactly to the target can be compensated with a face pointing into the opposite direction to make the ball still go straight. The numbers for each single putt are displayed on the left side.

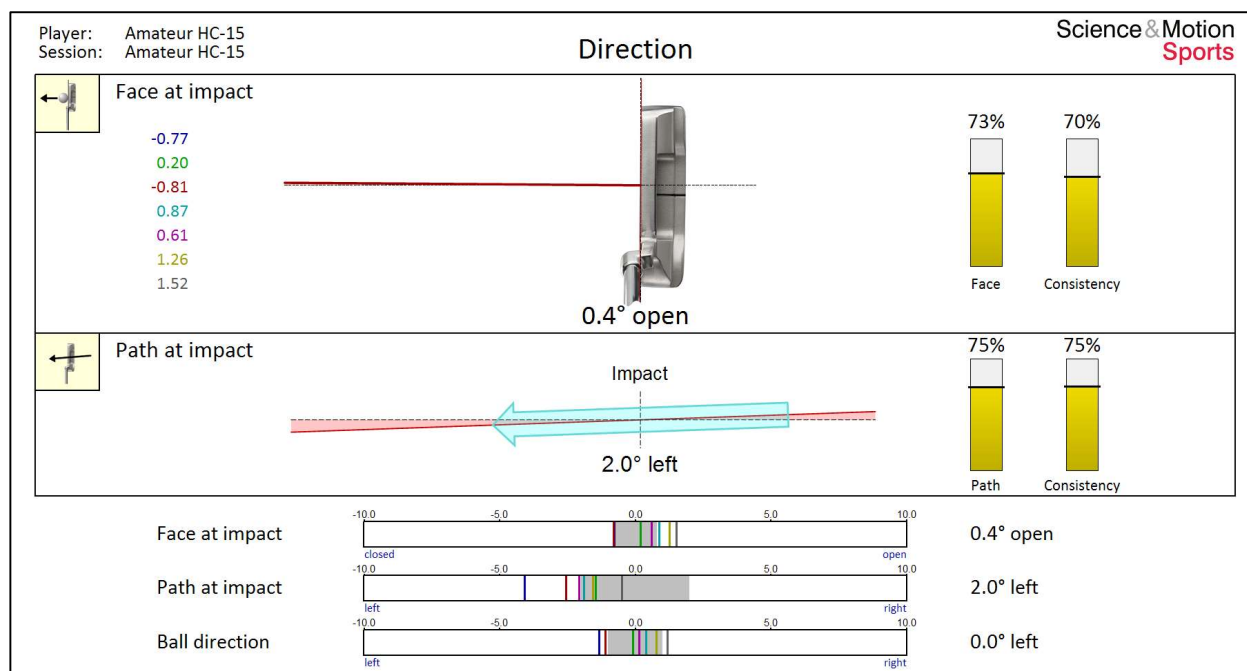
The two bars on the right side of the graph show the Score and Consistency rating for the different putts (see 2.6). The average Score for the single face angles results in 75 % performance. The Consistency rating is 75% which is ok for a HC 15 golfer.

The single data for **Path at Impact** show some spread and some of the data values are outside of the preferred range as indicated by the grey areas. As a result the Consistency is with 75% only in a mid-range.

The single data for **Path Arc** show a considerable spread, but the average path arc at impact is in the mid-range with 15.5 deg/s.

The **Backswing Ratio** is with 0.30 on the low end meaning that the follow-through is too long as compared with the length of the backswing (corresponding to 30%). The Tour data range for backswing ratio is between 0.35 and 0.40.

4.6 Direction



The Direction report summarizes the data from the Face at Impact and Path at Impact reports. Face angle and path direction can compensate for each other. A path which is not pointing exactly to the target can be compensated with a face pointing into the opposite direction to make the ball still go straight. For this player in fact the face is pointing to the right which is compensated by the path pointing to the left.

The average value for the face angle at impact is 0.4 degrees open which is slightly pointing to the right. Score with 73% and consistency with 70% are in the mid-range (see 5.4).

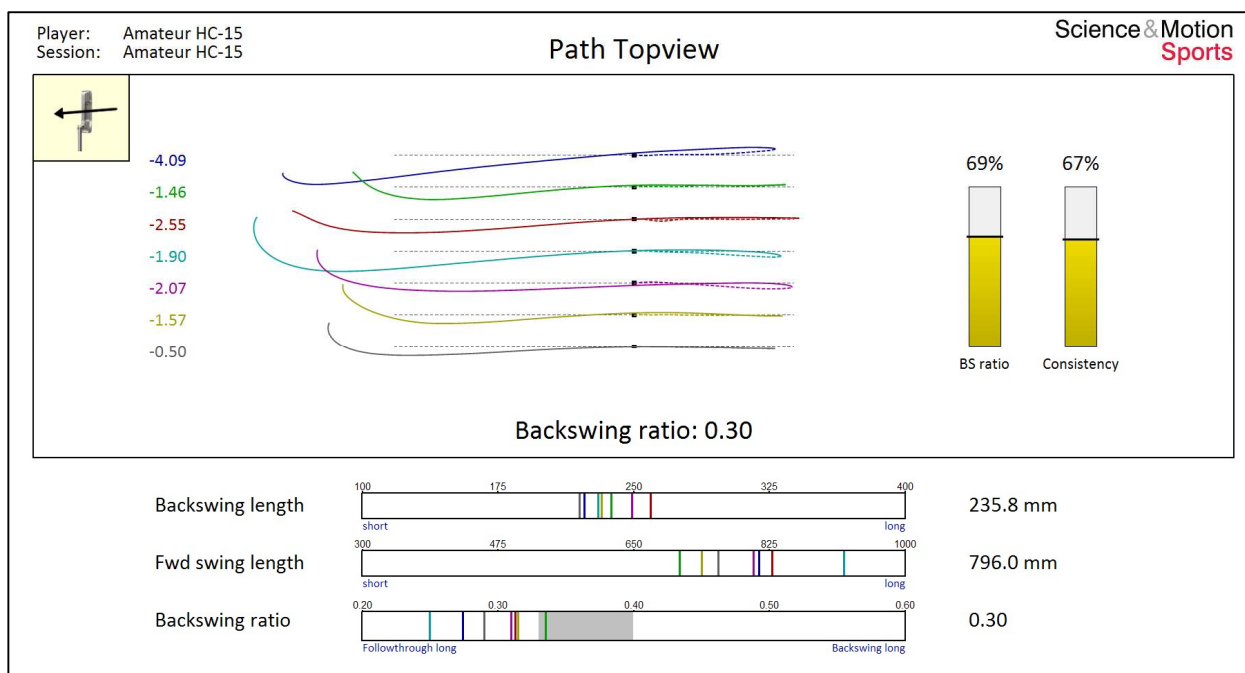
The blue arrow in this graph shows the average putter path direction at impact. The dotted line represents exactly the calibrated target direction. A putter path pointing 100% to the target results in 0 degrees. The average putter path direction at impact is pointing 2.0 degrees to the left. The average Score rating for the single path directions is 75% and the consistency is with 70% in the mid-range.

The single data for **Face at Impact** show some spread and some of the data values are outside of the preferred range as indicated by the grey areas.

The single data for **Path at Impact** is also distributed and some of the data values are outside of the preferred grey range.

The **Ball direction** is a calculation based on face and path direction at impact. Face angle is considered to contribute 83% and path direction contributes 17%. For this player the average Ball direction is perfect, but the single putts might still go left or right.

4.7 Top View



This Path Topview Report displays the path of the putter viewed from above during back swing (dotted lines) and forward swing (solid lines). The different putts are indicated by different colors, with the first blue putt at the top.

The graph shows the bird's-eye view. The small black spot represents the starting point of the movement. The backswing is going to the right. The forward swing starts at the end of the backswing, crosses ball position and then ends up at the left side where the putter stops moving. The target direction is indicated by horizontal grey dashed lines.

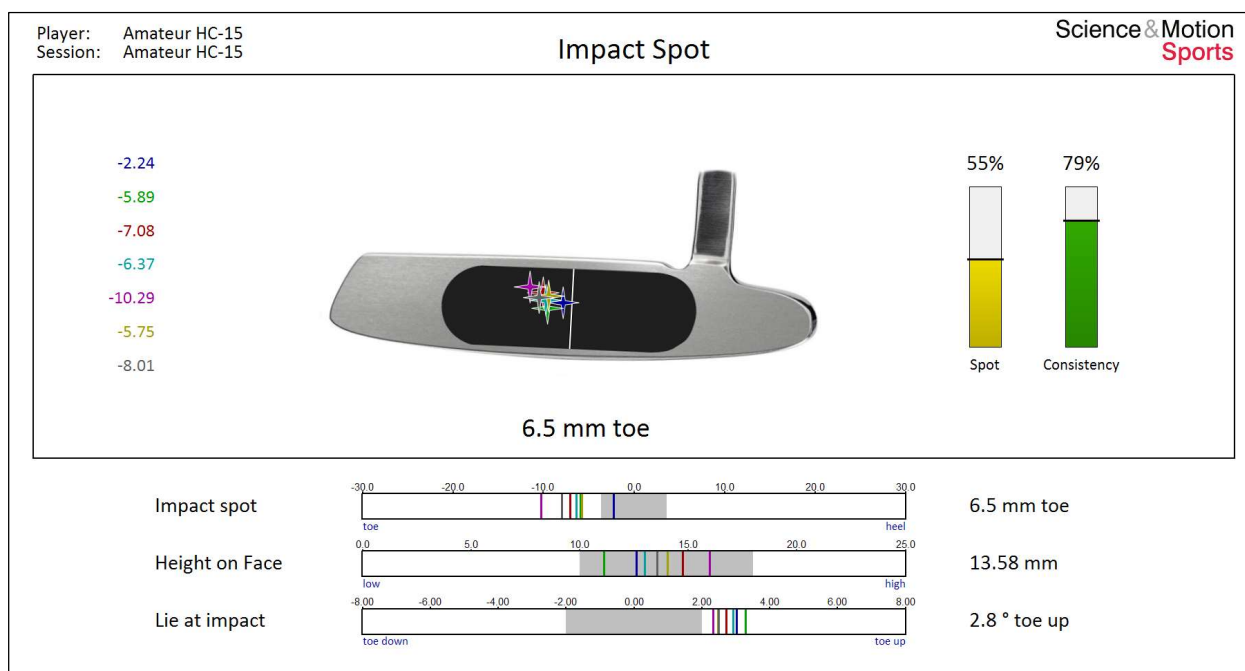
For this player the backswing is almost parallel to the target line. The length of the backswing varies slightly, indicating that the corresponding length of the putts will also vary. The consistency of the forward swing is poor. The putter path is arced to the left, and then at the end pushed back to the right. An irregular putter path is often a consequence of a putter length which does not fit to the player.

The length of the backswing is considerably smaller than the follow through in Tour players. Backswing length is on average about only 35% of the forward swing. Shorter backswing is helping to accelerate through impact.

The length of the **backswing** is 236 mm and length of **forward swing** is 796 mm. There are no references for backswing and forward swing as the length will depend on the specific length of the putts.

The **Backswing Ratio** is with 0.30 on the low end meaning that the follow-through is too long as compared with the length of the backswing (corresponding to 30%). The Tour data range for backswing ratio is between 0.35 and 0.40.

4.8 Impact spot



This graph shows where you exactly hit the balls on the putter face, with the putter head in the actual Lie at impact angle. The different impact spots are indicated by crosses in different colors. The vertical line in the middle of the putter face represent the geometrical center of the putter which is exactly the position where the putter has been calibrated. For this player the impact spot is left on the putter face with 6.5 mm at the toe. Because of the deviation the corresponding Score is only 55 %. Consistency level is higher with 79%. Consequences of off-center hits are reduced putt length and face angle errors. However for consistent off-center hits near to the sweet spot effects will be very small.

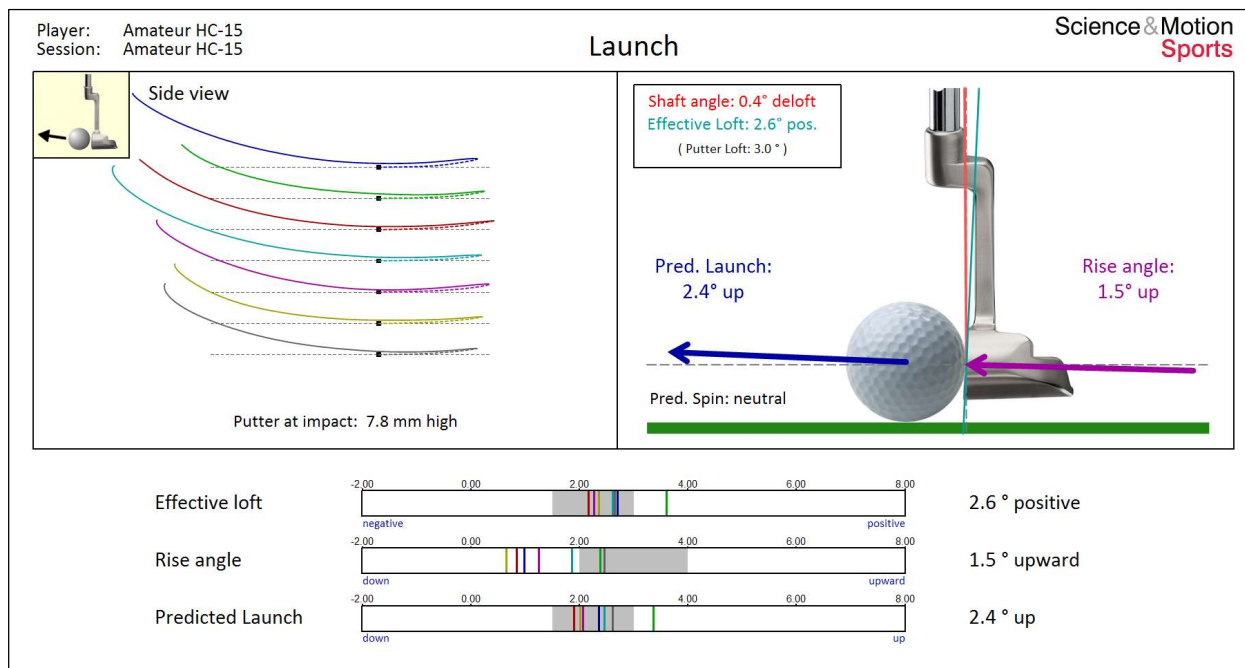
- Please note that the horizontal spot measured on the putter face directly refers to the calibration position!
- It is assumed that the ball lies exactly on the same spot for all putts (i.e. by using a position marker or a small ring). If you use different spots while putting you will get results for the hit spot which will deviate from the true hit spots!

The data bar for **impact Spot** shows that the single spots vary considerably to the left.

The **Height on Face** parameter represents the vertical height of the hit position on the putter face. As we do not know the true vertical height of the putter face, this measure is given relatively to the sole of the putter only. A height of 13.6 mm is slightly above the geometrical center of a standard putter. The vertical center of a standard putter is at about 12.5 mm.

The data bar for **Lie at Impact** shows the Lie angles for the different putts. The average Lie is 2.8 degrees toe up. As most putters have a rounded sole a Lie angle with slight toe up does not really matter, in particular for Blade putters slight toe up does still work. However for fitting purpose this angle might be adjusted as putters work best with neutral Lie angle.

4.9 Launch



The left graph shows a **horizontal side view** of the putter path during back swing (dotted lines) and forward swing (solid lines). The different putts are indicated by different colors, with the first putt at the top. The physical horizontal ground is indicated by horizontal grey dashed lines.

The right graph shows the putter face at impact in a side view and provides information on the **launch conditions**, the vertical angles and the height above ground at impact. The average **shaft angle** is represented by a red line. The **static loft** and the **shaft angle** at impact are adding up to the **effective loft** applied to the ball which is printed as a line in light blue.

The **Rise angle** shows the angle of attack of the putter to the ball relative to the ground. A Rise angle of 1.5 degrees is slightly less than the perfect range of about 3 degrees. A more positive rise angle will give the ball some more tendency for forward spin.

The **Predicted Launch** angle and **Predicted Spin** are estimations of ball behavior after impact. The Launch angle is mostly determined by dynamic loft by about 80%. A preferred launch angle on faster greens (Stimp 10) is between 1-2 degrees only. The predicted spin correlates to the Spin loft (difference between Rise and dynamic loft). For high Rise angle more top spin is applied, for high loft angles more backspin is applied. However these effects are quite limited.

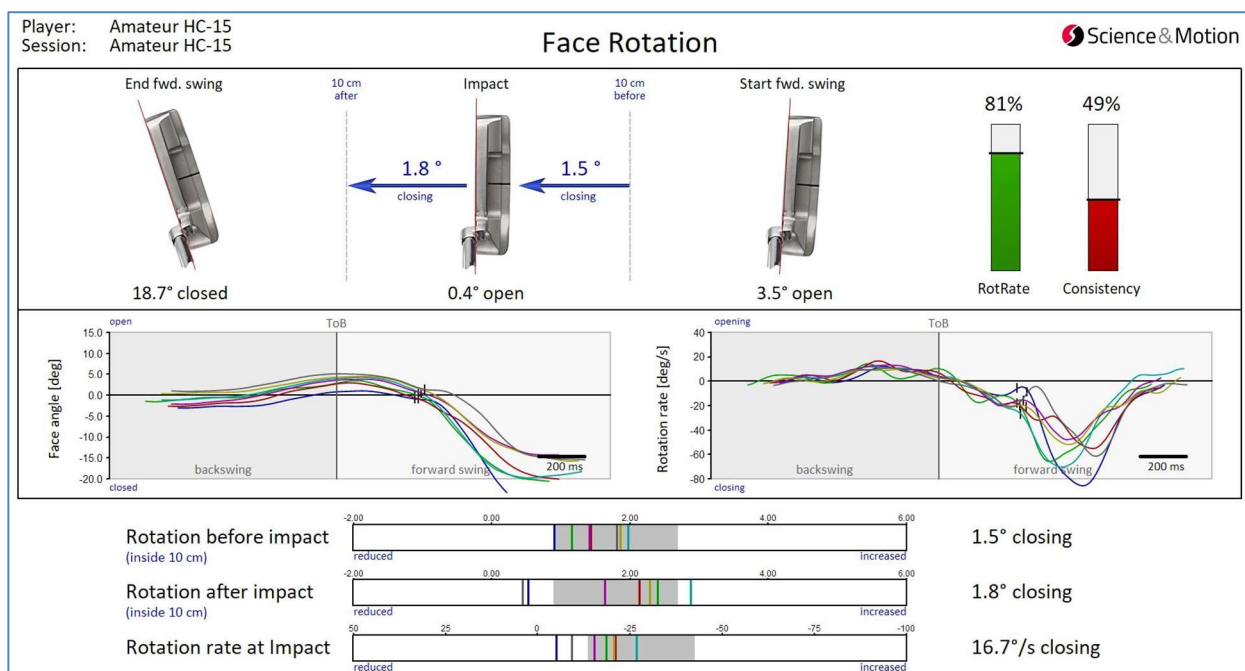
- As launch conditions should be measured parallel to the surface, please make sure that the measurement unit is placed parallel to the surface on sloped greens.

The **Effective Loft** is 2.6 degrees and is inside of the preferred grey data range.

The **Rise angle** is 1.5 degrees which is slightly low and additionally varies considerably.

The **Predicted launch** is 2.4 degrees up which is in the preferred range. A flat launch will increase friction with the ground which will increase topspin and reduce skidding.

4.10 Face Rotation



The upper graph shows the putter face angle at start of the forward swing (right), at impact (middle) and at end (left) of forward swing. The red lines indicate the deviations from square alignment. The putter face is open 3.5 deg at start of forward swing, at impact open 0.4 deg and is closed 18.7 deg at finish. Overall rotation in the forward swing is 22.2 deg. Additionally, the rotation in the **Impact zone** of +/- 10 cm around impact is shown, which is independent of the length of the putt. The data values of 1.5 deg and 1.8 deg closing are very close to the average of the Tour players, indicated by a high Score of 85%. This means that the strongly closed face angle at end of swing is more a consequence of the excessive forward swing length.

The graphs in the middle show the course of Face angle (left) and Face rotation (right) in the forward swing. The start of the data curves on the left side correspond to the putter picture on the right (start of fwd. swing). Impact is indicated in the data curves with small vertical stripes. If the stripe meets exactly the zero line then the face is square at impact.

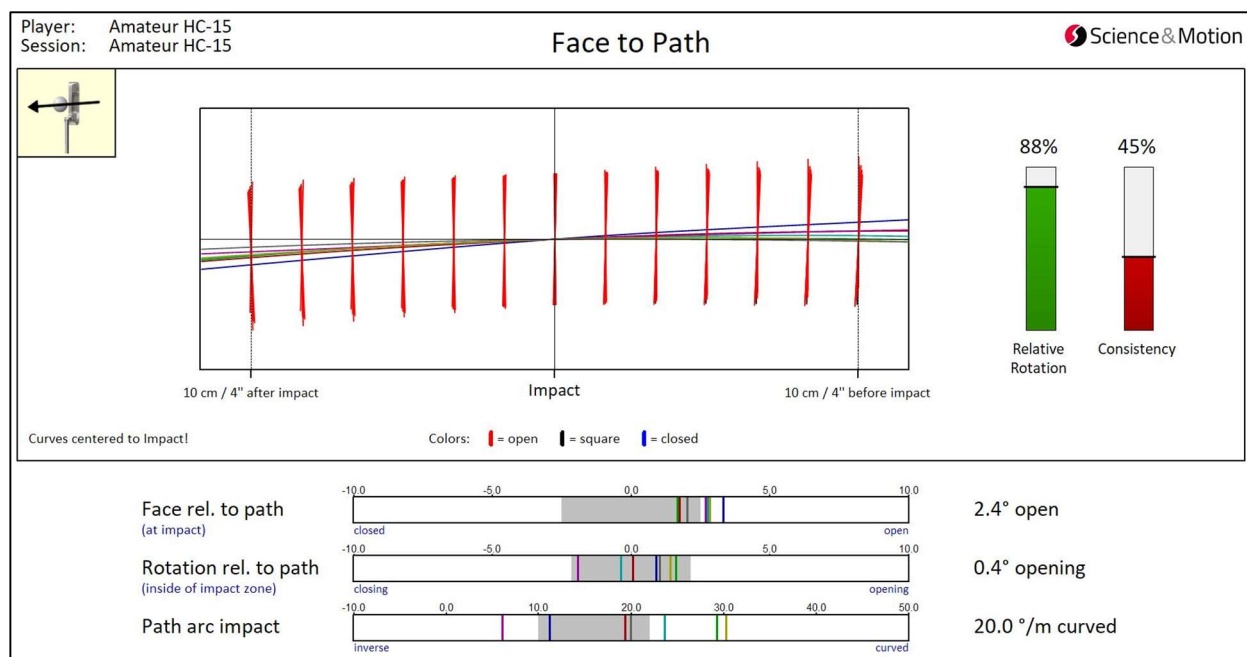
The shape of the data curves provides details on the face rotation behavior. In the left graph we can see that the putter face is blocked through impact as the curves are more flat in this region. After impact the curves are even more steeply down indicating breaking wrists. The rotation curve magnifies irregularities in putter face data with corresponding peaks. We see smooth rotation until impact, then an upwards oscillation indicating the blocking, and after impact inconsistent and increased rotation. These data curves should all be smooth and repeatable.

Rotation before impact inside of 10 cm is 1.5 degrees closing, which is in the preferred range.

Rotation after impact inside of 10 cm is 1.8 degrees closing, and is much more inconsistent.

Rotation rate at impact is the dynamic putter face change at impact. 16.7 deg/s closing is in the preferred range, but Consistency is rather low with 62%.

4.11 Face relative to path



The **Face to path** graph shows the putter path in top view in a range of 20 cm or 8 inches around impact. The vertical lines represent the relative putter face angle along the path in the displayed area. The different colors of the lines show how the putter face is aligned relative to the direction of the path (NOT TO THE TARGET!).

Red line: The Putter face is open more than 1 deg on the path

Black line: The putter face is between +/- 1 deg on the path (nearly perfectly square)

Blue line: The putter face is closed more than 1 deg on the path

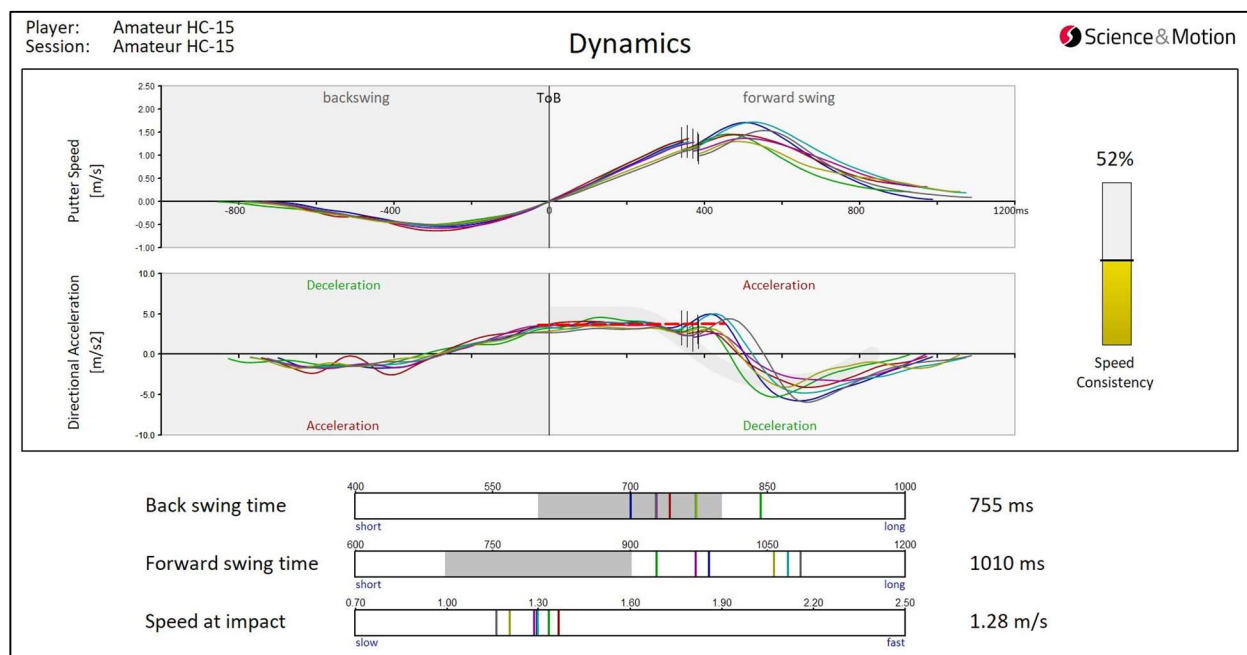
For this player almost all lines are red indicating that the face is always open relative to path.

The **face relative to path** at impact is open 2.4 deg. If face to path is consistent then we see a good biomechanical coupling between the hands (face angle) and the stroke (path). Problems in Setup and in alignment can still result in very different face angles or path direction.

The **rotation relative to path** represents the face rotation against the path direction in the impact zone. The **absolute** face rotation naturally depends on the tilt of the swing plane against the target line (see 5.10). However the **relative** face rotation inside of the tilted swing plane is independent from absolute rotation and will always be zero for a pure *in plane* type of stroke. If relative rotation is not neutral then the putter head is also rotated around its shaft. For this player relative rotation is neutral with only 0.4 deg opening (although there is a significant amount of absolute rotation). This results in 88% Score rating. Consistency is low with 45%

The single data for **Path Arc** show a considerable spread, but the average path arc at impact is in the mid-range with 20.0 deg/s.

4.12 Stroke Dynamics



Stroke dynamics include velocity and acceleration within backswing (left) and forward swing (right). Backswing and forward swing curves are displayed separately only for educational purpose. Movement dynamics are not directly related to putting technique and rather show the motor skill level and the movement strategies underlying movement planning and execution. Automated movements should be executed each time in exactly the same way. In particular acceleration signals are extremely sensitive to muscle action and show all details of movement execution. This refers to the shape of the curves, to height and position of the peaks, and to duration. For this player the repeatability of the curves is in the mid-range only.

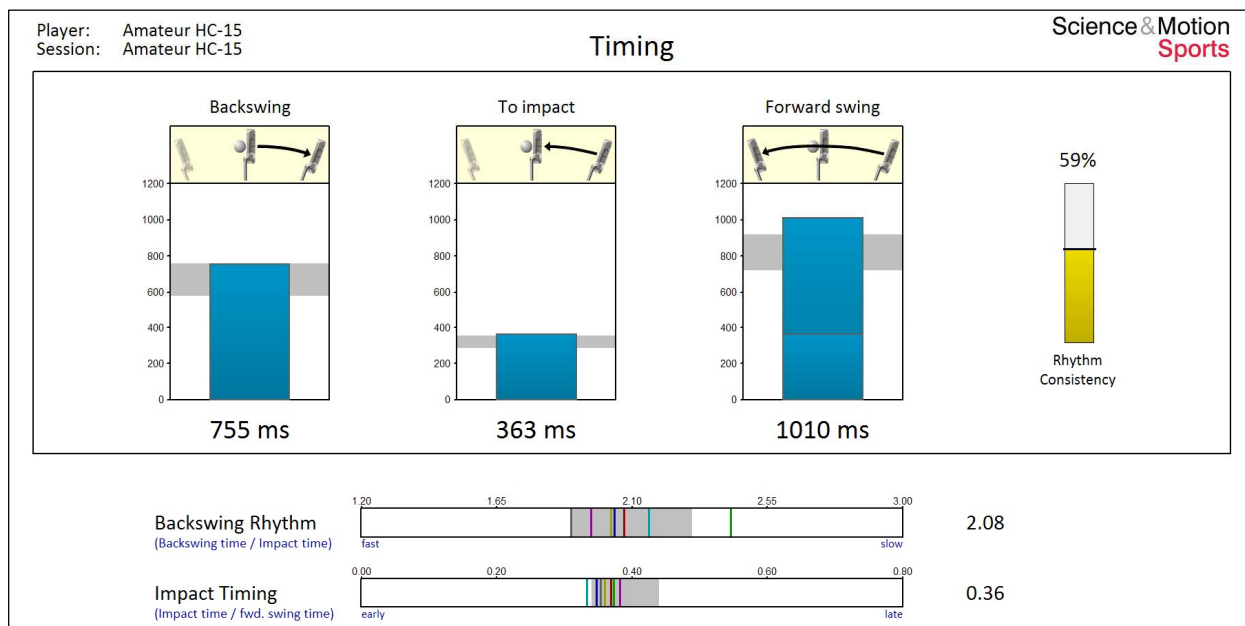
Movement **velocity** (upper graphs) is zero at begin and end of a swing. The maximum velocity lies roughly in the middle of the movement. The velocity curves should always be smooth and regular. Impact is indicated with a step at the vertical stripe. Movement **acceleration** (lower graphs) is the change of velocity over time: Positive acceleration is increasing velocity, negative acceleration is decreasing velocity. Zero acceleration means constant velocity.

The backswing should start with a smooth acceleration. At end of backswing is a sharp edge indicates the change of direction. The forward swing starts approximately at the level where the backswing ended. So a committed begin of forward swing is preceded by a committed end of backswing and a steep transition. The **backswing time** of 755 ms is slightly slow.

The acceleration profile allows identifying the putting technique of the player. For a **swing putt** technique acceleration starts at a high level and is then kept **constant** until impact. For a **hit putt** technique acceleration starts at a lower level and increases steeply just before impact (to more than double). For this player acceleration is on a plateau indicating a swing type stroke. The **forward swing time** of 1010 ms is slow and could be more consistent.

The **Speed at impact** of the putter is measured exactly at impact. High consistency of impact velocity is most important for distance control of the putt. Inconsistent impact velocity can be consequence of poor timing and / or inconsistent backswing length.

4.13 Stroke Timing



Rhythm and timing are generally guiding human movements. Consistent rhythm and timing are crucial for high consistency of the complete stroke. Proper rhythm and timing are the basic principles in skilled movement performance.

The graphs show the time of backswing, time to impact, and time of forward swing. Time to impact is also marked with a horizontal line inside of the forward swing bar. The grey areas indicate the preferred range of the PGA Tour players. The average stroke times (shown below the bars) can differ between different players, more aggressive (committed) players generally show shorter times and more cautious (anxious) players show longer times. However, rhythm and timing (the relation of the components) should still be in the preferred range.

The **Backswing time** should be generally about 100-200 ms shorter than forward swing time. The backswing time of 755 ms is slightly slower than the preferred range of 600-750 ms.

Time to impact from beginning of forward swing is approximately half time of backswing time which would mean 300-350 ms. For this player Impact time is 363 ms which is also slightly slow.

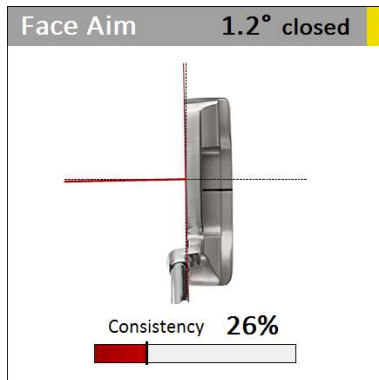
Forward swing time should be generally about 100-200 ms longer than backswing time. The forward swing time of 1010 ms is slower than the preferred Tour range of 750-900 ms.

The **Backswing rhythm** describes the ratio of backswing time to impact time. Backswing time should be approximately double as compared with impact time. Players with a fast rhythm (< 2) are normally faster and more aggressive in the backswing. Players with a slow rhythm (> 2.2) are cautious in the backswing and tend to monitor the stroke. Another reason can be a short backswing resulting in steep acceleration to impact. For this player a backswing rhythm of 2.08 almost exactly matches the Tour average of 2.1 but consistency could be higher.

The **Impact timing** describes the ratio of impact time to complete forward swing time. PGA players hit the ball early in the stroke at a ratio of 0.39. Hitting the ball early allows to accelerate through the ball. A value of 0.36 is in the preferred range of 0.35-0.45.

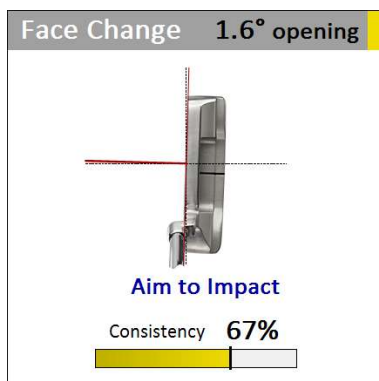
5. S- Tiles

5.1 Face Aim



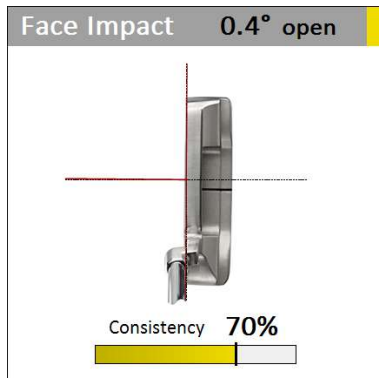
Average putter face angle exactly at address. The data image represents the deviation from the optimum.

5.2 Face Change



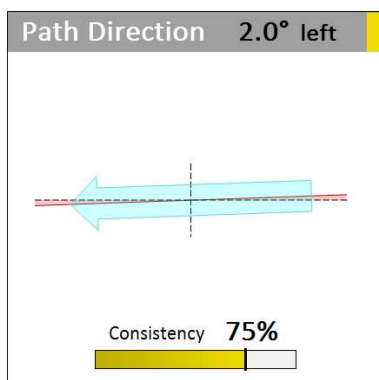
The change of putter face angle between address position and impact. The data image directly represents the angle of deviation the face change.

5.3 Face at Impact



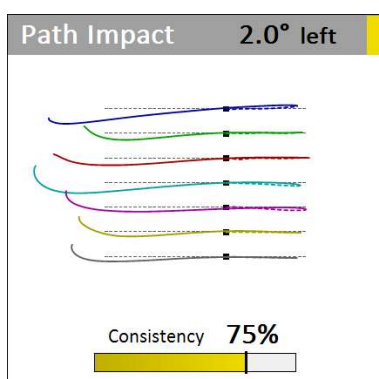
Average putter face angle exactly at Impact. The data image represents the deviation from the optimum.

5.4 Path direction



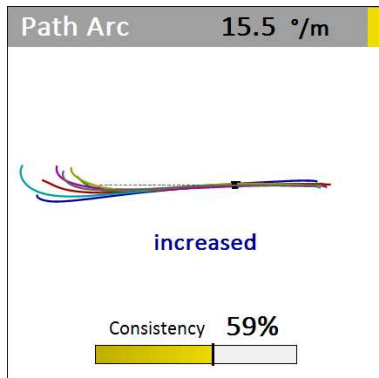
Average putter path direction angle exactly at impact. The arrow represents the deviation from the optimum.

5.5 Path at Impact



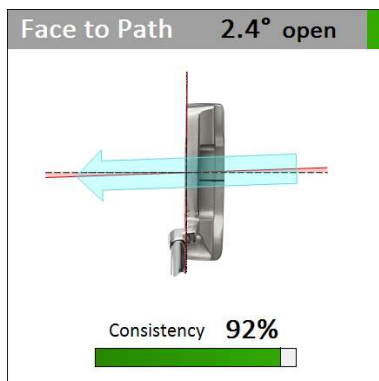
Putter path in a Top view with average putter path angle exactly at Impact. The angle and arc of the path represent true angles.

5.6 Path arc



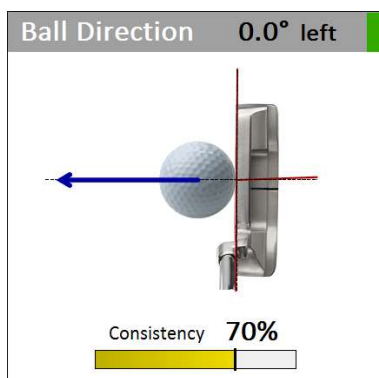
Overlaid putter path in a Top view with average putter path angle exactly at Impact. The angle and arc of the path represent true angles.

5.7 Face on Path



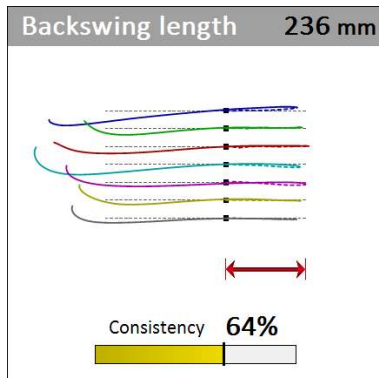
Face angle relative to putter path exactly at Impact. The angles in the image represent true angles.

5.8 Ball direction



Calculated average ball direction based on face at Impact and path at Impact. The angle represent true angles.

5.9 Backswing length



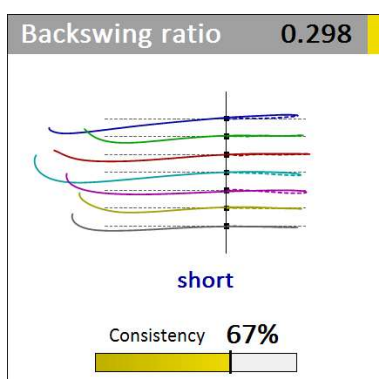
Average length of the backstroke. The graph shows the putter path in a Top view. The dot is the ball position. The angle and arc of the path represent true angles.

5.10 Forward swing length



Average length of the forward stroke. The graph shows the putter path in a Top view. The dot is the ball position. The angle and arc of the path represent true angles.

5.11 Backswing Ratio



Average ratio of length of the backstroke divided by the length of the forward stroke. The ratio of 0.298 corresponds to a percentage of 29.8%.

5.12 Spot at Address



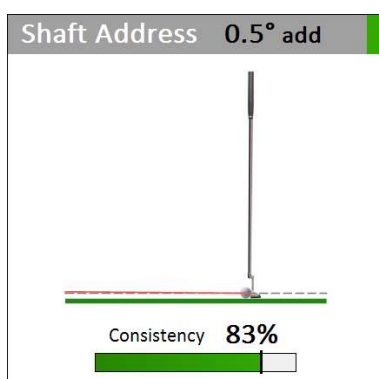
Average aim spot on the putter face (relative to the calibrated position). The graph shows the single colored spots and the average Lie angle at Address.

5.13 Spot at Impact



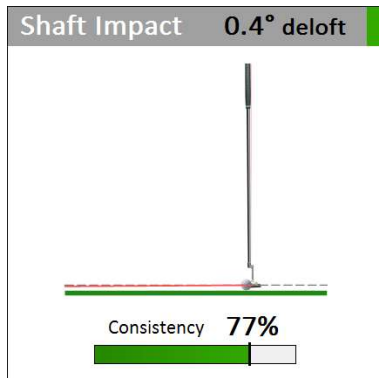
Average impact spot on the putter face (relative to the calibrated position). The graph shows the single colored spots and the average Lie angle at Impact.

5.14 Shaft at Address



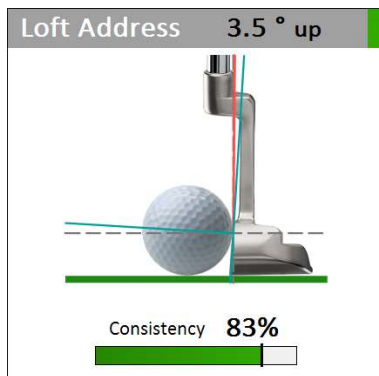
Average shaft lean at Address. The graph represents the true angle of the shaft.

5.15 Shaft at Impact



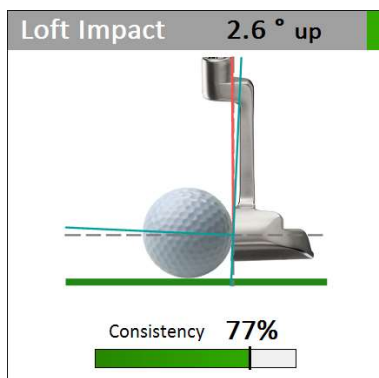
Average shaft lean at Impact. The graph represents the true angle of the shaft.

5.16 Loft at Address



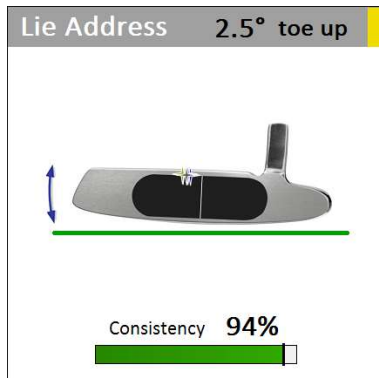
Average effective Loft at Address. The graph represents the true angles. The effective loft is the sum of the static Loft and Shaft lean.

5.17 Loft at Impact



Average effective Loft at Impact. The graph represents the true angles. The effective loft is the sum of the static Loft and Shaft lean.

5.18 Lie at Address



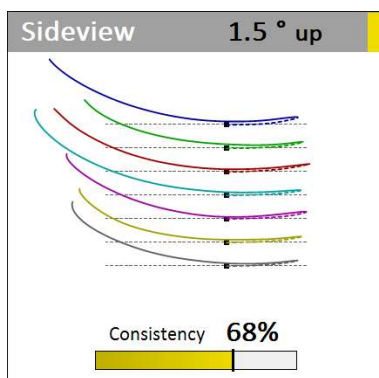
Average Lie angle at Address. The graph represents the true angles. The aim spots are also shown in the graph.

5.19 Lie at Impact



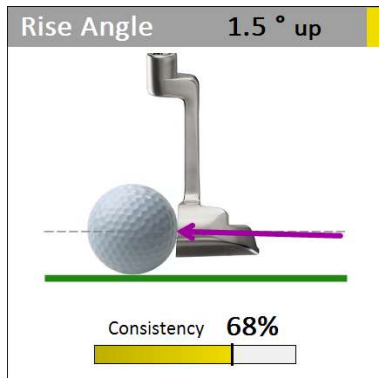
Average Lie angle at Impact. The graph represents the true angles. The aim spots are also shown in the graph.

5.20 Path Sideview



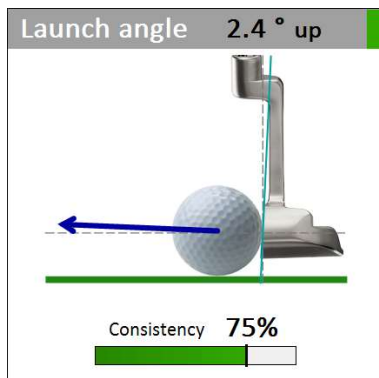
Putter path in a Sideview with average rise angle exactly at Impact. The angle and arc of the path represent true angles.

5.21 Rise angle



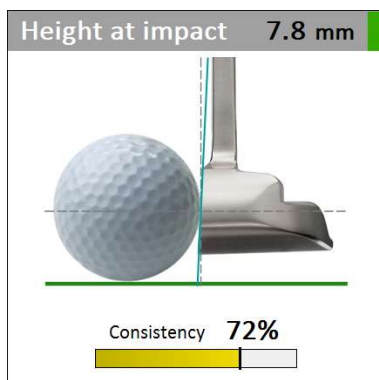
Average Rise angle at Impact. The graph and the arrow represent the true angles.

5.22 Launch angle



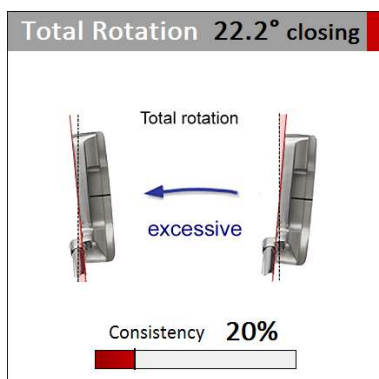
Average calculated Launch angle at Impact based on effective Loft and Rise angle at Impact. The graph and the arrow represent the true angles.

5.23 Height at impact



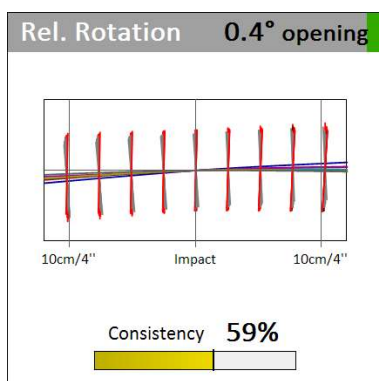
Average height of the putter above ground at Impact. The graph represents the true height relative to ball size.

5.24 Rotation total



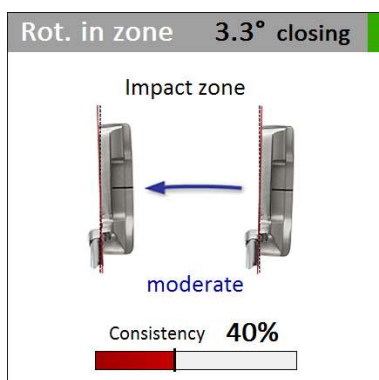
Average total rotation in the forward swing. The pictures represents the true face angles at start and end of forward swing. 5 grades with additional descriptions are displayed (here “excessive”).

5.25 Rotation relative



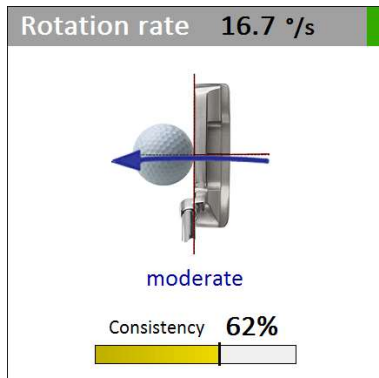
Average relative rotation of putter face against putter path direction in the Impact zone. The graph shows true angles with blue bars (open), black bars (neutral) and red bars (closed).

5.26 Rotation in zone



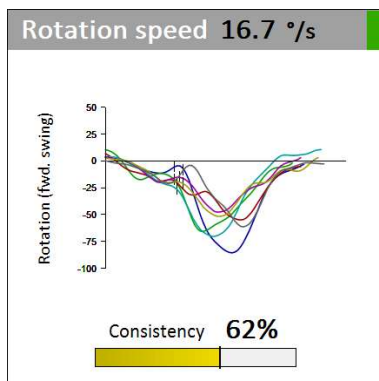
Average face rotation in the Impact zone of +/- 10 cm. The pictogram represents the amount of rotation in 5 grades with additional description (here “moderate”).

5.27 Rotation rate



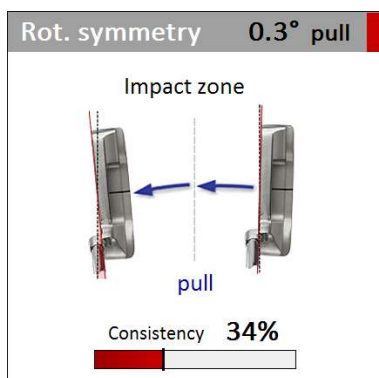
Average rate of rotation (rotation speed) exactly at Impact. The pictogram represents the amount of rotation in 5 grades with additional description (here “moderate”).

5.28 Rotation speed curves



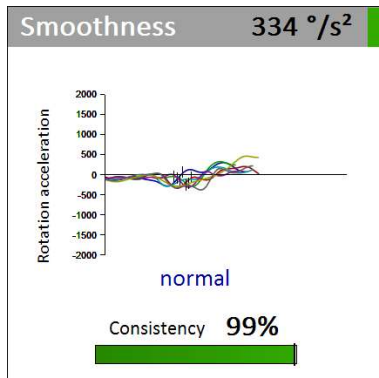
Average rotation speed exactly at Impact. The curves show the course of face rotation in the forward swing. The vertical stripes represent impact.

5.29 Rotation symmetry



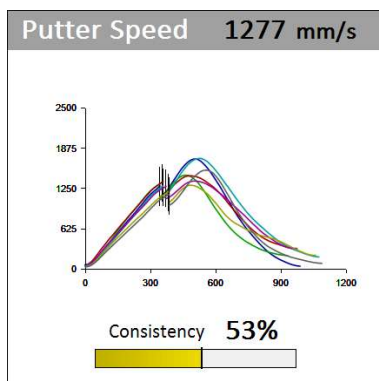
Average rotation symmetry in the impact zone, which is the difference of rotation before impact to rotation after impact. The pictogram represents the symmetry in 5 grades with additional description (here “pull”).

5.30 Smoothness



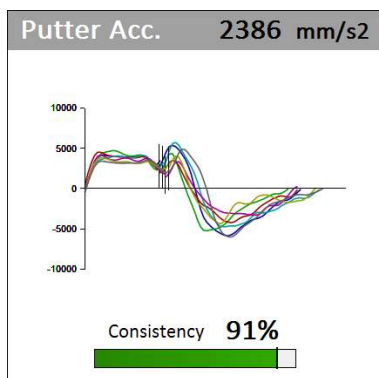
The smoothness of face rotation is described by the amount of rotational acceleration around impact. The data curves show the course of rotational acceleration in the forward swing. Severe irregular oscillations around impact can indicate Yips problems.

5.31 Putter Speed



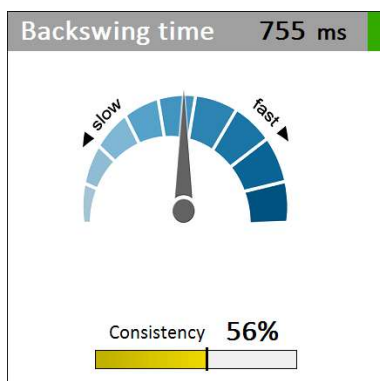
Average putter speed exactly at Impact. The curves show the course of putter speed in the forward swing. The vertical stripes represent impact.

5.32 Putter Acceleration



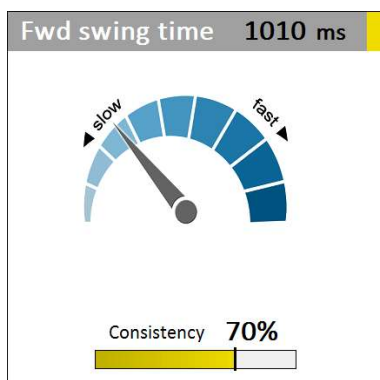
Average putter acceleration exactly at Impact. The curves show the course of putter acceleration in the forward swing. The vertical stripes represent impact.

5.33 Time Backswing



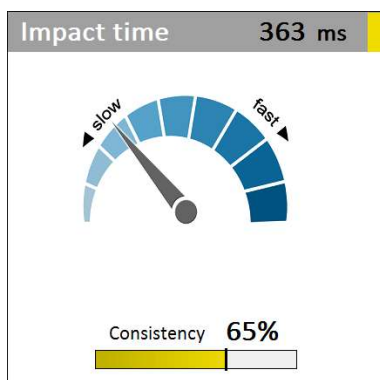
Average backswing time. The speed meter pictogram represents the time in 5 grades with additional description (here “normal”).

5.34 Time Forward swing



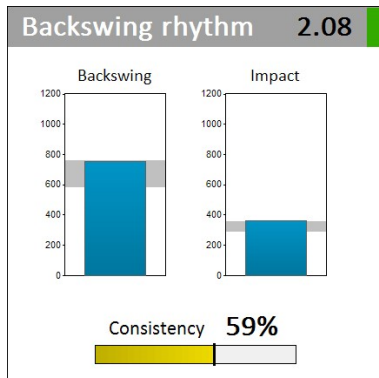
Average forward swing time. The speedometer pictogram represents the time in 5 grades with additional description (here “slow”).

5.35 Time Impact



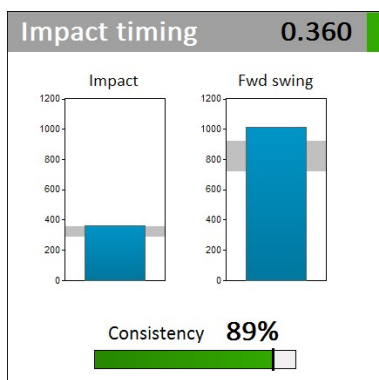
Average impact time. The speedometer pictogram represents the time in 5 grades with additional description (here “slow”).

5.36 Backswing rhythm



Average backswing rhythm, which is the backswing time divided by the Impact time (time from top of backswing to impact). The bars represent the true time.

5.37 Impact timing



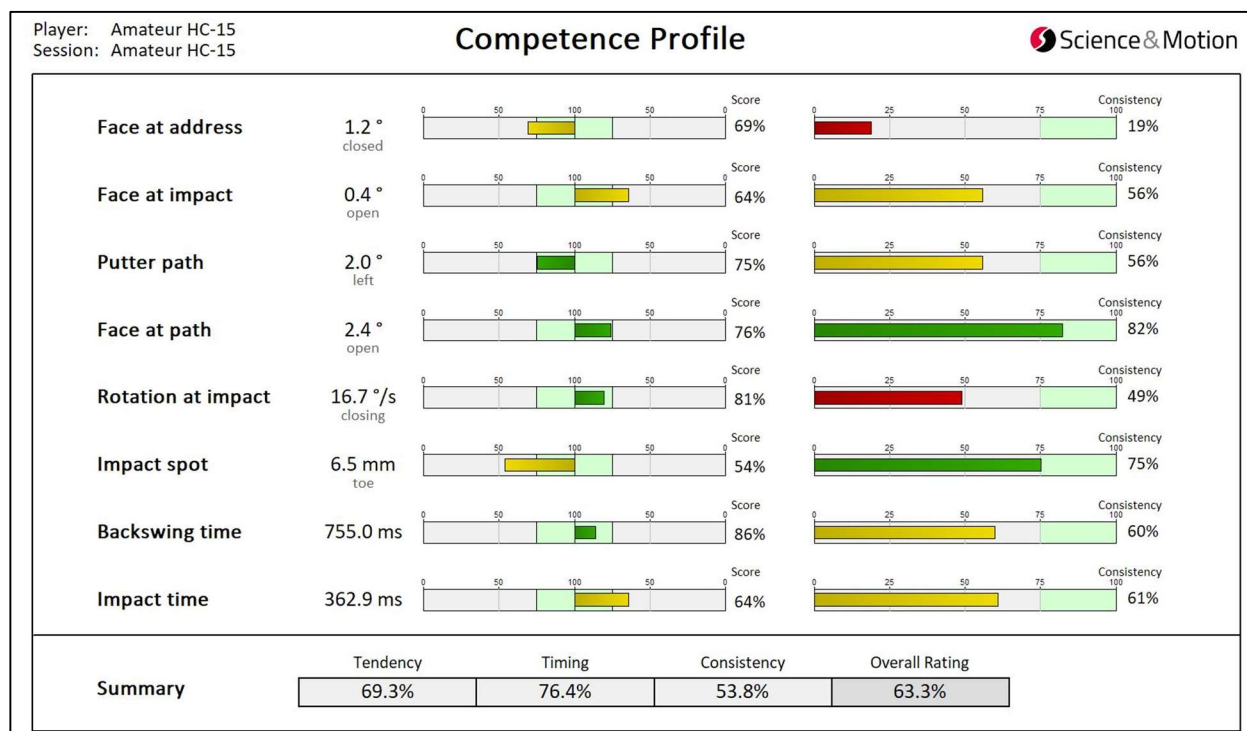
Average Impact timing, which is the Impact time (time from top of backswing to impact) divided by the forward swing time. A timing of 0.36 corresponds to a percentage of 36%. The bars represent the true time.

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6. Profile Reports

6.1 Competence Profile

The Competence Profile presents an overview on the putting performance in bar graphs.



The bars at the left side correspond to the **Tendencies** of a player (the deviation from an optimal *technical* value). Because the data is normalized, the length of the bars can be directly compared to identify the aspect with the largest or smallest deviation for an “optimum”. For a bar to the left, the average data value is smaller (i.e. for time) or is more left (i.e. face) than the optimal data value. To the right the average data value is higher or more right. The longer the bar the more the performance deviates from a Tour player’s average performance. 100% is optimal performance. The green range (75-100%) represents +/- one standard deviation of Tour player’s data.

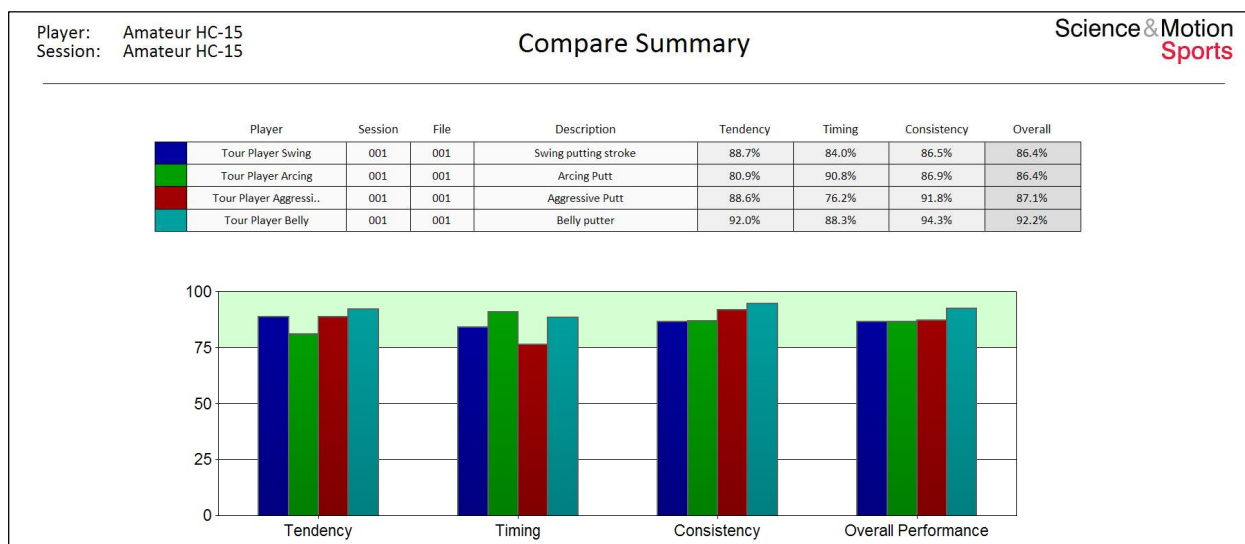
The bars on the right side correspond to the **Consistency** of a player and represent the repeatability of a putting stroke. The Consistency rating has no sign. The more the data values for each putt are close together the higher is the consistency. The longer the Consistency bar the better. The highest consistency is 100%. The shortest Consistency bar in the profile shows the aspect with the lowest consistency which needs to be considered in particular during training. For more information on the relationship between Score and Consistency please read Chapter 2.6.

The Summary displays an overview on the putting performance based on summary Ratings for Tendencies, Timing, Consistency and Overall rating. For more details see chapter 4.2.

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6.2 Comparison Profile

The Comparison Profile allows to directly compare the performance between different data sets, e.g. different putters, different putting conditions (e.g. using different grip styles), or data of different players. Up to eight conditions can be compared. The overall score directly shows the performance for the different conditions.



For a Putter Selection the header will look slightly different as the putter details will be listed for each dataset:

Player: Putter Selection
Session: Putter Selection

Summary

Science & Motion Sports

File	File / Putter	Loft	Lie	Length	Tendency	Timing	Consistency	Overall
001	Putter_1	3.0	72	33.5	69.4%	81.2%	71.4%	73.3%
002	Putter_2	3.0	72	33.5	69.3%	85.3%	80.5%	78.9%
003	Putter_3	2.0	72	33.5	65.6%	77.0%	61.9%	66.6%
004	Putter_4	3.0	72	33.5	70.3%	82.5%	65.2%	70.8%
005	Putter_5	4.0	72	33.5	61.3%	77.7%	74.6%	72.1%
006	Putter_6	3.0	72	33.5	75.0%	89.9%	70.2%	76.3%
007	Putter_7	3.0	72	33.5	74.1%	85.4%	75.0%	77.4%

You can compare any data sets stored in PuttLab by selecting the *Comparison Profile*. A dialog allows you to select data also from different players and projects. A guided comparison can also be run by starting the **Compare -> Optimizer** measurement. This measurement is perfect to directly compare different interventions to find the best solution for an individual player. To compare different putters the **Compare-> Putter Selection** measurement can be used. A dialog wizard is then completely guiding you through the process. The measurements will be grouped together in one session. The description for each condition is entered before each measurement.

The result table shows the respective scores in numbers, and the same Scores are shown graphically in the bar graphs beneath. The Score bars summarize the performance for Technique, Timing, Consistency, and the Overall performance (see 4.2).

On the subsequent report pages the differences for the specific parameters are displayed.

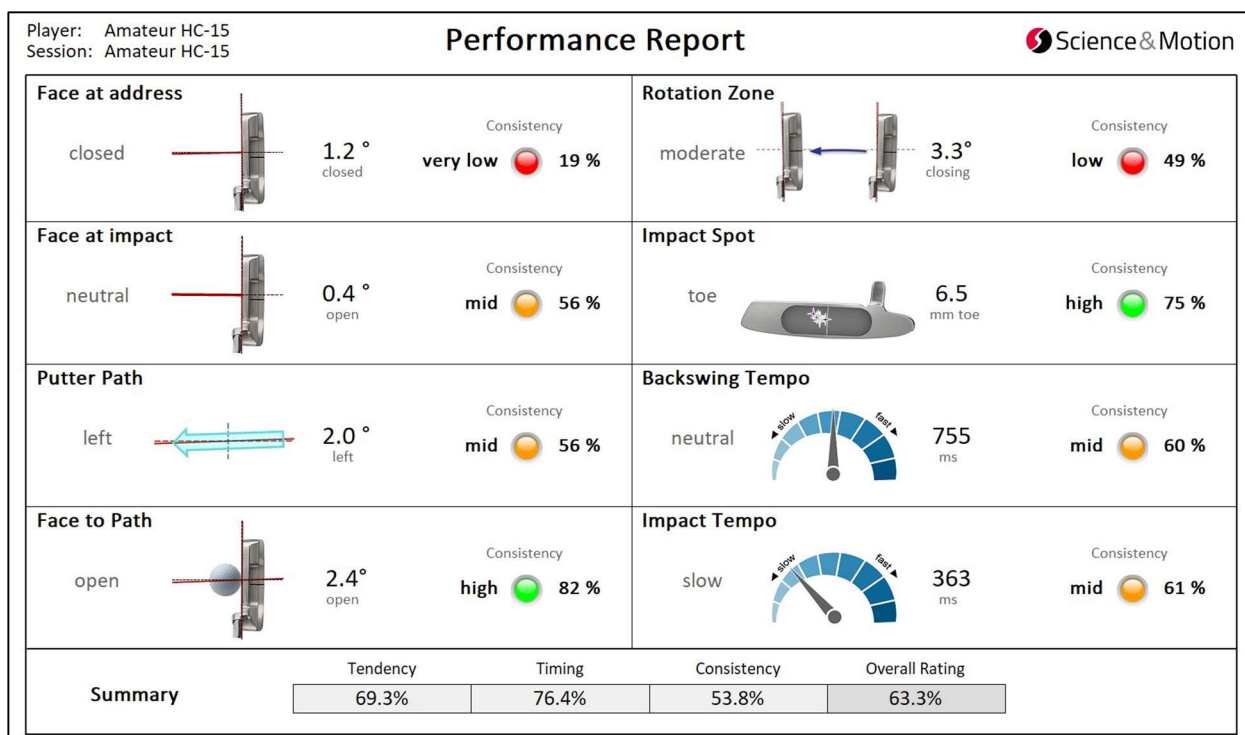


This Profile shows the 2. Page of the Comparison report displaying the performance of four different Tour players for the parameters Face at Address and Face change.

- Please note, that a deviation from a technical optimum (tendencies on the left side) might be acceptable as long as the deviation is consistent and as long as the profile as a whole makes sense (i.e. aim to the right and face change opening, as for the second player in the list).
- High consistencies are more important for the skilled players. Amateurs might show somehow neutral technique but will tend to show low consistency. The performance is then result of a random process.
- If on the other side the consistency is low, but the tendency is neutral, this does not really show a high performance. For low consistency the average technical data value on the left is more resulting from a random process.

6.3 Performance Report

The Performance Report presents a very easy to understand overview on the putting performance and is a good report to be given to the student without confusing him with too much details of the data. The Performance Report is quite similar to the Competence Profile. The *Performance Report* shows only data for the currently selected data set.



The data on the left side of each parameter box correspond to the *technical* aspects of a putt stroke. In the left center an image represents the average result for each aspect. The result is classified in 5 categories which are displayed at the left side. On the right side the numerical data value is displayed.

The traffic lights signs on the right side correspond to the *Consistency* of a player and represent the repeatability of a putting stroke. The more the data values for each putt are close together the higher is the consistency. The colors are red for a consistency lower than 50%, yellow for 50%-75%, green for 75% - 90%, and green-plus for the Tour Range with >90%.

7. EasyFit Report

The EasyFit Report corresponds to the EasyFit Fitting session which can be started on the main screen with the Fitting button.

However the EasyFit Report can also be run post-hoc for any existing dataset. Like in the EasyFit session, a putter fitting questionnaire is started which has to be filled out before starting the report if this has not been done before:

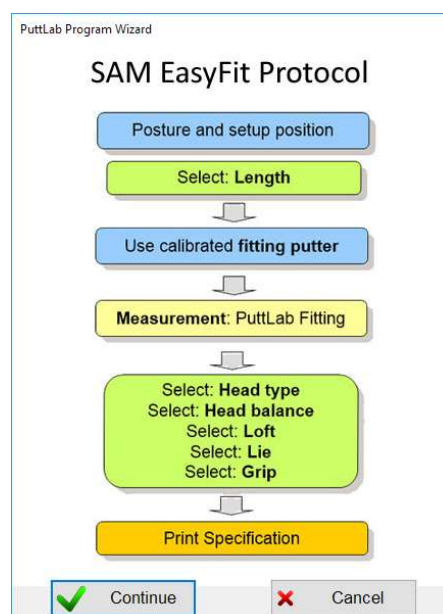
The screenshot shows the 'Putter Fitting Questionnaire' dialog box. It has a 'Database' dropdown set to 'Default'. Below is a section titled 'Putter data (valid for this fitting session)'. It contains several input fields: 'Putter name' (text box with 'Preset Blade Putter'), 'Head type' (dropdown with 'Blade' selected, with a '(select first!)' note), 'Balance' (dropdown with '45° toe hang' selected), 'Offset' (dropdown with 'single shaft' selected), 'Shaft length' (spin box with '34.0' selected, with '(inches)' and minus/plus buttons), 'Putter loft' (spin box with '3.0' selected, with '(degrees)' and minus/plus buttons), and 'Putter lie angle' (spin box with '71' selected, with '(degrees)' and minus/plus buttons). To the right of these fields are two buttons: 'Preset Blade' and 'Preset Mallet'. At the bottom are 'OK' and 'Cancel' buttons with green checkmark and red X icons respectively.

A putter can also be selected from a preset. All data fields need to be filled out, in particular putter loft, putter lie and shaft length are obligatory to continue with the report.

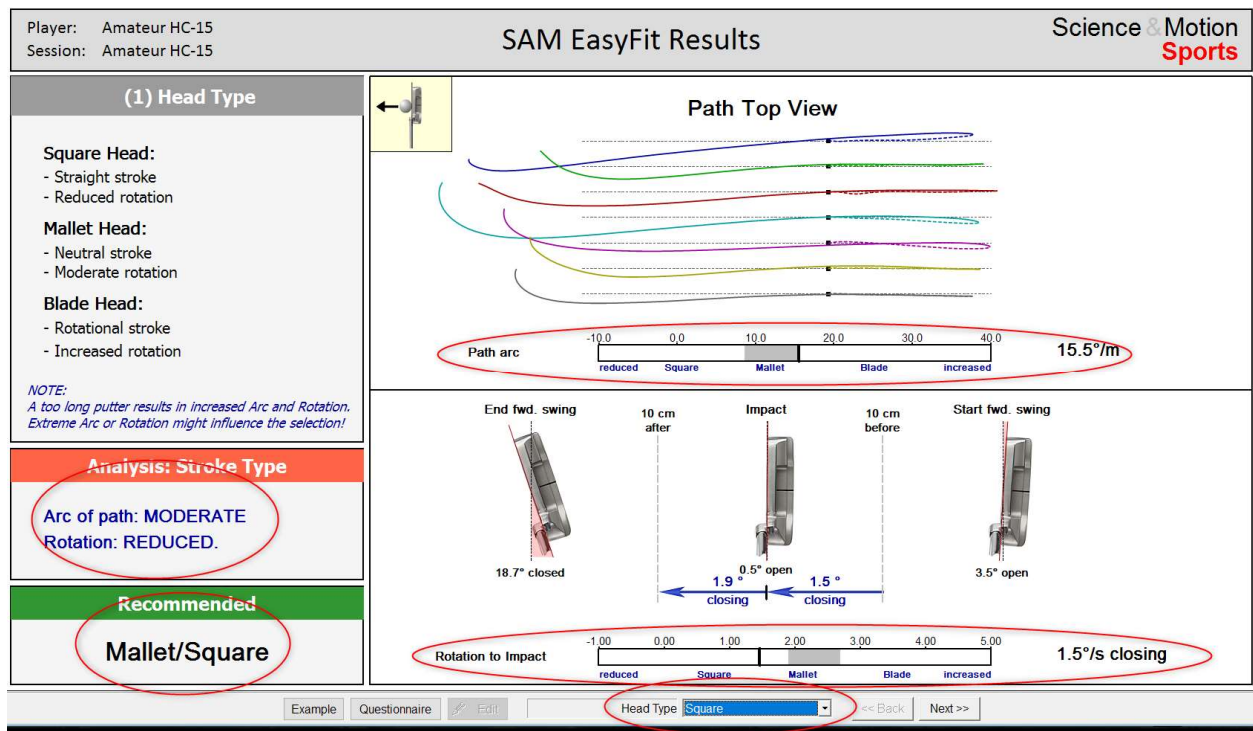
As an inadequate length of a putter can pollute the data results, in a normal EasyFit fitting session the correct putter length needs to be evaluated first. The fitting should then be continued with a putter with the appropriate length.

Then the report interactively helps to decide for head type, head balance, Loft, lie and grip configuration.

For more details on the EasyFit session please refer to the separate EasyFit documentation.



For each aspect to be fitted a separate screen is displayed showing all relevant information to decide on this aspect.



In the upper left box the options and the association to specific results are explained

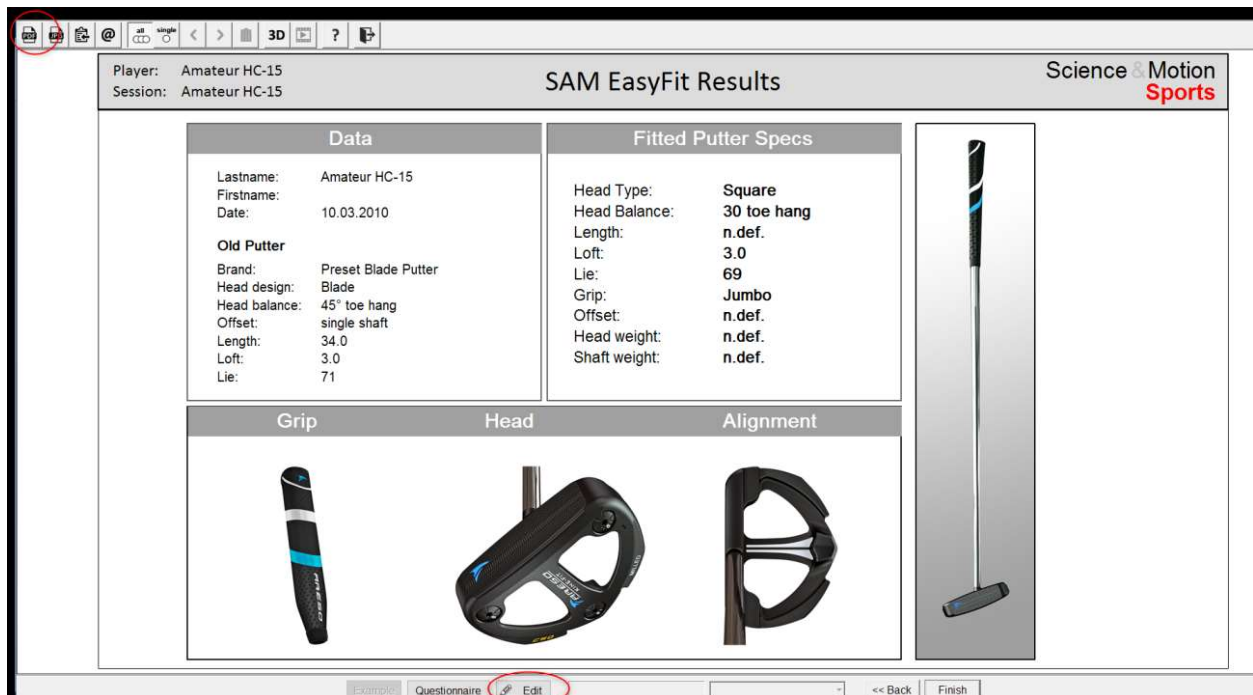
On the upper right side the corresponding data is shown. The data bars underneath the graphs show the results relative to the selection of the head type. Square putter heads correspond to reduced arc and reduced absolute rotation, Mallet putter heads correspond to intermediate arc and rotation, and Blade putter heads correspond to increased arc and rotation. In this case the data marker indicate moderate arc (Mallet) and reduced rotation (Square).

These results are also shown by the automatic analysis in the red box at the left side. Consequently, in the lower left green box the recommendation is "Mallet/Square".

This result is then already preselected in the dropdown list in the center of the lower toolbar. This selection can also be interactively changed by the fitter if necessary.

- The "Example" button in the lower left display example reports for the different options.
- The "Questionnaire" button re-opens the putter questionnaire dialog.
- The "Next" button saves the selection and scrolls to the next report screens, which are designed all in the same way.

After the last report page has been closed, the result page with the selected putter specifications is displayed:



The “PDF” button in the upper left allows to save the report and the results as a PDF file.

With the “Edit” button in the lower toolbar the selection can be further modified or completed in a specific fitting results dialog.

If the putter length has not been fitted yet it needs to be added manually if a post-hoc fitting was done.

Additionally, options such as Head or Shaft weighting can be added.

After closing the dialog the changes will be taken over by the result report and can be stored.

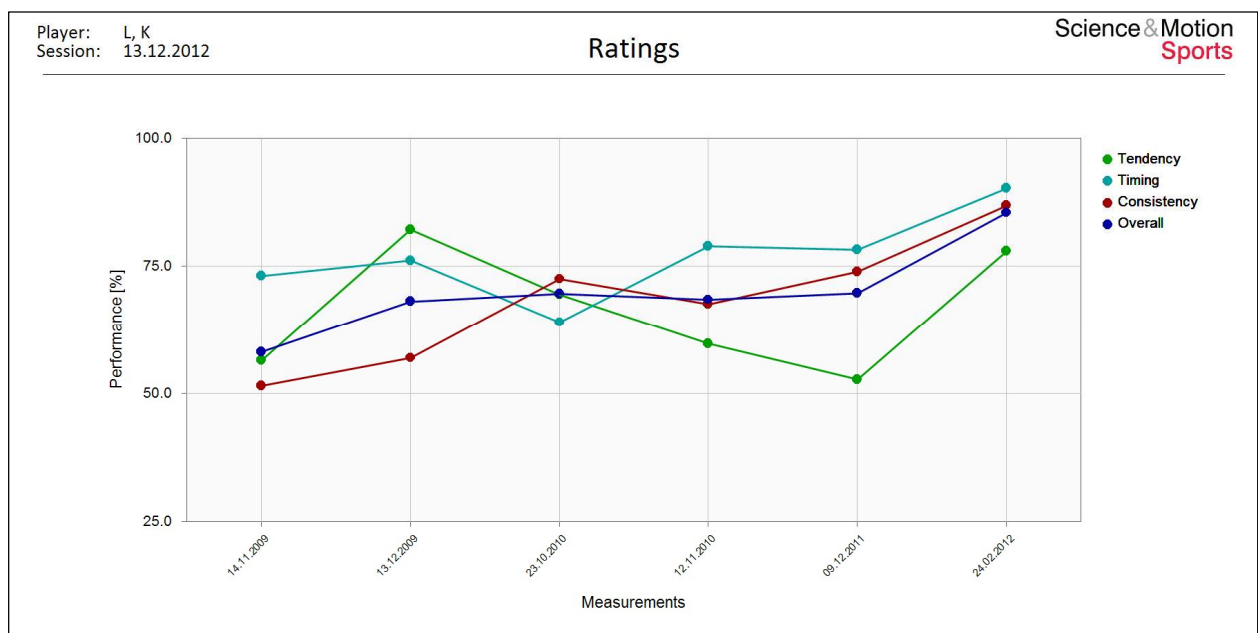
8. Player History report

The *Player History Report* displays the performance of a player over the time. The Player History Report can be selected from the Reports list. A checkbox then allows to add up to 99 data sets to be displayed. The *[Add all measurements]* button directly adds all session data which are measurements to the selection. Trainings sessions and other data sessions will not automatically be added. With the *[Add all session records]* button all records of the actually selected session will be added to the selection. Single measurements can be added with the *[Add selected]* button or by double clicking onto a measurement.

The displayed data will then be sorted due to the date of the measurement. The dates are shown on the horizontal axis.

➤ *Please note that the data is displayed in sorted order, but each data session is equally spaced irrespective of the time difference between two sessions.*

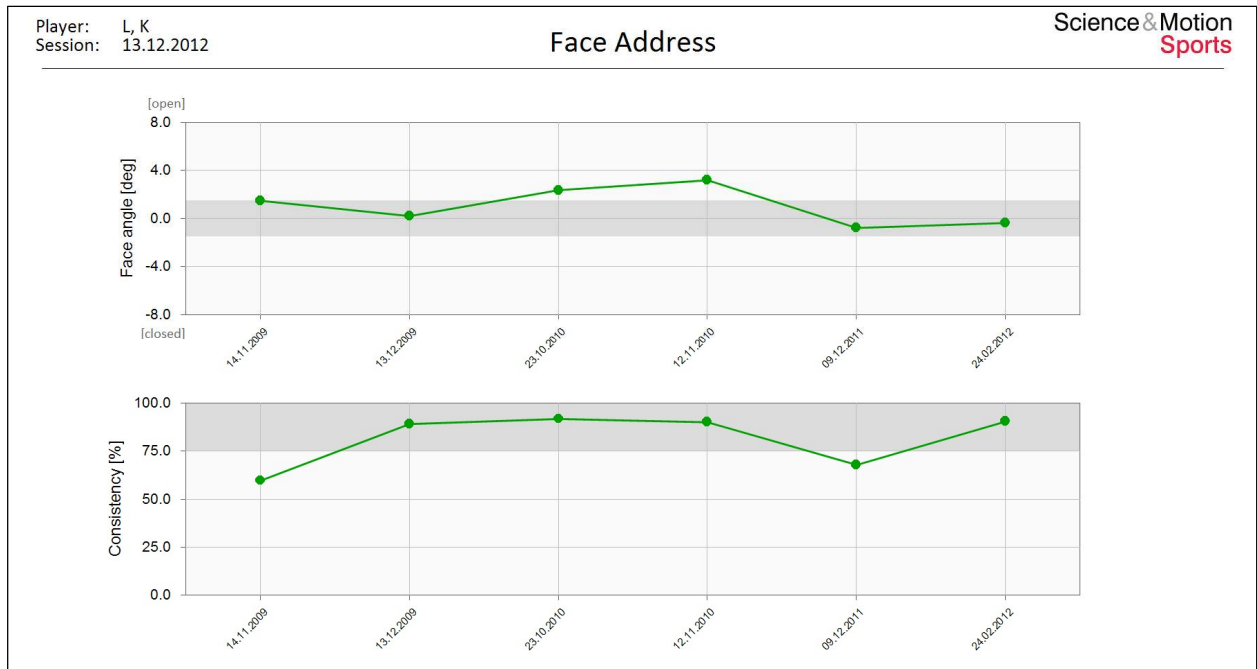
The first screen of the report displays an overview on the Tendency, Timing, Consistency and Overall Score Rating.



For this player the Scores were improving over time and ended on a very high level at the right.

The following report pages report display the performance over time for respective parameters.

The upper graph shows the average data value for a measurement, the lower graph shows the corresponding Consistency rating. The grey shaded area represents the Tour data range.



- Please note that the data is displayed in sorted order, but each data session is equally spaced irrespective of the time difference between two sessions.

9. Head Movement Report (Pro Edition only)

The PuttLab PRO edition includes an additional sensor for head or wrist measurement. The use of the sensor is described in the Head Wrist Manual. The data of the head sensor can be viewed at in a top view and in a side view. The head reports are part of the Professional Report as pages 7 and 8 (only PRO edition). The head position graphs can also be displayed in the trainings mode. If a recording containing head data is indicated by a “+” sign in the measurement icon:



The reference point at zero exactly corresponds to the position of the head sensor during calibration. The ball is displayed in real size. The movement trace of the head sensor is shown corresponding to the movement paths of the putter. The dotted line represents backswing and the solid line forward swing. The black spot is the address position.

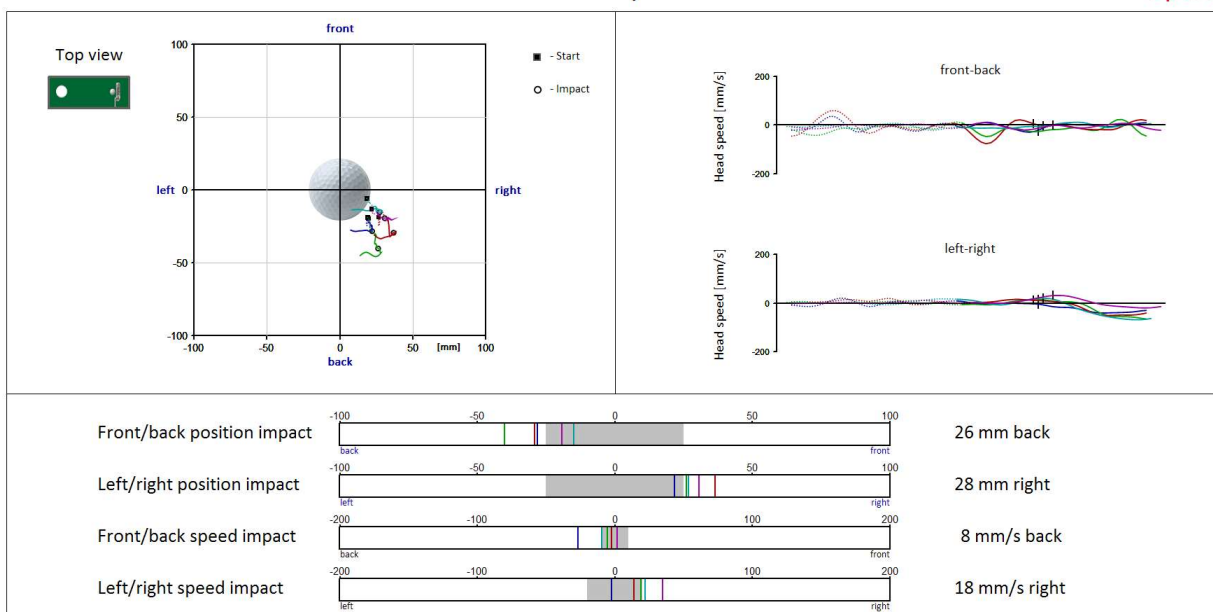
In this example, the head position at address is relatively stable slightly right and inside of the ball. At impact, the position of the head is 26 mm inside of the calibration position and 28 mm right of the calibration position.

At the right side of the report the corresponding movement (velocity) of the head is shown in data curves. There is some movement of the head in the front / back direction before impact as well as to the right at impact and then to the left at the end of the strokes. Left / right moves can also be a consequence of the head looking after the ball after impact. At impact, the head is moving with 18 mm/s to the right.

Player: Head Measurement
Session: Head Measurement

Head Topview

Science & Motion
Sports



This graph shows the data of the head sensor in a side view. The reference point at zero exactly corresponds to the position of the head sensor during calibration. The dotted line represents backswing and the solid line forward swing. The black spot is the address position.

- If data would be out of the display range this would be indicated by red arrows at the graph limits.

In this example, the head position at address is quite consistent in the up / down direction. At impact, the position of the head is 17 mm above the calibration position and 28 mm right of calibration position.

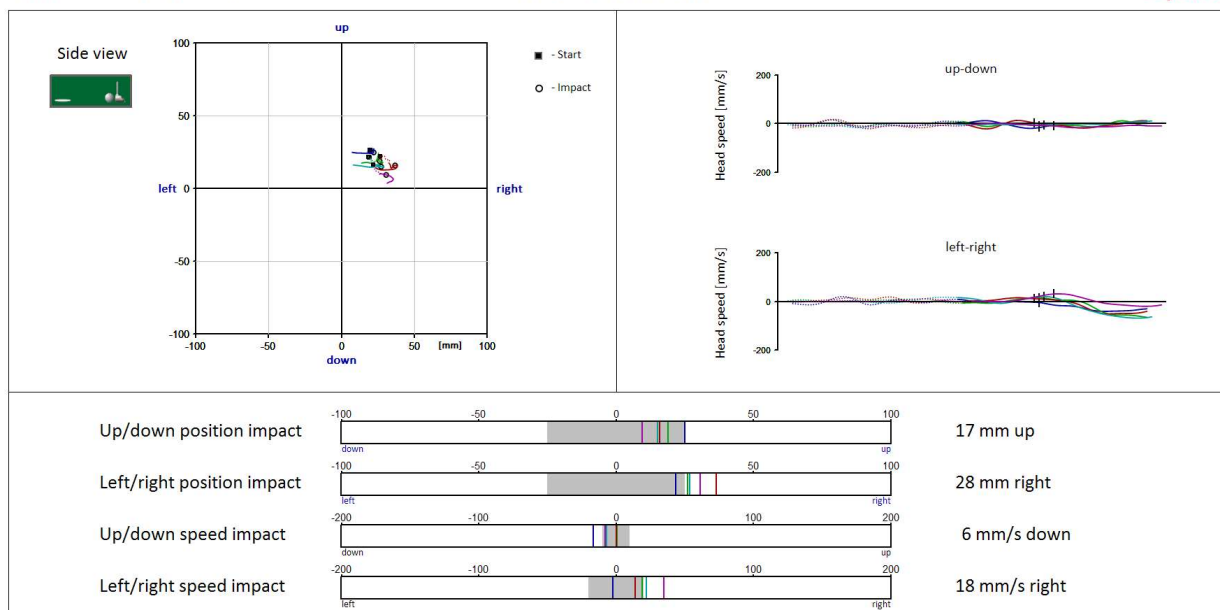
As said before, the head is slightly moved in the left / right direction. At impact, the head is moving with 18 mm/s to the right.

The data curves at the right show that the head is slightly moved up and down before impact and then very stable during follow through. The velocity of head curves in the middle show the movement slightly down through impact with 6 mm/s.

Player: Head Measurement
Session: Head Measurement

Head Sideview

Science & Motion
Sports

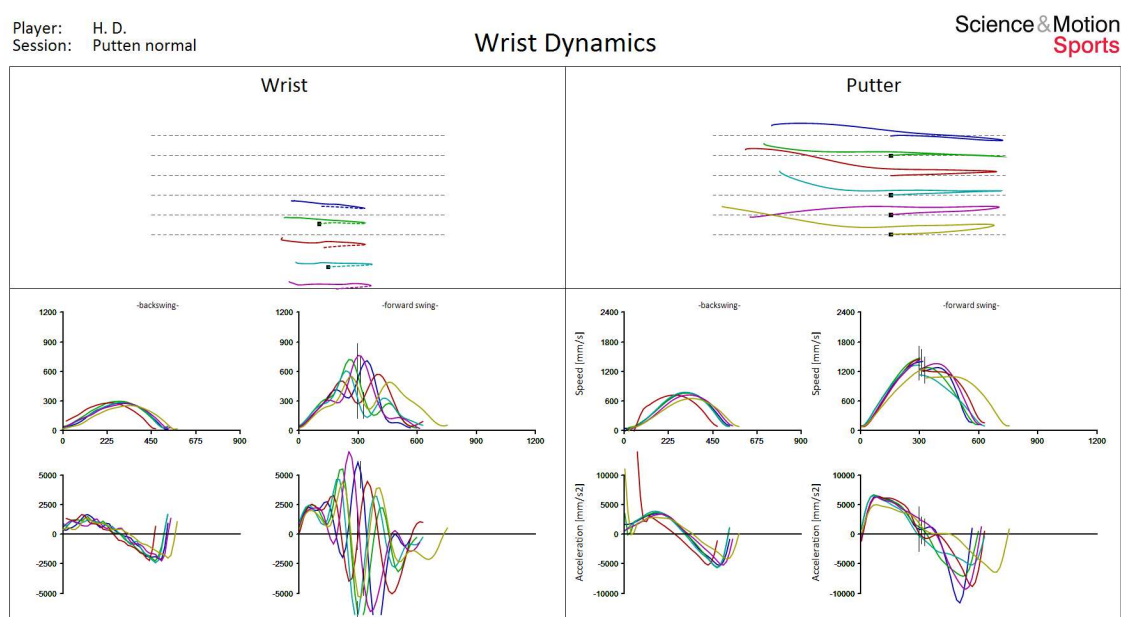


10. Wrist Movement Report (Pro Edition only)

The additional marker may both be used for head or for hand / wrist measurement. The wrist is important in particular in the measurement of Yips problems. Although the jerking of the hand can also be observed in the rotational signals, the additional measurement of the wrist can provide information on jerking, especially if the hand is only slightly gripping the putter (i.e. in a saw or claw grip). The wrist marker will normally be mounted to the right hand which is most affected by Yips.

The *Wrist Report* shows movement dynamics of the wrist (left) and the putter head (right) for backswing and forward swing. The levels of velocity and acceleration of the wrist amount to approximately 40% of the putter movement. Please note the different scaling of wrist and putter graphs (factor 2).

Wrist dynamics of a Yips affected golfer before training



For this golfer with Yips (before training) the report shows a dramatic disturbance and oscillation in the wrist velocity and acceleration around impact (left). In contrast, the backswing looks quite regular.

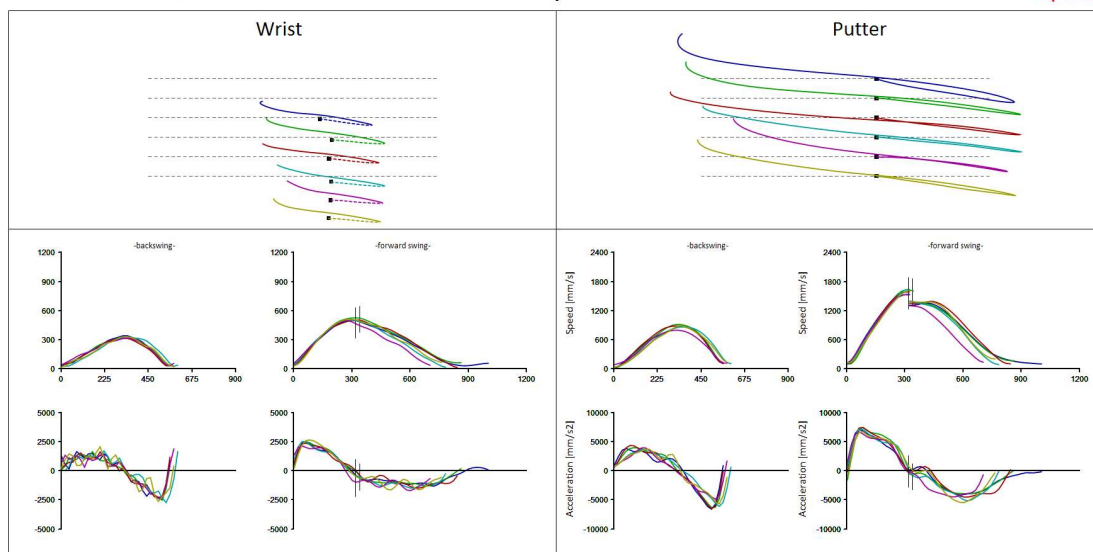
The movement dynamics of the putter (right) look far more regular. This means that it might be very difficult to identify the Yips in the putter movement data itself. Yips is a problem of control of face rotation, and therefore Yips can only be clearly identified in the wrist movement data and in the rotation data.

Same player after 2 hours of Yips training

Player: H. D.
Session: Nach Training: Putten normal

Wrist Dynamics

Science & Motion
Sports



This report shows the result after the two hours of a motor behavior Yips training. All curves now look very regular if not to say perfect. In particular the high consistency of the movement is surprising. The characteristics of wrist movement and putter movement look pretty much the same.

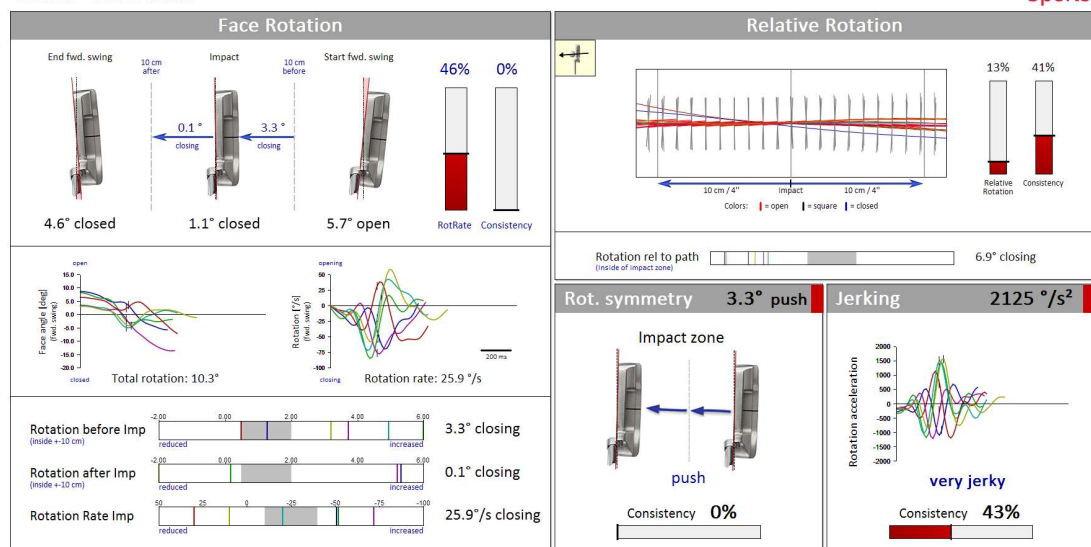
Yips problems in the rotation report

The rotation report shows problems with face rotation quite clearly. Face rotation is affected by Yips and will show a disturbance also in mid forms of Yips. Additionally the jerking report allows the judgement on the degree of the problem. Values higher than 1000 deg/s² are attributed to Yips problems.

Player: H. D.
Session: Putten normal

Rotation

Science & Motion
Sports



11. Example of Tour performance

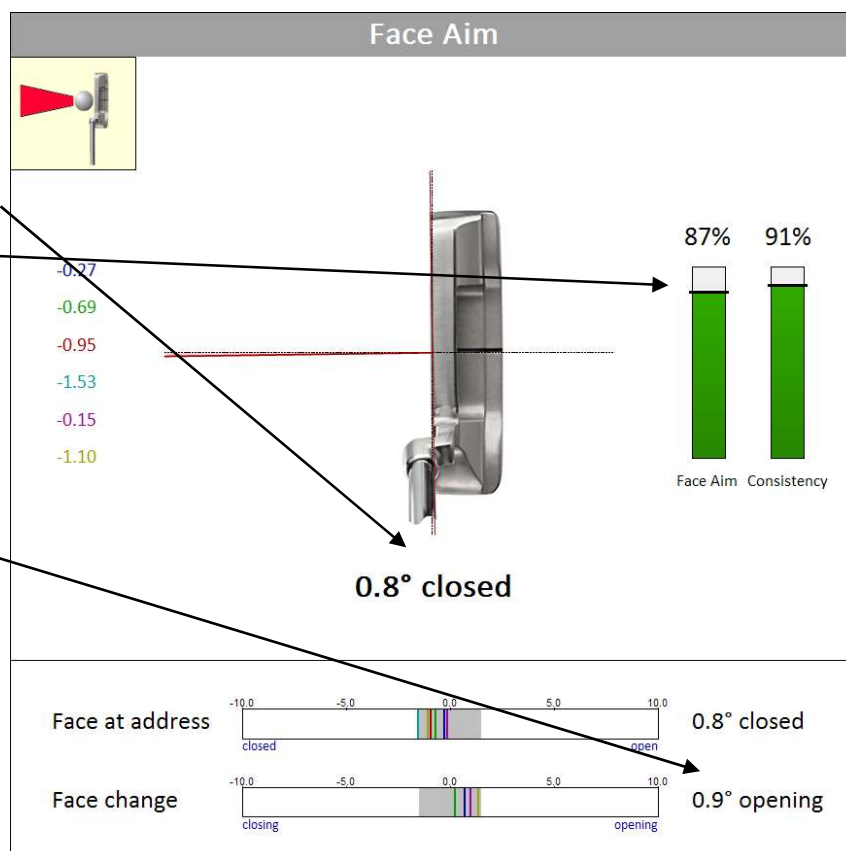
11.1 Aiming

The Putter Face angle describes the alignment of the putter face in relation to the intended target line. The face can be open (pointing right), square or closed (pointing left) as compared with the true putting line. The face angle at address is measured exactly before the putter is moved away from the address position to the right. At aim the putter face should point to the target. In repetitive aiming the consistency of the aim angle is of highest importance for control of face angle at impact.

Deviations from square aim can be consistently corrected as long as the deviation is also consistent. The aim angle should not deviate more than 2 degrees from the true target direction. If we translate mis-aiming to putt distance, than an error of 1 degree in face angle will point the face to the left or the right edge of the hole for a 12 feet putt.

Data analysis:

- Slightly closed at address 0.8°
- This deviation results in a Technical Score of 87%
- The repeatability of the aiming is very high
- This repeatability results in a Consistency Score of about 91%
- The left aiming is corrected to impact. The face change from aim to impact is small with 0.9° opening
- The consistency of the face change is also high.



11.2 Face and Path Direction

Generally face angle at impact and path direction determine the direction of ball travel. Putter path direction and face angle compensate each other. For an open face the path have to run inside left to make the ball roll straight, or the other way round.

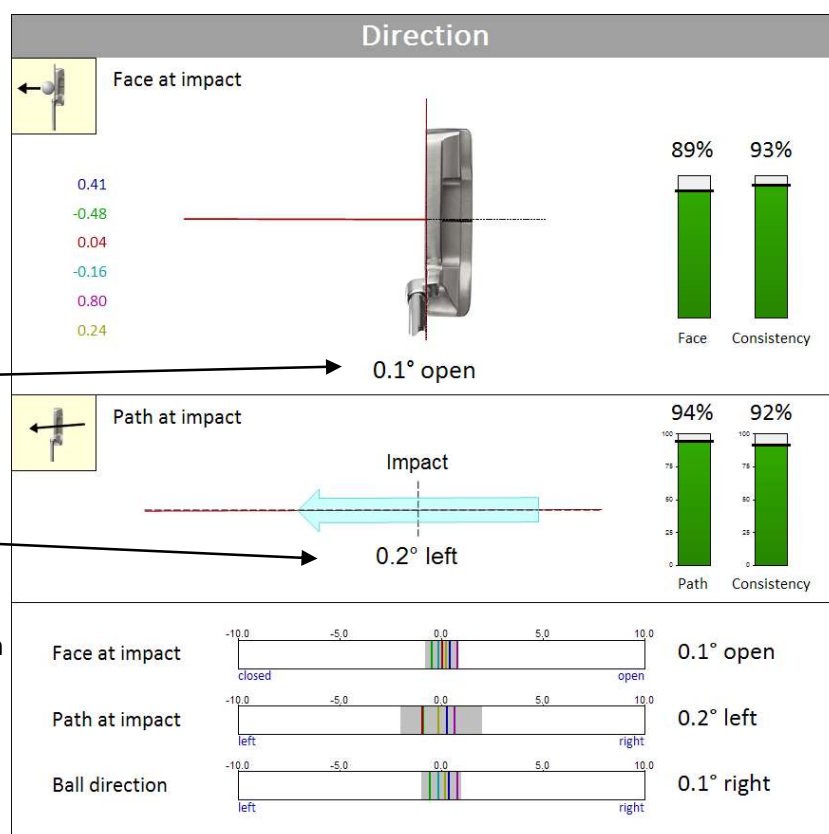
The face angle at impact has considerably more influence on the direction of the ball as compared with the putter path direction. The face angle at impact determines ball direction to 83% and is thus about 5 times more important than the putter path. An open face of about 1 degree can only be compensated with path cutting left 5 degrees.

If we correlate path errors to putt distance, than an error of 1 degree in face angle will result in missing the hole in a 4 meters putt (if the putter path is square at the same time). For half distance in a two meters putt the error can be double with about 2 degrees. This means that missing putts is mainly because of misaligned face angle. The ball direction as calculated with the PuttLab is considering face to 83% and path direction to 17%.

Data analysis:

This player is one of the best putters on the PGA Tour. He shows a perfect control and consistency of all direction parameters. All data values are inside of the preferred grey data ranges.

- The face is in average almost perfectly square at impact. This results in 89% average Score. Consistency is high with 93%
- The path is slightly left with 0.2°. Consistency is high with 92%.
- The face is almost square relative to path at impact with 0.3° open, again with high consistency.
- The resulting ball direction is in average 0.1° right and also very consistent.



11.3 Putter path and Impact spot

Path geometry

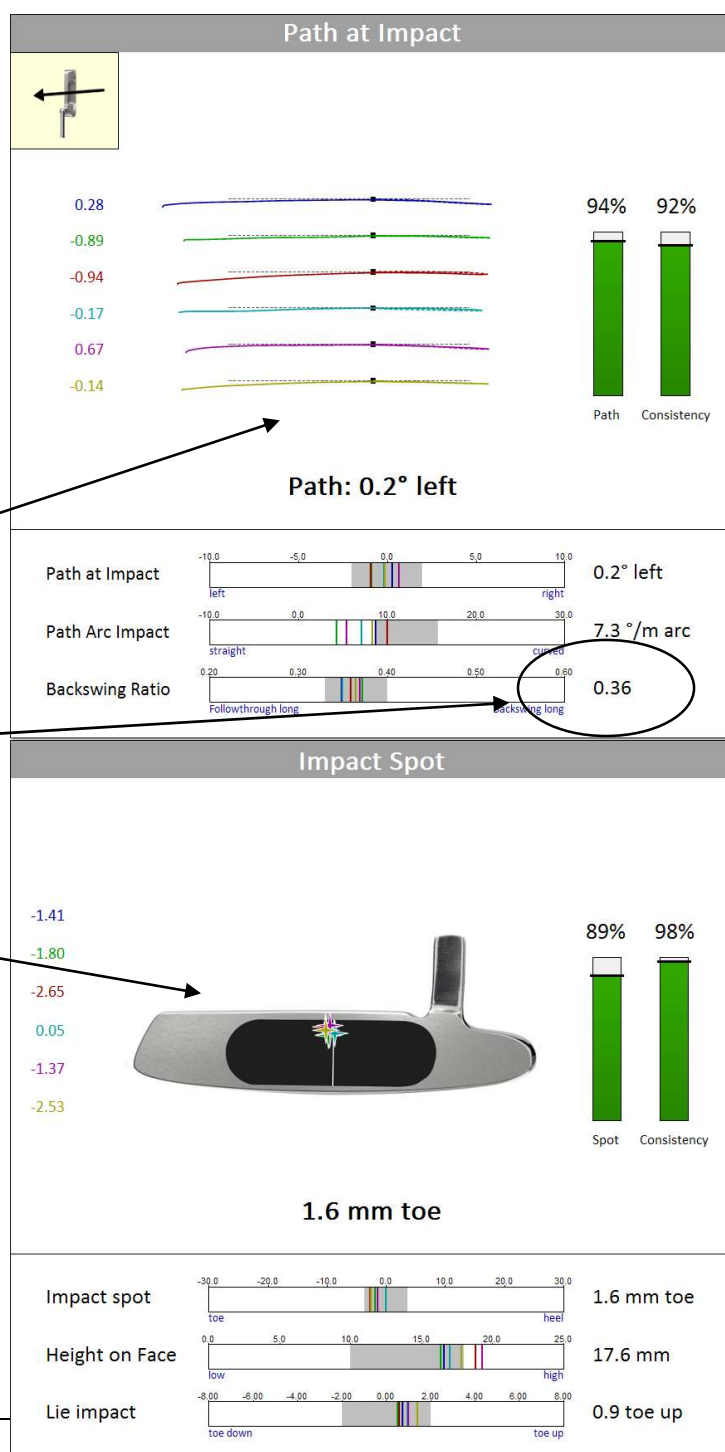
The putter is naturally moved back and forth on a *tilted* swing plane. If projected down to the target line a tilted swing plane results in an ellipse shape, so the putter will slightly move inside in the backswing, match the target line through impact and then again will move inside in the forward swing. The more the swing plane is tilted, the more this ellipse will be curved. The consistent length of the back swing is very important. The amplitude of the movement determines the length of the putt, as swing timing tends to be constant also for different lengths. Consistent length of backswing means consistent distance control. Very often the end of the forward swing is also neglected. Consistent length of forward swing is also important for a solid stroke and proper timing of speed.

Impact Spot

The setup position and putter path in the backswing will determine where you will hit the ball on the face. Very often an inconsistent hit spot is directly related to poor balance and a backswing which is too long.

Data analysis:

- A natural movement path is slightly curved inside at begin and end
- In plane backswing (dotted), no loop
- Backswing is shorter (36%)
- Very consistent length of backswing and forward swing
- The impact spot is 1.6 mm at the toe, which more often happens for paths cutting left through impact
- The hit spot for Tour players is often up on the putter face. The vertical sweet spot also tends to be more up on the face.
- The highly consistent impact spot corresponds to the smooth and consistent path
- Inconsistent spot is often a setup/balance problem



11.4 Dynamic Loft & Rise

Depending on the static loft on the putter and the hand position at impact, the dynamic loft applied to the ball is determined. For neutral hands a static loft of 2 degrees will result in 2 degrees dynamic loft to the ball. If the hands are in front of the ball (forward press) then a putter with higher loft might be ending up with the same amount of dynamic loft (static loft of 4 degrees, delofting 2 degrees, results in dynamic loft of 2 degrees). In contrast, if the hands are behind the ball thus adding loft to the static loft of the putter, the dynamic loft and the launch angle may end up with very high numbers.

Ball spin

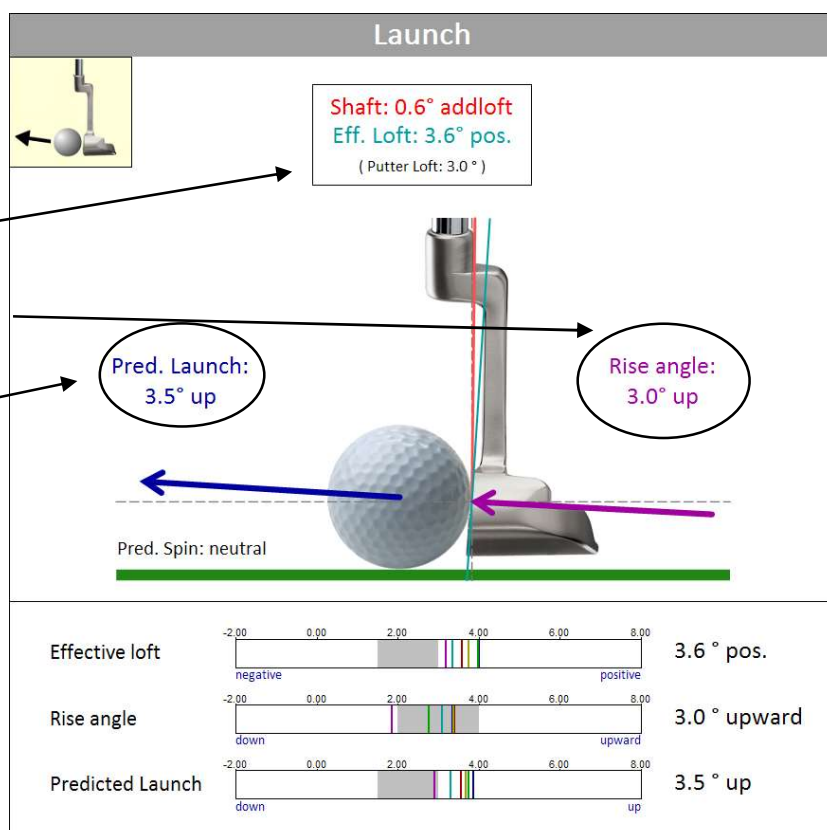
The difference between dynamic loft applied to the ball and angle of attack (Rise) determines ball spin. If rise angle of the putter through impact ($3-4^\circ$) is higher than the dynamic loft at impact (2°) then the ball will immediately start launching with some amount of topspin. If the rise angle is less than the dynamic loft then the ball will start with some backspin.

Launch angle

The dynamic loft applied to the ball primarily determines launch angle of the ball, like face angle determines ball direction. There is some additional minor influence of vertical angle of attack (Rise) on launch angle of the ball. High speed video shows that on fast greens (Stimp 11) a launch angle of about 2 degrees is enough for proper ball launch.

Data analysis:

- On fast greens flat launch and positive angle of attack is preferred.
- Shaft leaning slightly forward (0.6° addloft)
- Hitting the ball up through impact. Rise angle is 3.0 degrees upward
- Predicted launch 3.5° up is ok, fast greens with Stimp 10 requires 2° up
- Resulting neutral spin



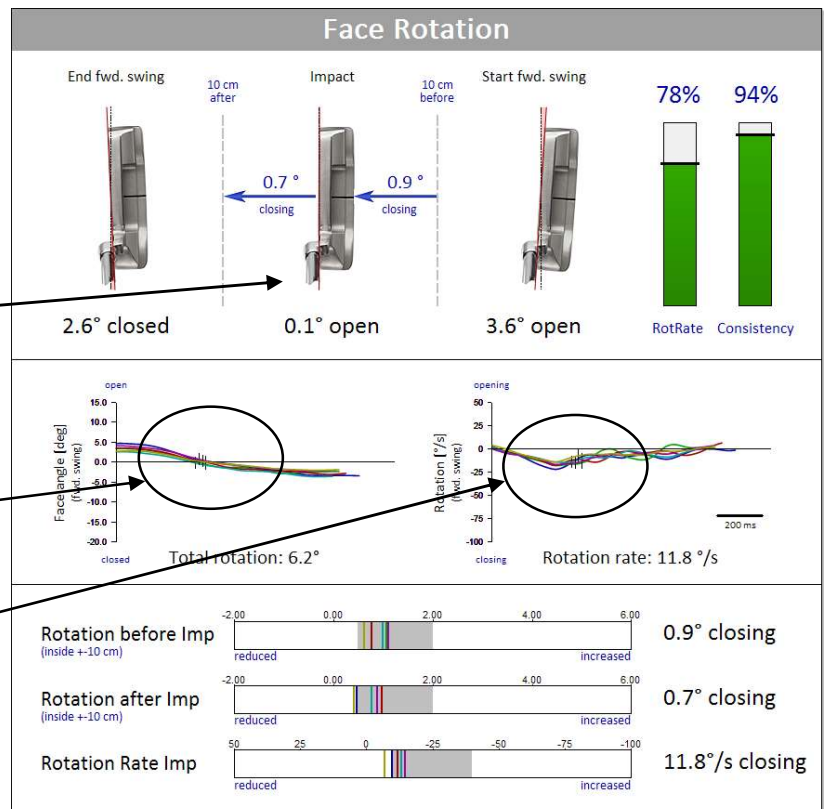
11.5 Face rotation

Face rotation is a consequence of moving the putter back and forth on a *tilted* swing plane. In a natural plane stroke the face will ALWAYS be square relative to movement path direction. Only if projected down to the target line a tilted swing plane will result in an ellipse form, but still will be square at impact. This means that rotation inside of a swing is NOT necessarily consequence of hand or wrist action but a normal consequence of the amount of tilt of the swing plane. For upright stand there will always be more rotation in the stroke as the swing plane will be more tilted. In contrast, for a truly vertical swing plane, there will be no rotation inside of the stroke. The amount of face rotation is an issue of putter fitting.

In amateurs you often find additional hand and wrist action adding more rotation to the stroke. On the other hand, a lot of the skilled players tend to reduce rotation by blocking the face through impact. These are both not very helpful strategies, as they alter the normal pattern of rotation and add some amount of inconsistency.

Data analysis:

- The graph shows forward swing only
- Naturally open to square to closed
- Slight and symmetric rotation in the impact zone
- Total rotation depends on length of swing
- If the stripe meets the zero axis, then the face is exactly square at impact
- Flat and stable rotation at impact
- High consistency if all putts show exactly the same profile



11.6 Movement dynamics

The PuttLab movement dynamics data directly reflect the movement of the putter face. This data is extremely sensitive and shows even smallest changes of the movement. For repetitive skilled and automated movements the trajectories, the velocity and acceleration curves, the height of the peaks and the timings will always be exactly the same. So if looking at the dynamic data, we always look at smooth and coherent curves. All the curves should be superimposed and look alike.

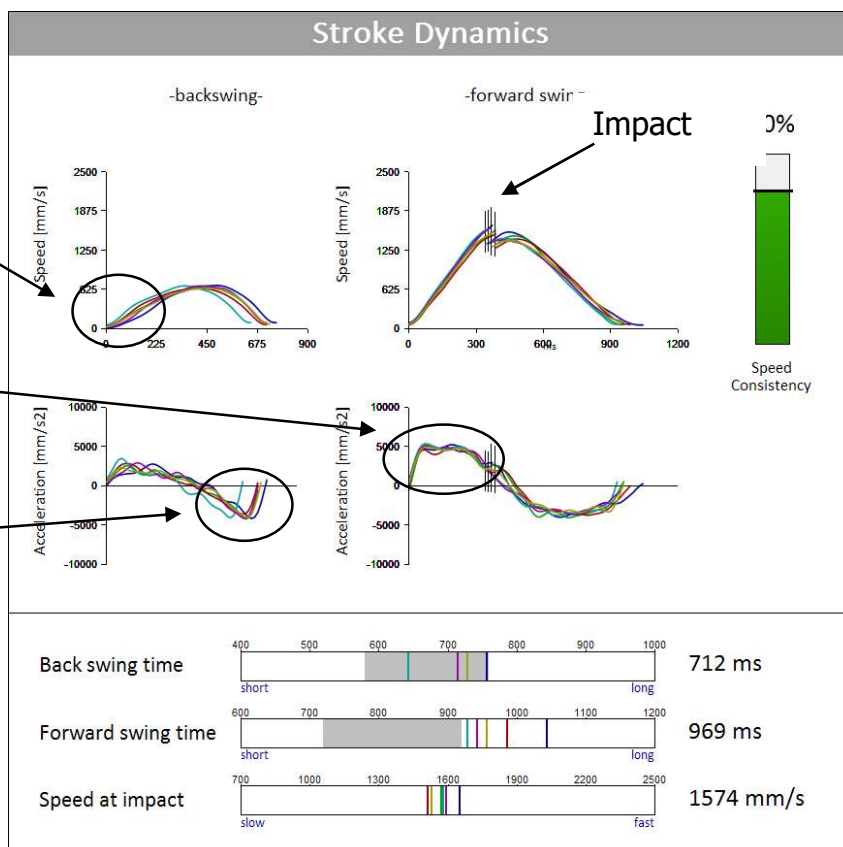
Generally, the backswing movement should start smoothly. The backswing should not be initiated through the hands rather than with the upper right arm. To end of backswing the acceleration is becoming more steeply with a sharp edge at the top of the backswing. The transition from deceleration at top of backswing to acceleration at begin of forward swing is associated with the change of movement direction. Backswing and forward swing should not be separated by stopping at top of the backswing. Backswing and forward swing should be ONE movement.

Until impact acceleration is then constant for **swing putters**. Constant acceleration means that the speed of the putter is constantly increasing. This is represented by a constantly ascending curve of velocity at begin of forward swing (upper right graph). In contrast, acceleration is steeply ascending for **hit putters**.

Impact reduces the energy of the putter moved and can be identified by a sharp peak downwards in the acceleration signal. After impact the acceleration is approaching back the zero acceleration for swing putters. For hit putters the acceleration is changing more steeply from positive acceleration before impact to negative acceleration after impact.

Data analysis:

- Consistent curve shapes and timings show high degree of movement automation
- Smooth start of backswing
- Same acceleration before / after transition
- Constant acceleration to impact (swing putt)
- Steep transition from backswing to forward swing (commitment)
- Acceleration would steeply increase to impact for a hit putt



11.7 Rhythm and Timing

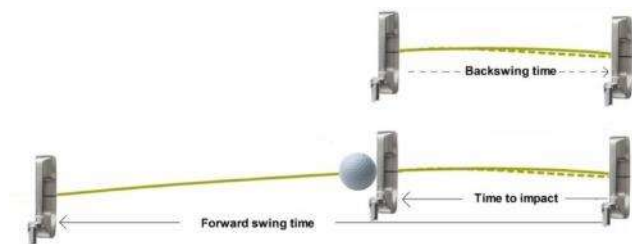
Rhythm and timing are generally guiding human movements. In skilled and automated movements we try to keep this sequence of action and the underlying timing constant. This principle is called the *isochronic* principle.

Movement duration will tend to be constant irrespective of movement amplitude. What will be adapted is just the amount of activation, more activation for longer putts, less activation for shorter putts. This results in a movement behavior where rhythm and timing will be almost independent from putt length.

Consistent rhythm and timing are also crucial for high consistency of the complete stroke. With a good rhythm and timing often everything seems to be in place automatically. While executing the stroke, we *feel* the rhythm which is guiding us through the process of moving. Good feel in fact means that timing is perfect, everything is in place, everything happens as planned. More than that, feeling the rhythm is also helping the brain to relax and to more focus on the task. In other words you will be more connected to the task. The more you automatically execute the movement, the more you will be able to connect yourself to the task – holing the putt.

Backswing Rhythm:

- Backswing time should be 100-200 ms shorter than forward swing time
- Consistent timing controls the complete stroke



Backswing rhythm =
Ratio of backswing time / time to impact

Data analysis:

- Regular backswing time (712 ms)
- Slightly longer impact time (369 ms)
- Slightly longer forward swing time (969 ms)
- Backswing time is double as compared with time to impact (ratio 1.93)
- Time to impact is about 38% of forward swing time

