Motor Strategy Disturbances in Golf:
The Effect of "Yips" on the Movement of the Putter Head

Marius Filmalter, Carrollton, Texas
Pierre-Antoine Noizet, University of Texas at Dallas
Ernst Pöppel, Ludwig Maximilian University of Munich, Germany
B.P.S. Murthi. University of Texas at Dallas

ABSTRACT

The purpose of this research was to identify the key differences between the "normal" putting stroke and the "yips-affected" putting stroke. The research was conducted in a controlled environment at the Hank Haney Golf ranch in McKinney, Texas, where 180 golfers volunteered to have their putting strokes measured with the "Super Sam" ultrasound system. Results revealed two types of disturbances present in the putting stroke of 27.22% of the participants. One disturbance was related to the directional control of the putter head during the forward stroke while the other was related to the control of the putter head's acceleration during the forward stroke. Some participants had both types of disturbances in their putting stroke, some only one. This paper focuses on the directional disturbance observed in the putting strokes of 20.44% of the participants. This disturbance was mathematically identified by statistical program designed with the SAS software by the authors. When comparing the average rotation curve of 'yips-affected' participants to that of the unaffected ones, 'yips-affected' participants tend to resist rotation during their forward stroke. With the exception of the 'yips-affected' participants who were possibly also affected by medical conditions such as Parkinson's and intentional tremors, none showed any signs of affliction while performing their practice strokes.

Keywords: Putting, Yips, Directional Yip, Acceleration Yip

INTRODUCTION

Described most frequently as jerks, tremors and spasms affecting mostly the forearms just before the time of impact while putting, the "yips" is believed to be a focal hand dystonia exacerbated by anxiety. First noticed in professions requiring skilled movements such as musicians and surgeons, a focal hand dystonia is classed as a movement disorder along with Parkinson's disease and is not considered to be

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

psychological in origin. “Yips-affected” golfers (McDaniel, Cummings & Shain, 1989) did not show differences in anxiety level compared to non-affected golfers and reported that the “yips” affected other activities than golfing sometimes involving body regions beyond the arms. The “yips” have also been noticed in other sports such as cricket and baseball with similar focal hand dystonia symptoms. The tremors have lately been separated from the following cases:

Freezing: The inability to initiate a desired movement at a specific time and,

Choking: The intended movement program is activated but mainly due to anxiety, such program fails to perform at a desirable level.

Choking seems to be a psychological matter leading to poor performance whereas the “yips” seems to be a physical symptom leading to incapacity to perform in any circumstances. In a recent study, the Mayo Clinic used surface EMG electrodes to demonstrate that at 200ms prior to impact, “yips-affected” participants (“yippers”) experienced co-contractions of wrist flexors and extensors (Adler, Crews, Hentz, Smith, & Caviness, 2005). We used a motion capturing device described below to measure the effects of these co-contractions on the movement of the putter head during the putting stroke. We intended to identify the key differences between the disturbed and the undisturbed putting strokes. We found two types of disturbances present in the putting stroke of 27.22% of the participants which we define as follows:

Directional: The inability to control the rotation of the putter head during the forward stroke thereby failing to keep the rate of rotation constant through impact.

Accelerational: The inability to control the acceleration of the putter during the forward stroke thereby failing to keep the rate of acceleration constant through impact.

The purpose of this paper is to illustrate the directional disturbance experienced by “yippers” during the putting stroke and define the rotational characteristics of an undisturbed putting stroke.

METHOD

Participants

Thirty-four women and 146 men volunteered to stroke level and straight putts three and one half meters in length in a controlled environment. The women had an average age of 31 years spanning from 10 to 59 years, an average handicap of 19.6, an average 8 years of experience playing golf, and played an average of 75 rounds per year. The men had an average age of 42 years spanning from 11 to 87 years,

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

an average handicap of 12.3, an average of 22 years of experience playing golf, and played an average of 66 rounds per year.

Apparatus

We used the “Super Sam" system to measure and quantify the putting strokes of 180 volunteer golfers. The system is calibrated by aligning the club head square to the intended target line with a laser pointing at the center of the hole and positioned at a 90-degree angle with the clubface. This defines a perfectly square clubface.

Procedure

Using the same standard length putter, participants performed the following tests:

Test A: Five putts with an uncorrected grip.

Test B: Five putts with a right hand only grip.

Test C: Five putts with a left hand only grip.

Test D: Five putts with an uncorrected grip but without a ball.

RESULTS

Undisturbed Stroke:

Figure 1 visually and graphically displays the rotational characteristics of the putter head of five putting strokes of a top ten ranked PGA Tour Golfer.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

Visually

The clubface is open 3.6 at the start of the forward swing, closes 4.6 to impact, 7.2 from impact to finish, and closed 8.2 at the end of the forward swing. The clubface rotates shut 3.2 in the 8-inch impact zone before impact and 4.2 after impact. This amount of hand rotation is much higher than the tour average highlighted in gray. This golfer is especially active with the hands during the time of impact.

Graphically

The left graph traces the alignment of the putter head in degrees relative to the zero target line. The right graph traces the rate of rotation over time. At the beginning of the forward stroke the clubface remains open then gradually closes (the toe of the clubface rotates toward the target relative to the heel). The rate of rotation increases gently until a constant rate is achieved and maintained through impact. At the end of the forward stroke, the rate of rotation decreases, once again, a mirror image of the beginning of the forward stroke. The curves are smooth and show signs of symmetry, herein after referred to as an undisturbed stroke. In 90% of the back strokes measured, the clubface rotated open by at least 3.07. In 90% of the forward strokes measured, the clubface rotated closed by at least 2.65 before impact and increased to 2.88 after impact.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

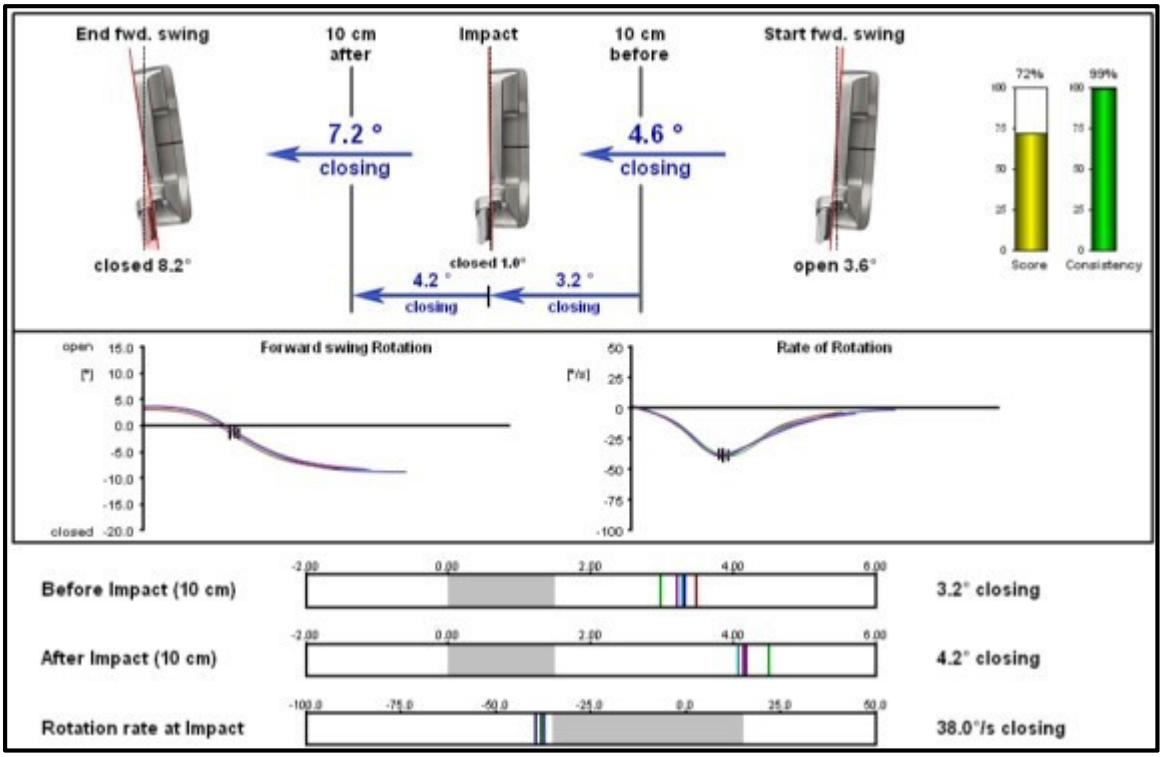

Figure 1. Undisturbed Stroke.

Disturbed Stroke

The graphs in Figure 2 represent the rotational characteristics of the putter head during five disturbed ("yip") putting strokes. The clubface is opened 4.6° at the beginning of the forward stroke. The initiation of the forward stroke is similar to that of the normal stroke but shortly before impact the pattern changes dramatically. Rotation becomes unpredictable in terms of rate and degrees, closing and opening without any consistency or control. This tendency is herein after referred to as a 'directional yip'.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

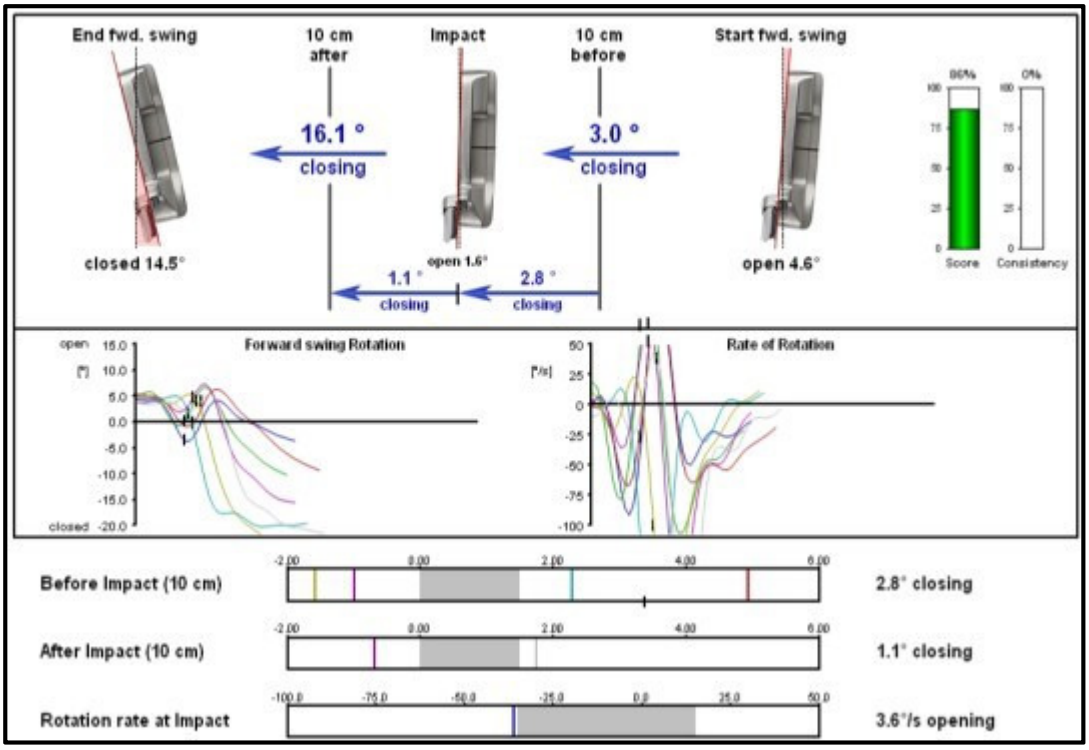

Figure 2. Disturbed Stroke.

Practice Stroke of a "Yipper"

The graphs in Figure 3 represent the rotational characteristics of seven practice strokes executed by the same participant whose 'directional yip' is illustrated in Figure 2. If we compare those two graphs, this particular participant uses different movement programs depending whether or not the ball is present at the time of impact. When the ball is not present, the brain fails to initiate the same program. Figure 3 depicts a simple movement program unaffected by exterior circumstances and very similar to that of the undisturbed strokes of Figure 1.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

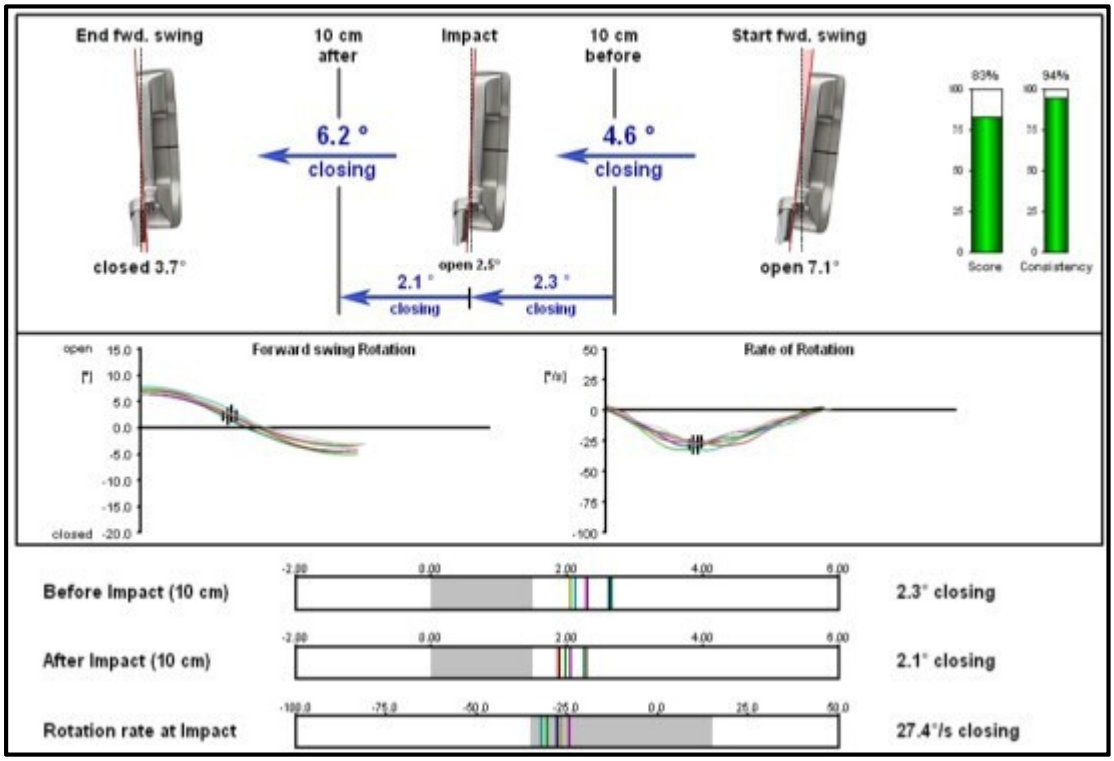

Figure 3. Practice Stroke of a “Yipper”.

Analysis of Rotational Characteristics

We used two mathematical methods to analyze the behavior of the rotation curves within our stroke database and identify the ones representative of a “yip”. Once identified, we intended to quantify the intensity of the “yips” with a third method. In a first phase, we designed a SAS program to execute a regression analysis on each of the data curves. The dependent variable was the alignment of the clubface and the independent variable was time. Given the erratic behavior of the disturbed stroke, each curve was divided into two data sets. The first part was defined as rotation before the time of impact and the second part as rotation after the time of impact.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

In the second phase the SAS program calculated the first and second derivatives at each data point and deducted the behavior of each curve. There are four possible types of curve behaviors, increasing concave up (case a), increasing concave down (case b), decreasing concave down (case c), and decreasing concave up (case d). The undisturbed forward stroke rotation graph illustrated in Figure 1 has only two types of curve behavior: (case c) before impact and (case d) after impact. The disturbed forward stroke rotation illustrated in Figure 2 on the other hand, has all the possible curve behavior types. We classified the presence of (case a) and (case b) within the forward stroke rotation curve of a putting stroke as a “yip”. In the third phase, the SAS program read the curve behavior value in each cell. When it came to a (case b) cell it confirmed that the previous cell was (case a) and extracted the value of the 1st derivative (slope) in a new column. Using the values in this new column the program classified all the rotation curves as either, undisturbed strokes, or disturbed strokes. Furthermore, from the distribution of these slopes, the program classified them as “low-yips”, “medium-yips”, or “heavy-yips”. The “low-yips” had less than 1.04 /ms of slope, the “medium-yips” had between 1.04 /ms and 3.2 /ms of slope, and the “heavy-yips” had more than 3.2 /ms of slope. According to the data collected, 20.44% of participants displayed a “directional yip” in at least one rotation curve.

Content copyright 2006-2010 Research Projects, LLC. All rights reserved.

Comparison of Rotational Characteristics

Figure 4 represents the average rotation curve of 26 directional “yips” (red curve) and 60 undisturbed strokes (blue curve). The horizontal axis represents the completion percentage of the total stroke. The vertical axis represents the alignment of the clubface, zero being the intended target line. The blue curve represents the average rotation of the putter head of non-yippers throughout the stroke which we suggest is the intended movement pattern. The red curve illustrates the average rotation of the putter head of ‘yippers’.

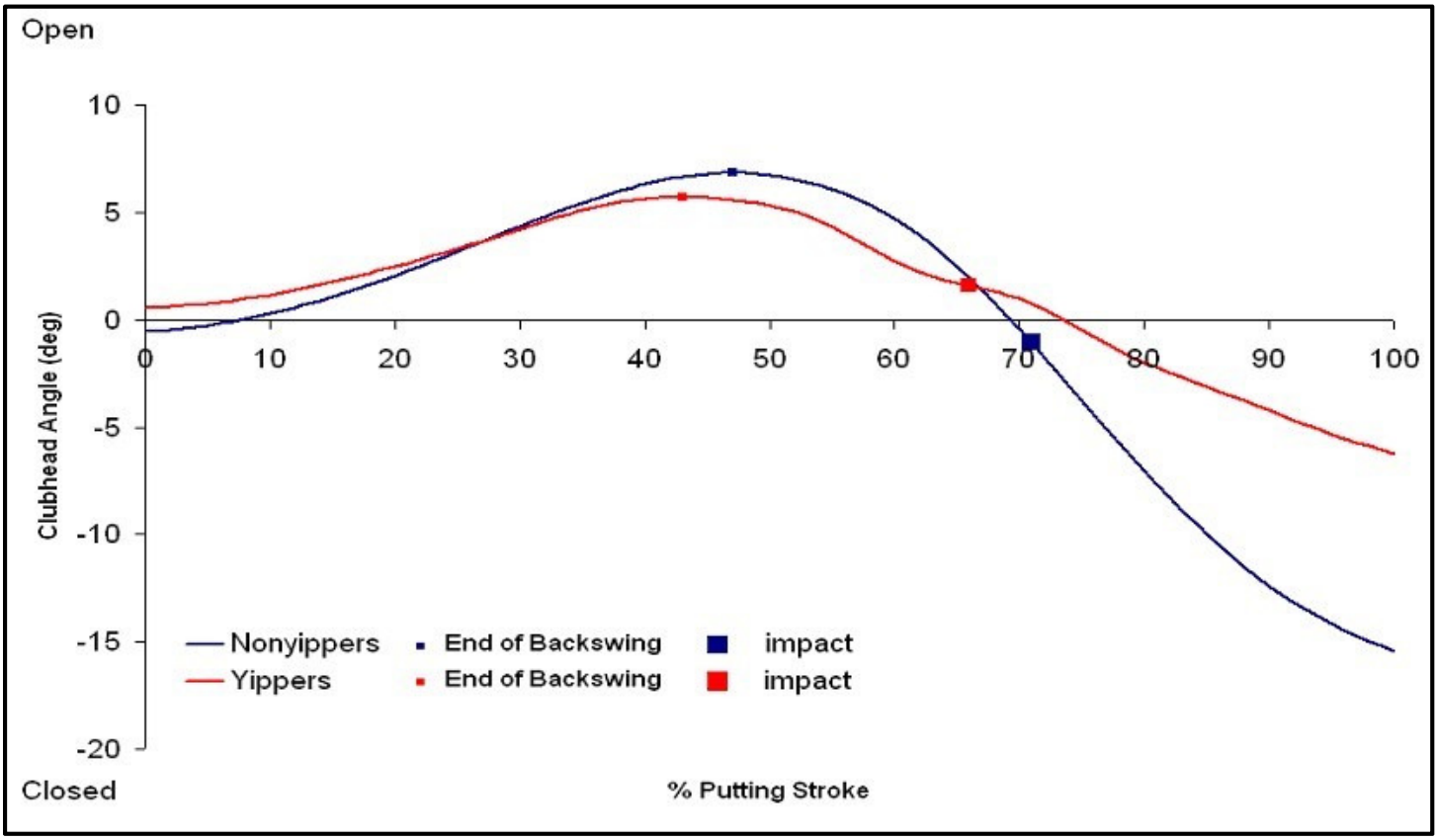

Figure 4. “Yipper” vs “Non-Yipper”.

Correlations

Although we found no definite relationship between age and “yips”, the youngest participant with “yips” was 10 years old and the oldest participants without the “yips” was 87 years old, the affliction seems more apparent with older golfers (Spearman correlation coefficient = 0.12, p = 0.10). The mean age for ‘yippers’ was 43 years and for ‘non–yippers’ was 39 years. No significant relationship

was observed between gender and ‘yips,’ which means females and males are equally prone to the “yips” (Spearman correlation coefficient = 0.04, p = 0.56). The Spearman correlation coefficient between handicap and “yips” was -0.08 but, it also had no statistical significance (p = 0.32). This could indicate though, that the “yips” may be more prevalent amongst lower handicap golfers. The Spearman correlation coefficient between the number of years playing golf and “yips” was 0.11, but again, this correlation was not significant (p = .14). This could indicate though, that the longer golfers play the game, the more they tend to develop the “yips”.

DISCUSSION

Causes of the yips have yet to be determined. We suggest, however, a cause to be a consequence of the battle between the actual physical and intended movements by the golfer. Without exception, the actual characteristics of their putting stroke greatly deviated from intended movements. When comparing the curves in Figure 4, ‘yippers’ tend to resist rotation during their forward stroke. They virtually discontinue the rotation of their putter head through the impact zone. The co-contractions experienced by ‘yippers’ may be caused by resisting rotation through impact. They were only apparent in the forward strokes, shortly before impact and when a ball was present.

This paper focused on ‘directional yips,’ or the inability to control the rotation of the putter head. Future work needs to be done to continue to understand the directional yip, as well as to investigate other possible categories of the ‘yips,’ such as ‘accelerational yips,’ or inability to control the acceleration of the putter during the putting stroke. Future research can also evaluate possible cures for this affliction.

APPLICATION

With the exception of the “yippers” which were possibly affected by medical conditions such as Parkinson’s and intentional tremors, none showed any signs of affliction while performing their practice strokes. This led our team to experiment with “yippers” and their anticipation of results due to impact. The theory was to get “yippers” to strike the ball with their practice stroke. The experiment was to randomly pull the ball away at the time of impact in such a manner that the golfer would not have time to react to it. Once the “yipper” gave up on predicting whether the ball would be pulled away or not he/she would solely focus on executing the ‘non-yip’ motor program. As the experiment continued the “yipper” would get to use that program to strike the ball when it was left in place. The more times the golfer stroke the ball with that ‘non-yip’ program the more efferent copies of that program were stored in the brain. In most cases, the “yip” symptoms dramatically decreased after “yippers” were subjected to that experiment.

REFERENCES

Adler CH, Crews D, Hentz JG, Smith AM, Caviness JN. (2005). Abnormal co-contraction in yips-affected but not unaffected golfers: Evidence for focal dystonia. *Neurology, 64*, 1813-1814.

Bawden M, Maynard I. Towards an understanding of the personal experience of the “yips” in cricketers. *Sports Science, 19*, 937-53. McDaniel KD, Cummings JL, Shain S. (1989). “The yips”: a focal dystonia of golfers. *Neurology, 39*, 192-195.

Sadchev P. (1992) Golfer’s cramp: clinical characteristics and evidence against it being an anxiety disorder. *Movement Disorder, 7*, 326-332.

Smith AM, Adler CH, Crews D, et al. (2003). The “yips” in golf: A continuum between a focal dystonia and choking. *Sports Medicine, 33*, 13-31.

Smith AM, Adler CH, Crews D, et al. (2000). A multidisciplinary study of the “yips” phenomenon in golf. *Sports Medicine, 30*, 423- 437.