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Temperament and its Effects on Visual Attention to Emotional Faces

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Abstract

This study investigated the effects of temperament on visual attention to emotional faces. In order to examine this research question, a sample of 48 children ages 3- to 9-years-old viewed faces depicting angry, fearful, happy, or neutral emotions on an eye-tracking computer. This visual attention data was combined with a parent-reported measure of temperament in order to determine correlations between the two. Results showed no statistically significant correlations between temperament and looking behavior, despite these correlations being significant when the same tasks were administered to adults. Overall, these results suggest that the participants did not display temperament effects in visual attention of emotional faces, thus implying that this pattern may emerge beyond middle childhood.

Temperament and its Effects on How Children View Emotional Faces

The effect of personality on how individuals view the world is an area that has been studied extensively in the psychological literature. Across the field, personality is characterized as an aspect of several pathways through which human behavior is modified, resulting in individual differences (Eysenck, 1970; McCrae & Costa 2003). The argument to the converse is that behavior varies not wholly due to personality, but in relation to situational factors surrounding the individual at the time that the behavior is displayed (Mischel 1977; Vernon 1964). It is important, therefore, to investigate the nature of the context/personality relationship on the social behaviors of humans (Mischel 2004; Mischel, Shoda, & Mendoza-Denton 2002). My intention was to extend current knowledge concerning personality as a moderator for social perception, in order to apply this knowledge to children.

One explanation of the interaction between context and personality, the Trait-Congruency Theory, states that the information one seeks out is the information which best fits the traits represented within one's personality (Bargh, Lombardi, & Higgins 1988; King & Sorrentino 1988). In support of this position, Segerstrom (2001) found that those participants higher in the optimism trait were more likely to give greater attention to positive words, whereas the converse was true for those lower in optimism. A similar effect was reported by Isaacowitz (2006), who found that participants higher in optimism were more likely than participants who were high in pessimism to avert their gaze from unpleasant images. These studies suggest that personality traits are correlated with how humans direct their attention. Moreover, the correlation tends to move towards stimuli which provide confirmatory evidence for their traits, and away from those which could lead to disconfirmation.

Another, more biological, aspect of personality is one's temperament. While temperament is thought to be largely innate, some environmental factors have been shown to play a role in its development (Thomas & Chess, 1977). The academic discussion of this construct is, for the most part, concentrated on the stable elements of personality which effect social behavior (Kagan, 1994; Rothbart, Ahadi, Hershey, & Fisher, 2001). The personality trait of neuroticism is often referred to as negative affectivity in the temperament literature, and is highly correlated with anxiety and depression. Making an extension from Segerstrom's 2001 finding, one might expect that those high in neuroticism or negative affectivity will pay more attention to emotionally negative information than would people lower in neuroticism.

Although this finding by Segerstrom has not been verified in any exact replications, a conceptual replication has recently been completed (Perlman, Morris, Vander Wyk, Green, Doyle, & Pelphrey, 2009). In this study, adult participants were presented with life-size images of emotional faces and were allowed to view them freely on an eye-tracking computer. Those participants who ranked higher in the trait of neuroticism spent a greater percentage of time looking at the eyes of the face than did those who ranked lower in neuroticism. This effect was particularly evident when the emotion of the presented stimulus was that of fear. A follow-up study (Perlman & Pelphrey, in press) in adults showed a similar pattern of data. In this study, an array of various objects, including emotional faces, covered the screen of the eye-tracking computer. This array of objects was meant to more realistically represent how persons view the world – as a mixture of objects and people spread throughout our visual field. Participants classified as having high neuroticism spent a greater proportion of time looking at the faces on the screen than did those with low neuroticism. In fact, the high neuroticism participants spent

very little time viewing objects in the array other than the face. As in the previous study, this result was particularly powerful within the condition presenting the fear emotion.

Though this effect has been shown in past studies, it is necessary to extend the finding to children. Because of the biological, innate nature of temperament, any effects that one's temperament has on his or her perception are likely to exist starting in early childhood. This study seeks to examine the development of this phenomenon from early childhood through pre-adolescence. Drawing from the results of previous studies, the hypotheses of the current study were twofold. First, it was hypothesized that children with higher scores on neuroticism-predictive scales would exhibit longer fixation durations towards the eye region of emotional faces. Second, when given the option to look at either a face or any number of other objects in the visual field, children with higher scores on neuroticism-predictive scales were predicted to fixate on faces longer than children with lower scores on these scales.

Methods

Participants

Participants in this research study were 48 children (20 girls, 28 boys) recruited from both The Children's School research preschool and through an internet advertisement. There were 24 younger children ($M_{\text{MonthsYoung}} = 43.83$, $SD_{\text{MonthsYoung}} = 4.74$) and 24 older children ($M_{\text{MonthsOld}} = 71.92$, $SD_{\text{MonthsOld}} = 18.76$). Grouping according to relative age was determined by a median split, with the young group ranging from 35 to 54 months and the older children falling in an age range of 54 to 119 months. The participants were randomly assigned into one of two orders of presentation of stimuli, and viewed each of 80 slides on the eye-tracking computer. Three participants viewed only 40 of the 80 slides, refusing to continue the study after the first block of 40 pictures.

Materials

Materials for this study included 80 slides depicting either a life-sized face, or an array of 25 objects which included a small picture of a face (for examples of each type, see Appendix A and B respectively). Each life-sized face was 9 x 11.5 inches in size, and each array of objects filled the entire 17 inch LCD screen, with the individual objects and faces being approximately 3 inches square. Objects in the arrays were common, everyday objects such as umbrellas, shoes, and cars. Arrays each included a face expressing emotions such as anger, fear, and happiness, appearing in a different area of the screen each time a new array was presented. Each photographic slide was presented for 4 seconds, with a crosshair displayed for 1 second between the photographs. Slides were arranged in a pseudo-random order and then separated into two blocks. Eye tracking was completed using a 50 Hz infrared eye-tracking computer (T60, Tobii Technology).

Looking behavior was characterized by calculating duration of fixation in specified areas of interest (AOIs). In the object arrays, these AOIs indicated the emotional face within the array and took up precisely 5.25% of the screen on all array trials. In the solitary face slides, AOIs were drawn for each of four regions: Eyes, Nose, Mouth, and Face. The duration of time spent fixated on any given AOI was calculated independently, and then collapsed across emotions. Analyses were conducted in reference to the proportion of time spent looking at the AOI, compared to the total amount of time spent looking at the screen. This measure was taken in order to control for individual differences in total looking time caused by blinking or distraction from the stimuli.

Temperament was measured by using the Children's Behavior Questionnaire Short Form (Rothbart 1996). This survey takes inventory of children's behavior patterns as described in several statements which parents rate on a scale from 1 (extremely untrue of your child) to 7

(extremely true of your child). These items are aggregated into several subscale scores (i.e. Activity Level, Fear, Inhibitory Control). Parents completed the survey either at home prior to the child's participation (Children's School pool), or in the lab while their child was taking part in the eye-tracking portion of the study (other participants).

Design

This study investigated the effect of temperament on attention to emotional faces in children using a 2 (neuroticism) x 2 (age) between-subjects design. The neuroticism factor was defined using two levels – high neuroticism and low neuroticism, as defined by a median split. The age factor had 2 levels, with participants grouped, via a median split, into categories of either younger child or older child. This study was conducted with all 80 slides arranged in two blocks and then presented in one of two orders, counterbalanced between subjects.

Procedure

Participants were tested by the experimenter using an eye-tracking computer. Participants were told that they would be "looking at some pictures," and to simply "look at them like you normally would." Participants were shown two blocks of slides, each containing 40 slides in pseudo-random order. Between presentations of the two blocks, participants were given an option to pause and rest their eyes. The task in its entirety was approximately 7 minutes in duration.

Results

Face Analysis

Eye Fixation.

In an attempt to replicate previous findings from an adult subject pool, the relationship between temperament and visual attention to eyes within an emotional face was examined. Prior

research with adults found significant positive correlations between fearfulness and the amount of time spent viewing eyes within faces. We thus predicted that measures of fearfulness in children should be the most indicative of any effect on visual attention to eyes within faces in the present experiment. To this end, correlations between fearful temperament and fixation on the eye AOI were computed across all faces, but these did not reach significance (r = .04, p = .789). In addition, this measure was correlated with eye fixation across each emotion. Fearful temperament scores did not display statistically significant correlations with eye fixation in either fearful (r = -.031, p = .832), happy (r = -.051, p = .728), angry (r = -.005, p = .975), or neutral (r = .142, p = .336) faces.

Median splits were completed on the sample, on the bases of temperament scores for Fear, Frustration, Approach, and Inhibitory Control, as well as Age. These temperament scores were chosen on the basis that they are the most highly predictive of neuroticism in adult life (Rothbart, Ahadi, & Evans, 2000). Mean percentages of fixations on the eye AOI, by age and temperament, are reported in Table 1. Following the median splits, an ANOVA was run to examine the effects of these factors on time fixated on the Eye AOI. Results of this test demonstrated that across all emotions, findings were not significant for Age as it related to visual attention to eyes ($F(1,46)$ = .367, p = .548). The same was true for Fear ($F(1,46)$ = .002, p = .962), Frustration ($F(1,46)$ = 1.479, p = .231), Approach ($F(1,46)$ = .401, p = .530), and Inhibitory Control ($F(1,46)$ = .474, p = .495). Similar results were found when analyses were completed within each emotion, as well. There was not a significant effect of gender ($F(1,46)$ = .065, p = .800) on eye fixation times, across all emotions or when emotions were analyzed individually.

Mouth Fixation.

A regression analysis was performed to compute correlations examining the relationship between the temperament measure of fear and attention to the mouth. When calculated across all faces, there was a significant negative correlation (r = -.412, p = .004). Like the data corresponding to eye fixation, these correlations were also calculated within individual emotions. Significant negative correlations were found for anger (r = -.334, p = .020) and fear (r = -.487, p < .001) emotions, though there were no significant correlations for happy (r = -.248, p = .089) and neutral (r = -.273, p = .061) faces. There was a moderate, negative correlation between age and mouth fixation only for the neutral faces (r = -.358, p = .012), but these correlations were not significant for any other emotion.

An ANOVA was also performed to determine the effect of age and temperament variables on visual fixation to the mouth of emotional faces. Results did not display significance for any of the aforementioned temperament scales, either across emotions or within any individual emotion ($F(1,46)$ = .003-3.467, p = .956-.070), with the exception of the Fear scale in the analysis of the fearful faces ($F(1,46)$ = 6.044, p = .018). Older vs. Younger Age displayed a significant effect in the overall analysis ($F(1,46)$ = 4.822, p = .034), and for the neutral ($F(1,46)$ = 7.826, p = .008) stimuli. Means and standard deviations describing the percentage of total fixation time that attention was on the mouth are displayed in Table 2.

Nose Fixation.

To examine the relationship between age, temperament, and fixation time on the nose, correlations were calculated. Both age and the fear measure were positively linked to fixation time on nose, with varying significance across emotions. Overall, age was significant (r = .449, p = .001) while fear was marginally significant (r = .276, p = .058). Age also showed a significant

correlation with nose fixation times in the fear ($r = .393$, $p = .006$) and neutral ($r = .412$, $p = .004$) stimuli. The temperament scale for fearfulness was significantly correlated with nose fixation time in the anger ($r = .332$, $p = .021$) stimuli set alone.

Significance of temperament and age was determined using an ANOVA. Results did not display significance for any of the aforementioned temperament scales or for age, either across emotions or within any individual emotion ($F(1,46) = .000\text{-}3.472$, $p = .997\text{-}.069$), with the exception of the Frustration scale in the overall analysis ($F(1,46) = 5.047$, $p = .030$) and that of the neutral faces ($F(1,46) = 11.783$, $p = .001$). Means for the percentage of nose vs. total fixations, by temperament and age, are displayed along with their standard deviations in Table 3.

Array Analysis

To replicate previous findings, the relationship between temperament and visual attention to emotional faces within an object array was examined. Correlations between the temperament measure of fear, and fixation on all faces did not reach significance ($r = -.16$, $p = .915$). Similarly, this measure was correlated with looking times across each emotion. These analyses indicated that fearful temperament scores did not correlate significantly with either fearful ($r = -.031$, $p = .836$), happy ($r = -.022$, $p = .882$), angry ($r = -.042$, $p = .777$), or neutral ($r = .042$, $p = .780$) faces. Correlations between age, by which the participants were divided by a median split, and overall total looking time were moderate, positive, and significant. This was true both across the entire data set ($r = .328$, $p = .023$), and when fearful ($r = .352$, $p = .014$), happy ($r = .357$, $p = .013$), angry ($r = .288$, $p = .047$), and neutral ($r = .345$, $p = .018$) faces were analyzed separately. Correlations between other temperament scales and visual attention to faces were also examined, with none reaching significance.

As in the Face Analyses, median splits were performed on Age, Fear, Frustration, Approach, and Inhibitory Control. An ANOVA was used to determine the effects of high vs. low age and temperament scores on visual attention to faces within the arrays. Descriptive means and standard deviations of face fixation by age and temperament are listed in Table 4. Across all emotions, findings were not significant for age as it related to visual attention ($F(1,46) = .011, p = .915$). The same was true for fear ($F(1,46) = .006, p = .938$), frustration ($F(1,46) = 0.024, p = .878$), approach ($F(1,46) = .493, p = .487$), and inhibitory control ($F(1,46) = .040, p = .843$). Similar results were found when analyses were completed within each emotion, as well. In addition, there was a significant effect of gender ($F(1,46) = 4.368, p = .042$) on fixation times on all faces, with females fixating longer on faces than males. It should be noted that this effect, when each emotion was analyzed separately, only remained significant for happy faces ($F(1,46) = 4.207, p = .046$).

Discussion

Contrary to what would have been expected based on prior research, temperaments high in neuroticism were not predictive of visual attention to emotional faces. When adults participated in the same tasks, their data displayed a pattern in which higher levels of neuroticism corresponded to longer fixations on emotional faces, particularly in fearful faces, and especially on the eyes (Perlman & Pelphrey, in press; Perlman et.al, 2009). We expected that since temperament, an innate characteristic, is so highly predictive of personality traits such as neuroticism, a similar pattern would be observed in young children. However, this expected data pattern was not observed in the fixation data for the either the life-sized faces or the object arrays.

Several explanations can be cited as reasons that the expected data was not observed in this sample. Firstly, it could be that the effect of personality variables on visual attention does not develop until later in adolescence or early adulthood. An extension to older children would be necessary to determine if this may be the case. If so, the mechanism behind this relationship probably involves a predisposition towards certain behavior pattern, which then leads to a continuous strengthening of the trait and behavior pattern.

According to social psychologists, we as humans tend to engage in self-verification, the goal of which is to ensure that others see us the way we see ourselves, even if this self-view is negative (Swann, Stein-Seroussi, & Giesler, 1992). In this sense, someone who believes themselves to be a negative person will act in ways that demonstrate to others their negativity. In a sense, the validation of being correct about one's negative aspects is more rewarding than having been incorrect and discovering one's positive attributes. From this model, we can see how neuroticism may develop, and possibly add to itself perpetually across a lifetime. References are necessary here.

A second possible reason behind this outcome could be a confound of some children having a difficult time attending to the task in general. Although the task was relatively short in duration (< 7 minutes in total), this amount of time proved difficult for some children to be able to sit still and observe photographs on a screen. Differences in attention to stimuli may have been present between groups defined by age, gender, or perhaps personality. It is conceivable that either the youngest children, one gender of the two, or the children with a more active temperament, would have a harder time attending to the stimuli for the duration of the study. Any of these cases could potentially lead to the lack of significant effects of temperament. One measure taken in order to prevent this was the calculation of fixation times not as raw data but as

the percentage of time spent looking at the AOI, out of total time attending to the stimulus. This should control for some of the variance caused by inattention to stimuli, though differences between those participants whose looking times were in the extremes may have still contributed to confounds in the data set.

Apart from the lack of significance in the eye fixation and face fixation results, we found an unexpected age effect on mouth fixation times. Although previous research has shown that attention to the eyes of emotional faces begins during infancy, this sample showed a pattern of behavior in which younger children spend more time than older children looking at the mouth area of emotional faces. Although the tendency to have the greatest looking time focused on the eyes is one that begins in early infancy, it may be that children increase in this tendency over time. Perhaps a larger proportion of time is spent viewing mouths of faces, in order to boost understanding of emotions projected by social others, when the child is very young. As experience with viewing and decoding emotional faces grows, the child is better able to focus on social faces holistically. Research has shown that young children, moreso than older children, are able to process faces when they are presented in an upside-down orientation (Carey & Diamond, 1977). This finding provides evidence suggesting that younger children have a stronger tendency to focus on individual features of a face – rather than on the face as a whole. This would explain the tendency of older children in our sample to focus less of their attention on the mouths of the stimuli than did the younger portion of the sample.

Future directions for this study include the collection of more data from an older subject pool. This process would have the potential to eliminate at least one, if not all, of the aforementioned pathways to the unexpected results found here. Firstly, if the effects of temperament on visual attention emerge later in childhood, this effect would be more likely to

appear in a dataset which included older children. Secondly, the addition of older children to the sample might lead to a better representation of the fixations on AOIs, as they would not be confounded by overall looking time.

A final note to consider is the idea that these results may not be due to error, as research is often inclined to assume when outcomes are unexpected. Perhaps even with inclusion of older participants, the data would show a similar pattern in which temperament showed no significant relationship with visual attention to faces. Assuming this is the case, why would children not show the same effect? One possible explanation is that temperament, while highly predictive of personality, does not predict neuroticism perfectly, and this variance might account for the lack of significance in this relationship. In addition, neuroticism is a trait measured by self-report, whereas temperament is reported by the child's parent. This could mean that either personality, temperament, or both have biases associated with how they are reported. Even if neither measure is particularly biased in one direction or the other, the two reporting methods are still likely to differ at least slightly, thus leading to another opportunity for error between the personality study in adults and the temperament study in children. Perhaps the most fail-proof method to determine the exact nature of the development of this phenomenon across time would be to examine temperament and visual attention longitudinally until self-report of personality is appropriate. Following this collection, correlations between temperament measures and visual attention early in childhood would be compared with personality measures vs. visual attention early in adulthood, as well as examining a few time points in between. Whether the results found here were due to sampling error, or represent unexpected truths, more research must be pursued in order to fully characterize the development of visual attention to emotional faces as a function of temperament and personality.

References

Bargh, J.A., Lombardi, W.J., Higgins, E.T. (1988). Automaticity of chronically accessible constructs in person situation effects on person perception: It's just a matter of time. *Journal of Personality and Social Psychology,* 55(4): 599–605.

Carey, S., Diamond, R. (1977). From piecemeal to configurational representation of faces. *Science,* 195(4275): 312-314.

Eysenck, H.J. (1970). The Structure of Human Personality (3rd ed.). London: Methuen.

Isaacowitz, D.M. (2006). Motivated gaze- The view from the gazer. *Current Directions in Psychological Science* 15(2): 68–72.

Kagan, J. (1997). Temperament and the reactions to unfamiliarity. *Child Development,* 68, 139-143.

King, G.A., Sorrentino, R.M. (1988). Uncertainty orientation and the relation between individual accessible constructs and person memory. *Social Cognition* 6: 128–149.

McCrae, R.R., Costa, P.T.J. (2003). Personality in Adulthood: A Five-Factor Theory Perspective. New York: Guilford.

Mischel, W. (1977). The interaction of person and situation. In Endler NS, Magnusson DS, eds. Personality at the crossroads: Current issues in interactional psychology. Hillsdale, NJ: Lawrence Earlbaum Associates. pp 333–354.

Mischel, W., Shoda, Y., Mendoza-Denton, R. (2002). Situation-behavior profiles as a locus of consistency in personality. *Current Directions in Psychological Science* 11(2): 50–54.

Mischel, W. (2004). Toward an integrative science of the person. *Annual Review of Psychology* 55: 1–22.

Perlman, S.B., Morris, J.P., Vander Wyk, B.C., Green, S.R., Doyle, J.L., et al. (2009) Individual Differences in Personality Predict How People Look at Faces. *PLoS ONE* 4(6): e5952. doi:10.1371/journal.pone.0005952

Rothbart, M.K., Ahadi, S.A., Evans, D.E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology* 78(1): 122-135.

Rothbart, M.K., Ahadi, S.A., Hershey, K.L., & Fisher, P. (2001). Investigations of temperament at 3-7 years: The Children's Behavior Questionnaire. *Child Development*, 72, 1394-1408.

Segerstrom, S.C. (2001). Optimism and attentional bias for negative and positive stimuli. *Personality and Social Psychology Bulletin* 27(1): 1334–1343.

Swann, W.B., Stein-Seroussi, A., Giesler, R.B. (1992). Why people self-verify. *Journal of Personality and Social Psychology.* 62(3): 392-401.

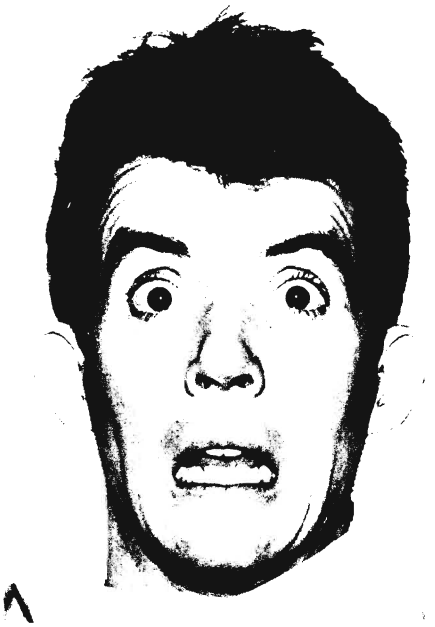
Thomas, A. & Chess, S. (1977). Temperament and development. New York: Brunner/Mazel.

Vernon, P.E. (1964). Personality Assessment: A Critical Survey. New York: Wiley.

Appendix A

Examples of Face Stimuli.

Angry



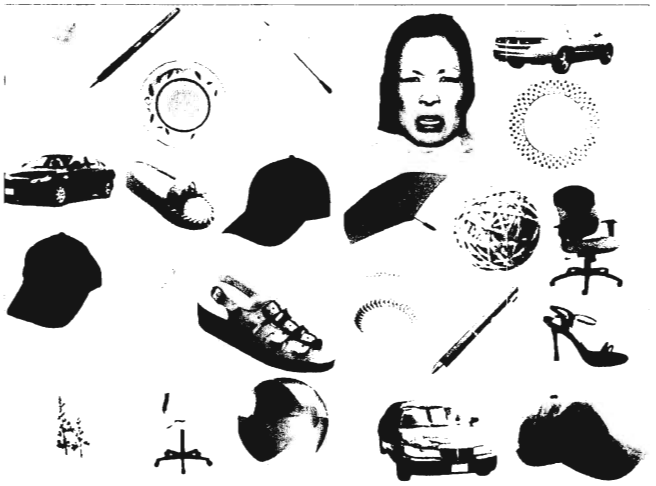
Fearful

Happy

Neutral

Appendix B

Examples of Array Stimuli.



Angry

Fearful

Happy

Neutral

Table 1

Table of Means of Eye Fixation Percentage Times

	Age		Approach		Fear		Frustration		Inhibitory Control	
	Young	Old	Low	High	Low	High	Low	High	Low	High
Mean	23.291	23.951	22.030	25.045	23.679	23.512	21.089	25.725	24.940	22.144
St. Dev	1.479	1.259	1.491	1.234	1.313	1.416	1.296	1.378	1.340	1.320

Table 2

Table of Means of Mouth Fixation Percentage Times

	Age		Approach		Fear		Frustration		Inhibitory Control	
	Young	Old	Low	High	Low	High	Low	High	Low	High
Mean	32.374	23.416	31.029	24.654	30.353	25.064	27.323	28.035	29.288	25.992
St. Dev	1.377	1.036	1.420	1.061	1.438	1.028	1.220	1.302	1.370	1.125

Table 3

Table of Means of Nose Fixation Percentage Times

	Age		Approach		Fear		Frustration		Inhibitory Control	
	Young	Old	Low	High	Low	High	Low	High	Low	High
Mean	13.524	18.435	15.659	16.470	14.237	17.926	18.895	13.701	14.992	17.267
St. Dev	.788	.829	.723	.928	.675	.950	.861	.762	.879	.778

Table 4

Table of Means of Face Fixation Percentage Times

	Age		Approach		Fear		Frustration		Inhibitory Control	
	Young	Old	Low	High	Low	High	Low	High	Low	High
Mean	40.888	40.400	42.208	39.231	40.547	40.763	41.035	40.201	40.929	30.351
St. Dev	1.470	1.603	1.478	1.565	1.473	1.600	1.290	1.807	1.645	1.391