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Assessment of calibration accuracy of Pacific University's Goldmann tonometers

Bart P. Hamblin
Pacific University

Shawn P. Murray
Pacific University

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Abstract

In the therapeutic management of glaucoma, the clinician must determine a target intraocular pressure (IOP). Goldmann applanation tonometry is the standard of care for measuring IOP. This study investigates the calibration accuracy of the Goldmann tonometers in Pacific University's primary care and ocular disease clinics to see if variations when using different Goldmann tonometers on successive visits could significantly affect the outcome of IOP measurement. Our results showed that the Goldamnn tonometers at Pacific University's optometry clinics are sufficiently calibrated and will have an insignifcant effect on the determination of achievement of target IOP when therapeutically managing glaucoma.

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Assessment of Calibration Accuracy of Pacific University's Goldmann Tonometers

By

Bart P. Hamblin
Shawn P. Murray

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Advisor: Nada J. Lingel, O.D., M.S.

SIGNATURES:

Bart P. Hamblin ______________________

Shawn P. Murray ______________________

Nada J. Lingel, O.D., M.S. ______________________

BIOGRAPHIES:

Bart P. Hamblin received a Bachelor of Science degree in Zoology from Brigham Young University in Provo, Utah in 1996. He is currently in his fourth year of optometry school at Pacific University College of Optometry and will receive a Doctor of Optometry degree in May of 2000.

Shawn P. Murray received a Bachelor of Science degree in Zoology from Weber State University in Ogden, Utah in 1995. He is currently in his fourth year of optometry school at Pacific University College of Optometry and will receive a Doctor of Optometry degree in May of 2000.

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ABSTRACT:

In the therapeutic management of glaucoma, the clinician must determine a target intraocular pressure (IOP). Goldmann applanation tonometry is the standard of care for measuring IOP. This study investigates the calibration accuracy of the Goldmann tonometers in Pacific University's primary care and ocular disease clinics to see if variations when using different Goldmann tonometers on successive visits could significantly affect the outcome of IOP measurement. Our results showed that the Goldmann tonometers at Pacific University's optometry clinics are sufficiently calibrated and will have an insignificant effect on the determination of achievement of target IOP when therapeutically managing glaucoma.

KEY WORDS: glaucoma, target intraocular pressure (IOP), Goldmann applanation tonometry, calibration

Introduction

It has long been accepted that the most efficacious treatment for reducing the amount of retinal damage due to glaucoma is a therapeutic plan to decrease the intraocular pressure (IOP)[1-4]. For optimal therapy to be achieved, the estimate of IOP must be as accurate as possible. Due to it's relative reliability, Goldmann applanation tonometry is considered the standard technique of choice for evaluating IOP[5].

When developing a treatment plan for glaucoma it is imperative that the clinician determine a target IOP and reduce the patient's IOP to the target IOP. There are many factors that can influence the values obtained by Goldmann tonometry. Sources of error include, but are not limited to, the amount of fluorescein in the pre-corneal tear film and its relation to mire thickness, corneal epithelial abnormalities, corneal thickness, corneal astigmatism, number of measurements performed, lid contact with the applanating prism, patient apprehension, examiner and procedural error. It is important to eliminate as many sources of error as possible in order to achieve the most accurate estimate of IOP.

Goldmann found that the amount of fluorescein in the pre-corneal tear film and its relation to mire thickness could have a significant effect on IOP measures[6,7]. A thick mire showed an over-estimation of 2.0 mm Hg, while a thin mire resulted in an under-estimation of 0.36 mm Hg. Moses found similar results[7].

Kaufmann et. al. studied patients with irregular, scarred, or edematous corneas and found Goldmann applanation readings to be highly inaccurate and unreproducable due to the effects of pooling and distortion of the fluorescein ring[8].

Ehlers et. al. looked at corneal thickness and its effect on Goldmann applanation accuracy and found that a thick cornea may cause an over-estimation of IOP up to 7 mm. In addition, a thin cornea may cause an under-estimation of 5 mm[9]. Similar results were reported by Whitacre et al[10].

Motolko et. al. studied sources of variability in applanation tonometry and found that repeated tonometry measurements cause a lowering of IOP up to several mm due to the aqueous being forced out of the eye[11]. Schmidt and Armaly concurred with these findings in two additional studies[12,13].

Moses studied the effects of the applanating prism touching the lids and found that interaction between the lids and the prism artificially increases IOP measures[7].

Although examiner error is expected when IOP measurement is taken, this error would be expected to remain fairly consistent with respect to an individual optometrist. However, Thorburn performed a study in which intra-observer readings were compared and found that two measurements obtained by the same observer varied by 2 mm Hg or more 8% of the time[16].

There is also the possibility of a significant difference between the measurement of IOP in the same eye with two different Goldmann tonometers, if the tonometers have not been properly calibrated. This could present implications when attempting to reach a target pressure if using different Goldmann tonometers for successive measures.

This experiment is designed to check the calibration of all the Goldmann tonometers at Pacific University's optometric clinics in an attempt to see if variations due to using different Goldmann tonometers on successive visits could significantly affect the outcome of IOP measurement. A properly calibrated Goldmann tonometer will produce readings within +/- 1 mm Hg of the actual IOP under controlled conditions[16]. We believe the findings of this study will show that the tonometers at Pacific University's optometry clinics are calibrated and will not significantly affect the results of monitoring glaucoma treatment.

Methodology

Procedure:

The research group consisted of two optometry students. Calibration of the Goldmann Tonometers at Pacific University's optometric clinics were checked using the calibration bars provided by the tonometer manufacturer. A one hour training session was held to teach the research group the proper use of the calibration units. The trainer was Nada Lingel, OD, who is a faculty member at the Pacific University College of Optometry.

Calibration was checked using the metal calibration balance bar at the 0 mm Hg position, the 20 mm Hg position, and the 60 mm Hg position. When checking the drum at the 0 position, the bar was placed at the 0 position and the pressure adjustment drum was set at 5 mm Hg above the 0 mark. The drum was then rotated until movement of the pressure arm was noted. The drum was then set at 5 mm Hg below the 0 mark and rotated again until movement was noted. The same method was used to check calibration at the 20 and 60 position. The only difference was the placement of the balance bar, which was set in the proper positions[16].

In order to eliminate examiner error when assessing tonometer calibration the following technique was used: student A was seated behind the slit lamp rotating the pressure adjustment drum with a piece of paper blocking the view of the drum and the applanating prism. Student B observed the applanating prism for movement, at which time student B would instruct student A to stop rotating the pressure adjustment drum and the measurement was recorded. After five successive measures by student A, the students changed positions and the same procedure was repeated. Neither examiner could see the measuring drum until after the endpoint of applanation movement was achieved. A total of ten calibration measurements were made for each instrument. The calculated mean was considered the absolute error for that instrument.

We evaluated all tonometers in primary care and ocular disease clinics at all five Pacific University clinics. These clinics were Forest Grove, Northeast Portland, Southeast Portland, Virginia Garcia, and Portland Family Eye Care Center. A total of forty-one tonometers were included in the study.

Results:

In order to determine the significance of the calibration error we utilized a two-tailed t-test. Each of the two examiners took five measurements at each of three settings, "0", "20", and "60", on each of 41 instruments. We then averaged each set of five measurements for each examiner and took the difference of the measures. We also calculated the correlational coefficient for the two examiners over each set of 41 averaged measurements.

For the "0" mm Hg measurement, the average difference in the measures for the 41 instruments was 0.054 mm Hg with the standard deviation (s.d.) equal to 0.187. This difference is $t(40) = 1.835$, $p = 0.0746$, which is not statistically significant. The correlation coefficient for the two examiners equals 0.901.

For the "20" mm Hg measurement, the average difference is 0.002 with the s.d. equal to 0.069. This difference is $t(40) = 0.227$, $p = 0.822$, which is not statistically significant. The correlation coefficient for the two examiners equals 0.991.

For the "60" mm Hg measurement, the average difference is 0.012 with the s.d. equal to 0.119. This difference is $t(40) = 0.658$, $p = 0.515$, which is not statistically significant. The correlation coefficient for the two examiners equals 0.969.

These results indicate that there is no significant difference between the two examiner's measurements and the measurements made by the two examiners are highly correlated.

The overall average value in the calibration measurements were also evaluated using a two-tailed t-test comparing overall averages to the nominal value.

For the "0" mm Hg measurement, the overall average value was 0.183 with a s.d. equal to 0.407. The difference of 0.183 with respect to a nominal value of zero, is statistically significant, $t(40) = 2.875$, $p = 0.006$.

For the "20" mm Hg measurement, the overall average value was 20.23 with a s.d. equal to 0.501. The difference of 20.23 minus 20 equals 0.23 mm Hg, which is again statistically significant, $t(40) = 2.946$, $p = 0.005$.

For the "60" mm Hg measurement, the overall average value was 60.20 with a s.d. equal to 0.469. The difference of 60.20 minus 60 equals 0.20 mm Hg, is also statistically significant, $t(40) = 2.68$, $p = 0.011$.

For each of the three settings, the overall average calibration error was shown to be statistically significant. However, there is no clinically significant difference based on the manufacturer's published acceptable error of +/- 1.0 mm Hg.

Discussion

Based on the results of our research, we conclude that the Goldmann tonometers at Pacific University's optometry clinics are sufficiently calibrated so as to not have an adverse effect on the determination of achievement of target IOP when therapeutically managing glaucoma. This conclusion is based on the statistical findings that showed calibration to be within normal limits as defined by the manufacturer's instruction manual. We also conclude, based on research of others, that other sources of error have a much larger potential effect on IOP values compared to the calibration values found with Pacific's Goldmann tonometers[6-15].

Our findings showed a mean calibration error of 0.204 with a maximum error of 2 mm Hg (found with only one instrument). When comparing these results to other much more significant sources of potential error, an error in calibration of 0.204 mm Hg is inconsequential.

This is by no means an exhaustive list of variables that affect the accuracy of IOP readings with Goldmann applanation tonometry. It does, however, effectively demonstrate that the small error in Goldmann tonometer calibration encountered at Pacific University's clinics is inconsequential when compared to other possible sources of error with Goldmann applanation tonometry. Based on this information, we believe that the use of two different Goldmann tonometers in Pacific University's clinics in the evaluation of a target IOP will not have a significant impact on the therapeutic management of glaucoma.

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	"0"							"20"							"60"						
Tono	Trial	Shawn	Bart	Savg5	Bavg5	S-B	avg10	Trial	Shawn	Bart	Savg5	Bavg5	S-B	avg10	Trial	Shawn	Bart	Savg5	Bavg5	S-B	avg10
1	A	0	0					A	20	20					A	60	60				
	B	0	0					B	19.5	20					B	60	60				
	C	0.5	0					C	20	20					C	60	60.5				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0.1	0	0.1	0.05	E	20	20	19.9	20	-0.1	19.95	E	60	60	60	60.1	-0.1	60.05
2	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
3	A	0	0					A	20	20					A	59.5	60				
	B	0	0					B	20	20					B	60	60				
	C	0	-0.5					C	20	19.5					C	60	60.5				
	D	0	0					D	20	20					D	60	60				
	E	0	-0.5	0	-0.2	0.2	-0.1	E	20	20	20	19.9	0.1	19.95	E	60	60	59.9	60.1	-0.2	60
4	A	0	0					A	20.5	20.5					A	61	61				
	B	0	0					B	20	20					B	61	61				
	C	0	0					C	20.5	20					C	60.5	61				
	D	0	0					D	20	20					D	61	61				
	E	0	0	0	0	0	0	E	20	20	20.2	20.1	0.1	20.15	E	61	61	60.9	61	-0.1	60.95
5	A	0	0					A	20	20					A	60.5	61				
	B	0	0.5					B	20.5	20					B	60.5	60.5				
	C	0.5	0					C	20	20					C	60	60.5				
	D	0	0					D	20	20					D	60.5	60.5				
	E	0	0	0.1	0.1	0	0.1	E	20	20	20.1	20	0.1	20.05	E	60.5	60	60.4	60.5	-0.1	60.45
6	A	0.5	0.5					A	20	20					A	60	60				
	B	0.5	0					B	20.5	20					B	60	60				
	C	0.5	0.5					C	20	20.5					C	60	60				
	D	0.5	0.5					D	20.5	20.5					D	60.5	60				
	E	0.5	0.5	0.5	0.4	0.1	0.45	E	20	20	20.2	20.2	0	20.2	E	60	60	60.1	60	0.1	60.05
7	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	19.5					B	60	60				
	C	0	-0.5					C	20	20					C	60	60.5				
	D	0	0					D	20	20					D	60	60				

	E	0	0	0	-0.1	0.1	-0.05	E	20	20	20	19.9	0.1	19.95	E	60	60	60	60.1	-0.1	60.05
8	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
9	A	2	2					A	22	22					A	62	61.5				
	B	1.5	2					B	22	22					B	62	62				
	C	2	2					C	22	22					C	62	62				
	D	2	2					D	22	22					D	62	61.5				
	E	2	2	1.9	2	-0.1	1.95	E	22	22	22	22	0	22	E	62	62	62	61.8	0.2	61.9
10	A	1	0					A	21	21					A	60.5	61				
	B	1	0					B	21	21					B	60.5	61				
	C	1	0					C	21	21					C	61	61				
	D	1	0					D	21	21					D	61	61				
	E	1.5	0	1.1	0	1.1	0.55	E	21	21	21	21	0	21	E	61	61	60.8	61	-0.2	60.9
11	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
12	A	0	0					A	20.5	21					A	60.5	60.5				
	B	0.5	0					B	20.5	20.5					B	60.5	60.5				
	C	0.5	0.5					C	20.5	20.5					C	60.5	60.5				
	D	0	0					D	20.5	20.5					D	60.5	60.5				
	E	0	0	0.2	0.1	0.1	0.15	E	20.5	20.5	20.5	20.6	-0.1	20.55	E	60.5	60.5	60.5	60.5	0	60.5
13	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20.5					B	60	60				
	C	0.5	0					C	20	20					C	59.5	59.5				
	D	0	0					D	20.5	20.5					D	60	59.5				
	E	0	0	0.1	0	0.1	0.05	E	20	20	20.1	20.2	-0.1	20.15	E	60	60	59.9	59.8	0.1	59.85
14	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
15	A	1	0.5					A	21	21					A	60.5	61				

	B	1	1					B	21	21					B	61	61				
	C	1	1					C	21	21					C	61	61				
	D	1	1					D	21	21					D	60.5	61				
	E	1	0.5	1	0.8	0.2	0.9	E	21	21	21	21	0	21	E	60.5	61	60.7	61	-0.3	60.85
16	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	-0.5					C	20	20					C	60	59.5				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	-0.1	0.1	-0.05	E	20	20	20	20	0	20	E	60	60	60	59.9	0.1	59.95
17	A	0.5	0.5					A	20	20.5					A	60.5	60.5				
	B	0.5	0.5					B	20.5	20.5					B	60.5	60.5				
	C	0.5	0.5					C	20.5	20.5					C	60.5	60.5				
	D	0.5	0.5					D	20.5	20.5					D	60.5	60.5				
	E	0.5	0.5	0.5	0.5	0	0.5	E	20.5	20.5	20.4	20.5	-0.1	20.45	E	60.5	60.5	60.5	60.5	0	60.5
18	A	0	0					A	19.5	19.5					A	60	60				
	B	0	0					B	19.5	20					B	60	60				
	C	0	0					C	19.5	19.5					C	60	60				
	D	0	0					D	19.5	19.5					D	60	60				
	E	0	0	0	0	0	0	E	19.5	19.5	19.5	19.6	-0.1	19.55	E	60	60	60	60	0	60
19	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
20	A	0	-0.5					A	20	19.5					A	59.5	59.5				
	B	-0.5	0					B	19.5	19.5					B	60	59.5				
	C	0	0					C	20	20					C	59.5	59.5				
	D	0	-0.5					D	19.5	20					D	59.5	60				
	E	0	0	-0.1	-0.2	0.1	-0.15	E	19.5	20	19.7	19.8	-0.1	19.75	E	59.5	59.5	59.6	59.6	0	59.6
21	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
22	A	0.5	0.5					A	20.5	20.5					A	60	60				
	B	0.5	0.5					B	20.5	20.5					B	60	60				
	C	0.5	0.5					C	20.5	20.5					C	60	60.5				

	D	0	0.5					D	20.5	20.5					D	60	60				
	E	0.5	0.5	0.4	0.5	-0.1	0.45	E	20.5	20.5	20.5	20.5	0	20.5	E	60	60	60	60.1	-0.1	60.05
23	A	-0.5	0					A	20	20					A	60	59.5				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	19.5	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	-0.1	0	-0.1	-0.05	E	20	20	19.9	20	-0.1	19.95	E	60	60	60	59.9	0.1	59.95
24	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20.5	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20.1	20	0.1	20.05	E	60	60	60	60	0	60
25	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
26	A	0.5	0.5					A	20.5	20.5					A	60.5	60				
	B	0.5	0.5					B	20.5	20.5					B	60	60				
	C	0.5	0.5					C	20.5	20.5					C	60	60				
	D	0	0.5					D	20.5	20.5					D	60	60				
	E	0.5	0.5	0.4	0.5	-0.1	0.45	E	20.5	20.5	20.5	20.5	0	20.5	E	60	60	60.1	60	0.1	60.05
27	A	0	0					A	20	20					A	60	60				
	B	0.5	0.5					B	20	19.5					B	60.5	60				
	C	0	0					C	20	20					C	60.5	60				
	D	0	0					D	20	20					D	60	60				
	E	0.5	0	0.2	0.1	0.1	0.15	E	20	20	20	19.9	0.1	19.95	E	60	60.5	60.2	60.1	0.1	60.15
28	A	0	0					A	20	20					A	59.5	59.5				
	B	0	0					B	20	19.5					B	59.5	59.5				
	C	0	0					C	20	20					C	60	59.5				
	D	0	0					D	20	20					D	59.5	59.5				
	E	0	0	0	0	0	0	E	20	20	20	19.9	0.1	19.95	E	59.5	59.5	59.6	59.5	0.1	59.55
29	A	-0.5	0					A	20	20					A	61	61				
	B	0	0					B	20.5	20.5					B	61	61				
	C	0	0					C	20.5	20.5					C	60.5	61				
	D	0	0.5					D	20	20.5					D	60.5	61				
	E	0	0	-0.1	0.1	-0.2	0	E	20	20	20.2	20.3	-0.1	20.25	E	61	60.5	60.8	60.9	-0.1	60.85

30	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
31	A	0.5	0					A	20	20					A	60	60.5				
	B	0	0					B	20	20					B	60	60				
	C	0.5	0.5					C	20	19.5					C	60	60.5				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0.2	0.1	0.1	0.15	E	20	20	20	19.9	0.1	19.95	E	60	60	60	60.2	-0.2	60.1
32	A	0	0					A	20.5	20.5					A	60	60				
	B	0	0					B	20.5	20.5					B	61.5	61.5				
	C	0	0					C	20.5	20.5					C	60	60				
	D	0	0					D	20.5	20.5					D	60	60				
	E	0	0	0	0	0	0	E	20.5	20.5	20.5	20.5	0	20.5	E	60	61.5	60.3	60.6	-0.3	60.45
33	A	0.5	0.5					A	21	21					A	60.5	60.5				
	B	0.5	0.5					B	21	21					B	60.5	60.5				
	C	0.5	0.5					C	21	21					C	60.5	60.5				
	D	0.5	0.5					D	21	21					D	60.5	60.5				
	E	1	0.5	0.6	0.5	0.1	0.55	E	21	21	21	21	0	21	E	60.5	60.5	60.5	60.5	0	60.5
34	A	-0.5	-0.5					A	19.5	19.5					A	60	59.5				
	B	-0.5	0					B	19.5	19.5					B	59.5	59.5				
	C	-0.5	-0.5					C	19.5	19.5					C	59.5	59.5				
	D	-0.5	-0.5					D	19.5	19.5					D	60	59.5				
	E	0	-0.5	-0.4	-0.4	0	-0.4	E	19.5	19.5	19.5	19.5	0	19.5	E	59.5	59.5	59.7	59.5	0.2	59.6
35	A	1	1					A	21.5	21.5					A	61	61				
	B	1	1					B	21.5	21.5					B	61	61				
	C	1	1					C	21.5	21.5					C	61	61				
	D	1	1					D	21.5	21.5					D	61	61				
	E	1	1	1	1	0	1	E	21.5	21.5	21.5	21.5	0	21.5	E	61	61	61	61	0	61
36	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	19.5					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	19.9	0.1	19.95	E	60	60	60	60	0	60
37	A	0	0					A	20	20					A	59.5	59.5				
	B	0	0.5					B	20.5	20					B	59.5	59.5				

	C	0.5	0					C	20	20					C	59.5	59.5				
	D	0	0					D	20	20.5					D	60	59.5				
	E	0	0	0.1	0.1	0	0.1	E	20	20.5	20.1	20.2	-0.1	20.15	E	59.5	59.5	59.6	59.5	0.1	59.55
38	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
39	A	1	0					A	21	21					A	60.5	60.5				
	B	1	0.5					B	21	21					B	61	60.5				
	C	1	1					C	21	21					C	61	61				
	D	0.5	1					D	21	21					D	61	60.5				
	E	1	1	0.9	0.7	0.2	0.8	E	21	21	21	21	0	21	E	61	61	60.9	60.7	0.2	60.8
40	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20					B	60	60				
	C	0	0					C	20	20					C	60	60				
	D	0	0					D	20	20					D	60	60				
	E	0	0	0	0	0	0	E	20	20	20	20	0	20	E	60	60	60	60	0	60
41	A	0	0					A	20	20					A	60	60				
	B	0	0					B	20	20.5					B	60	59.5				
	C	0	0					C	20	20					C	59.5	60				
	D	0	-0.5					D	20	20					D	60	60				
	E	0	0	0	-0.1	0.1	-0.05	E	20	20	20	20.1	-0.1	20.05	E	59.5	60	59.8	59.9	-0.1	59.85
mean		0.2098	0.1561	0.2098	0.1561	0.0537	0.1829		20.229	20.232	20.229	20.232	-0.002	20.23		60.19	60.202	60.19	60.202	-0.012	60.196
s.d.		0.4455	0.4259	0.4288	0.4068	0.1872	0.4074		0.5084	0.5157	0.5006	0.5037	0.0689	0.501		0.488	0.509	0.4636	0.4819	0.1187	0.4691
n		205	205	41	41	41	41		205	205	41	41	41	41		205	205	41	41	41	41
SEM		0.0311	0.0297	0.067	0.0635	0.0292	0.0636		0.0355	0.036	0.0782	0.0787	0.0108	0.0782		0.0341	0.0355	0.0724	0.0753	0.0185	0.0733
t		6.7419	5.2476	3.1319	2.4567	1.8352	2.8753		6.457	6.4336	2.9324	2.9455	0.2267	2.9459		5.5818	5.6947	2.6277	2.6898	0.6577	2.6801
p		0.000	0.000	0.003	0.018	0.074	0.006		0.000	0.000	0.006	0.005	0.822	0.005		0.000	0.000	0.012	0.010	0.515	0.011
correl		0.8149		0.9009					0.9417		0.9906					0.8803		0.9692			
max							1.95							22							61.9
min							-0.4							19.5							59.55