Testing Reactivity on Interoceptive Awareness - An Experience Sampling Study

B.Sc. Thesis

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Abstract

Theoretical Background. The reactivity effect in previous research has shown to change participants behaviour due to their awareness of being examined. This effect was also found to be present in experience sampling, where participants are tested in their natural environment. In general, experience sampling towards different measurements of body signals has been found to increase individual's accuracy in understanding oneself.

Objective. Therefore, this study wants to examine interoceptive awareness (IA), which is the understanding of bodily responses, with said experience sampling method. It is assumed, that participant's IA will change when they become aware of the repeated measurements.

Methods. This research tested 45 participants in their IA levels in a longitudinal experience sampling study of six days with a pre-post questionnaire. The control group was asked to fill out the Multidimensional Assessment of Interoceptive Awareness (MAIA-2) questionnaire as the pre- and post-questionnaire, while the experimental group was also asked to fill out four daily questionnaires over a period of four days.

Results. The data analysis showed a higher difference in pre- and post-measurements in the experimental group compared to the control group. Further, there was a positive relationship between number of completed questionnaires and IA pre- and post-difference.

Conclusion. The paper concludes that interoceptive awareness levels can be slightly enhanced in participants with the answering of daily questions. With this finding, this research is one of few to find an increase in IA without the use of biofeedback but only with a self-reported questionnaire. Hence, the application of IA questionnaires into the psychological field could be more closely considered in the future.

Keywords: interoceptive awareness, experience sampling method, reactivity, students

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Introduction

We all experience a high number of stimuli in our daily lives that can influence our thoughts, emotions and body both positively and negatively. In general, people can direct their attention towards several stimuli, which can, in turn, affect our bodily responses (Chun, Golomb, & Turk-Browne, 2011). Nevertheless, we are only able to attend to a limited number of stimuli at a time, shifting our attention and awareness between features. Due to the ever-increasing rise in information in our modern world, the danger of overstimulation has influenced our ability of concentration, causing us to be incapable of processing all the information (Bakal, 1999). Researchers have found that a high level of understanding one's own emotions, feelings and thoughts is the key to maintaining well-being. If one cannot understand one's bodies needs while ignoring body signs and suppresses those emotions, people have found to be more inclined to experience negative emotions (Boden, Thompson, Dizén, Berenbaum, & Baker, 2013). Since body awareness is viewed as the connection of oneself to the body and predicts the increase of mental and physical well-being, an increase in body awareness seems beneficial (Price, 2007). Since decades, researchers are searching for a way to advance the human's mind and body, intervening in the individual's ability to get more aware of themselves to enhance individual's well-being and decrease stress (Myin-Germeys et al., 2003; Verhagen, Hasmi, Drukker, & van Os, Delespaul, 2016).

In general, the concept of interoceptive awareness is primarily the individual's consciousness and their ability to see, feel and understand the environment around them (Critchley, Wiens, Rotshtein, Öhman, & Dolan, 2004; Nida-Rümelin, 2014). So far, interoceptive awareness was mostly analysed regarding training with a psychologist or in interaction with biofeedback (Bornemann, Herbert, Mehling, & Singer, 2015; Critchley et al., 2004; Derks, Klaassen, Westerhof, Bohlmeijer, & Noordzij, 2019). Biofeedback is a method that measures biological signals, like heartbeat and blood flow. The gathered information is then sent to the person to provide feedback about those measures. This method has been used by many studies to provide information on emotional awareness, arousal, stress and many other bodily responses and has found to be helpful in determining the enhancement of participant's body awareness (Kotozaki et al., 2014; Derks et al., 2019). The research of Quinlan Cutler, Doherty, & Carmichael (2018) has stated that one possible reason for psychological enhancement in the biofeedback of participants is the act of repeatedly focusing and monitoring one's behaviour during those experiments. Those results are also in line with other studies, that have found out that exposure to filling out questionnaires will precipitate the behaviour of the concept being analysed (Barrett & Barrett, 2001; Putnam & Wilson,

1982). Putnam and Wilson (1982) found an actual change in cognitive, attitude and personality measures after letting participants fill out several daily questionnaires. Further studies have shown that individuals have to be aware of their conscious experience when filling out questionnaires, which, in turn, influences their awareness (Barrett & Barrett, 2001). Interestingly, no study has been found solely on the individual level of interoceptive awareness with the sole analysation of a questionnaire. When considering the results of the studies mentioned above, interoceptive awareness should also be influenced when participants answer several self-reported IA questionnaires. Therefore, it might be interesting to examine fluctuations and changes when individuals respond to questions about IA, which might, in turn, already change their IA level. To measure this, individuals should answer questions repeatedly in a natural setting. Hence, a study is needed, that can assess to what extent repeated questioning regarding interoceptive awareness changes the IA level.

Interoceptive Awareness

The process of interoceptive awareness describes the awareness and understanding of bodily responses on a conscious level. This process includes the sensing, interpreting and signalling of information of the physiological state of our body (e.p. the feeling of anxiety, hunger, the heartbeat, respiration and more) (Critchley et al., 2004; Mehling, Acree, Stewart, Silas, & Jones, 2018). Further, interoceptive awareness is described on a level with multiple dimensions, that are all available for our self-report. Those several processes are described as emotional awareness, attention regulation, self-regulation, trusting, noticing, not-worrying, non-distracting and body listening. With the understanding of those dimensions, we are able to tell how we feel, depending on the condition of our body (Mehling et al., 2018).

Adding to this definition of interoceptive awareness, several studies have also stressed the beliefs of the interaction between mental and somatic functions (Critchley et al., 2004; Ferguson and Katkin, 1996). Wiens, Mezzacappa, and Katkin (2000) state that the body can affect the mind. Therefore, the ability to perceive those bodily responses can help in understanding the emotions, feelings and thoughts that are presented from our mind. Of course, some physical sensations are maladaptive and unhealthy, including those negative emotions such as chronic stress, anxiety or worry. For example, the heartbeat can influence the affective experiences, and finally, the emotions, feelings or thoughts of an individual (Putwain, 2007). If someone's heartbeat suddenly increased significantly, he or she might begin to feel stressed, anxious or worried (Critchley et al., 2004; Wiens et al., 2000). If that person is in turn able to sense the increase of the heartbeat right away, and understand its

origin, that person can be able to learn certain habits to counteract the negative feelings. When this process is understood by each individual, we can talk about a higher level of interoceptive awareness (Critchley et al., 2004).

Experience Sampling Method (ESM)

So far, researchers have found, that laboratory and unnaturalistic settings in studies are not as successful in capturing natural human experience, as naturalistic settings are. One method that enables the studying of humans in their natural environment over time is the experience sampling method (ESM) (Conner & Lehman, 2012). This method includes the selecting of data of people in their usual, daily surrounding without much interference by researchers. Here, people can feel their regular moods and feelings in their daily social and emotional circumstances. For this to be integrated into a study, the experience sampling method can be used. This method benefits of the naturalistic environments, with capturing the experience of individuals throughout several days (Palmier-Claus, Myin-Germeys, Barkus, 2011). The method often leads participants to reflect on their emotions and social connections through self-reflection by answering daily short questionnaires (Verhagen et al., 2016). In general, the method has multiple strong points in research, including the real-life assessment and the answering of multiple daily questionnaires. Further, it promises a rich dataset with participants mental information and a lower assessment error due to the repeated measures (Csikszentmihalyi, 2013; Verhagen et al., 2016). Also, ESM allows the determination of mechanisms that are otherwise challenging to examine in unnaturalistic settings, such as stress-sensitivity or other state emotions. Here, the ability to examine the real experience with moment-to-moment fluctuations of their moods and thoughts of the participant is much more likely (Myin-Germeys et al., 2018).

The use of technological devices, like smartphones or smartwatch sensors, are becoming more common in the modern world with the aim of turning people more self-centred about themselves and their well-being (Umek, Tomažič, & Kos, 2015). Those devices are also an efficient help in the experience sampling, as almost everyone owns a smartphone or wearables. A lot of applications are already on the market, that help enable individuals to measure their mental performance and provide features to experience and improve themselves. In turn, researchers can use this technological equipment for their measurements and sent the surveys to the participants to exchange the data (Myin-Germeys et al., 2018). With the combination of experience sampling and the use of technology (over older paper and pencil methods), the reactivity of the participants could be strengthened. People can be

examined through their devices from home or work multiple times a day (Heron & Smyth, 2010). Verhagen et al. (2016) have found that people are more likely to respond to questionnaires or surveys, if they are in a naturalistic setting and participants have more freedom on when and where to answer. Here, the use of notifications and reminders can help in telling the participants when to react to the task.

The Reactivity Effect in Experience Sampling

The effect of reactivity has been successful in multiple studies concerning psychological disorders and stress (Myin-Germeys et al., 2003). Primarily, in the method of ESM, reactivity has been found to show remarkable effects (Ainley, Maister, Brokfeld, Farmer, & Tsakiris, 2013; Myin-Germeys et al., 2003). Reactivity has been described by Conner and Lehman (2012) as the phenomenon of people to actively and repeatedly attend to specific stimulus over a period of time to intensify changes in those behaviours due to the monitoring. Therefore, the effect of reactivity is a by-product in different studies, where participants are aware of the assessment by others (Schrimsher & Filtz, 2011). The phenomenon of participant's awareness of being testing can be seen in the 'Hawthorne effect'. Scientist have observed, that participants alter their behaviour when getting attention of the supervisors in a study. This can be dangerous for the results of the study, as participants tend to report what they think researchers want to see, instead of communicating their actual thoughts or feelings (Paradis & Sutkin, 2017).

Further, the reactivity effect in experience sampling may also influence and change participants measurements as they reflect on their emotions, feelings or thoughts. This effect was analysed in the study of Rowan et al. (2007), where participants were made aware of their smoking issues by paying attention and answering several behaviour questionnaires. Still, the effect of reactivity did not lead to abstinence from smoking. In contrast to this study, Widdershoven et al. (2019) did find positive changes in the differentiation of negative emotions in depressive patients. The results have indicated, that self-monitoring, caused by reactivity, has enabled participants to understand their different negative emotions.

In terms of interoceptive awareness, the higher attention to body signals due to reactivity, has been found to enhance individual's accuracy in comprehending somatic and cognitive dimensions of oneself (Ainley et al., 2013). Here, the actively answering to specific stressors increases the possibility of reward or consequences to a situation depending on the bodily signals. Therefore, it increases the interoceptive awareness and enhances the likelihood

that the individual can act with more awareness to that stressor (Rith-Najarian, McLaughlin, Sheridan, & Nock, 2014).

For ensuring positive findings in a study, the attitude of the participants towards the study and the type of question is essential (Wood et al., 2016). First, reactivity can decrease or increase with the attitude of the participant. When participants obtained an overall positive attitude towards the researched concept, the response rate was higher, and the effect size was more substantial (Morwitz et al., 2004). In contrast to this, when participants viewed the researched concept with a negative attitude, response was less likely (Wood et al., 2016). In turn, participants with a positive attitude were more likely to change their behaviour in line with the survey, whereas participants with a negative attitude did not change their behaviour (Morwitz et al., 2004). Second, the type of questions asked seems to cause people to change their behaviour, where researchers distinguish between intention question and prediction questions. Sheppard, Hartwick, and Warshaw (1988) explained that self-predictions determine what one will do, whereas behavioural intentions are established on the desirability that embody an idealized aim, which is mostly hard to reach. Therefore, prediction questions should be used instead of intention questions in any research (Sheppard et al., 1988).

This Study

As already mentioned, not a lot of studies have found a way to increase levels of IA with the use of questionnaires yet, wherefore this study tries to add the effect of reactivity in experience sampling to ensure the enhancement in understanding one's body awareness. Most specifically, our reactivity to specific IA questionnaires could establish a better understanding of our body's needs. If we are able to be more sensitive of certain feelings and emotions, we are more prone to understand them and in turn, change our perception or behaviour in future situations where we experience the same feelings or emotions. Hence, we are learning to be more sensitive to our bodily needs and therefore, increase our introspective awareness. The application of awareness questionnaires could help people in becoming more aware of their bodily sensations. Hence, when individuals are answering to a higher amount of interoceptive awareness items, their interoceptive awareness level is assumed to be higher in post-measurements than those that do not answer a lot of interoceptive awareness items. Biofeedback has already shown that the enhancement of awareness is a possible and competent solution for psychological patients. Now, it seems sufficient to analyse more methods that could be a substitute for biofeedback, as the study of Barrett and Barrett (2001) has already shown this possibility with their use of survey methods to improve awareness.

To see whether there is an effect on interoceptive awareness due to repeatedly answering IA questionnaires, one group will be tested on reactivity in pre- and post-measurements while answering daily IA questionnaire subscales in between. As a comparison, a control group will briefly answer IA pre- and post-measurements. Concerning the terms established above, the following hypotheses will be analysed in this study to develop a closer picture about people's ability to increase IA via reactivity:

1. There is a main effect of time in the experimental group.
2. The interaction effects lead to a higher score difference for the experimental group than the control group between pre- and post-measurements.
3. There is a positive relationship between number of completed questionnaires and IA pre- and post-difference.
4. Post-measurement subscale scores used for the daily questionnaires in the experimental group are higher than pre-measurement subscale scores.
5. There is a positive relationship between number of completed questionnaires and subscale pre- and post-difference in the experimental group.

Methods

Participants

For this study, the target group of students was chosen. Therefore, 74 students were randomly selected as participants for this study, but only the data of 46 participants could be used. Of those participants, 37 took part in the experimental group, while nine of the participants took part in the control group. In total, the data of 28 participants could not be included into the study, since they did not complete the pre- or post-questionnaire.

The final sample of this study, as shown in Table 1, consisted of 46 participants that were selected for the control and experimental group. Out of those participants, the majority was female and of German nationality. The minimum of age for all participants was 16 and the maximum age of all participants was 26. In total, the experimental group consisted of four times more participants than the control group.

Due to the high number of dropouts in this study, an analysation with the remaining information was done to examine those participants for specific patterns. Results can be seen in Table 2. In general, 13 participants dropped out of the control group and 15 dropped out of the experimental group. Further, five of them did not fill out the pre- and post-questionnaire, while ten did not fill out the post-questionnaire. The analysation has shown, that mostly German and female participants dropped out, although most people partaking in this study

had those characteristics as well. Actual patterns were seen in the characteristics of age and interoceptive awareness scores. The age range (Max_{age}=57, Min_{age}=24) of the dropouts was slightly higher than those of the participants of this study, indicating that older people were more likely to drop out of this study.

The participants have been derived mostly through convenience sampling, which happened through the communication of smartphones via text messages between participants and researchers. Here, friends and colleagues have been asked to participate in either the control or experimental group. Following, the researchers provided them with the necessary information and the link to the study. Another sampling process was derived with the SONA System of the University of Twente. SONA enables students of the university of Twente to publish their research and have other students to participate in exchange for course credits via the internet. For the participation in this study, SONA granted 0.25 credits. Other participants that did not participate via SONA did not receive any rewards. Further, a general requirement for all participants was the accessibility of a smartphone.

Table 1

Participant Characteristics in Experimental and Control Group (N=46)

Characteristic	Experimental group		Control group		Full sample	
	N	%	N	%	N	%
Gender						
Female	29	78.4	6	66.7	35	76.1
Male	8	21.6	3	33.2	11	23.9
Others	0	0	0	0	0	0
Nationality						
German	35	94.6	6	66.7	41	89.1
Dutch	1	2.7	3	33.3	4	8.7
Others	1	2.7	0	0	1	2.2
	M	SD	M	SD	M	SD
Age	20.86	2.175	22.67	1.732	21.22	2.200

Table 2

Participant Dropout Characteristics in Experimental and Control Group (N=28)

Characteristic	Experimental group		Control group		Full sample	
	N	%	N	%	N	%
Gender						
Female	11	73.3	9	69.2	20	71.4
Male	3	20.0	3	23.1	6	21.4
Others	0	0	0	0	0	0
Missing	1	6.7	1	7.7	2	7.2
Nationality						
German	12	80.0	8	61.5	20	71.4
Dutch	0	0	3	23.1	3	10.7
Others	0	0	1	7.7	1	3.6
Missing	3	20.0	1	7.7	4	14.3
	M	SD	M	SD	M	SD
Age	20.92	2.234	25.75	10.39	23.33	7.755

Design

This is a quantitative research that consists of a longitudinal experience sampling study. For both groups, the experimental time was a total of six days. To compare both groups in the first hypotheses, the between-group design will be used. Here, the independent variable in this study consisted of the participation in either control or experimental group, while the dependent variable was considered to be the level of Interoceptive Awareness as assessed with the MAIA-2. To see whether reactivity has had an effect on Interoceptive Awareness in the experimental group for the second hypotheses, a within-group design is needed. Here, the independent variable is the amount of completed surveys, while the dependent variable is the difference of mean scores in pre- and post-measurement.

Materials

Trait questionnaire

The Multidimensional Assessment of Interoceptive Awareness Version 2 (MAIA-2) questionnaire consists of 37 items in 8-scales that can measure multiple dimensions of

Interoception (see Appendix B). The questionnaire is self-reported and tests for the trait of each taker. The MAIA-2 is a revised questionnaire of the original MAIA questionnaire. The MAIA-2 was published in 2018 and added 5 questions to the original questionnaire in the items of Non-Distracting and Not-Worrying. The questionnaire consists of a 6-point Likert scale, ranging from 0 (never) to 6 (always). Reversed scores are to be used on the items 5, 6, 7, 8, 8 and 10 on Not-Distracting, and items 11, 12 and 15 on Not-Worrying. Scoring is derived by the average of the items on each scale (University of California San Francisco, 2018). No further definition is given on the final score of the questionnaire.

Mehling et al. (2018) have calculated an overall good internal consistency (Cronbach's alpha=.74) for the overall second MAIA version. Six out of the eight subscales have obtained sufficient factor loading of above .70. Only the subscales of Noticing (.64) and Not-Worrying (.67) did not made the standard criterion of .70 but were included into the final version. Therefore, the MAIA-2 has been found to be most successful in measuring the Interoceptive awareness level of individuals (Mehling et al., 2018), and was therefore used in this study. Hence, the MAIA-2 has been chosen to analyse the trait characteristics of the participants in this study. To measure those trait characteristics, the questionnaire was put as a pre- and post-questionnaire for the control and experimental group.

Further, the Short Form Self-Regulation Questionnaire (SSRQ) (31 items) and psychological wellbeing (18 items) questionnaire were added to the total pre- and post-questionnaire. However, the SSRQ and psychological wellbeing questionnaire were part of other student's thesis projects and therefore irrelevant for the current thesis and will not be mentioned further.

State questionnaire

The state questionnaire was consistent of five specific MAIA-2 items to test for the association of repeatedly answering the daily questionnaire and change in IA score in participant's daily life. Researchers of this study had chosen the items with the highest factor loadings (all above .70) on interoceptive awareness in order to reach the best scores possible in this study as well. Also, items were chosen that seemed to fit to the everyday situation of the participants. For example, items that describe a certain kind of emotion which might not be present at that specific time a participant is conducting the questionnaire was not included. All items, however, have been restated to the present tense in order to establish a realness and presence to the participants. Those items are: 1. *At this moment, I listen for information from my body about my emotional state*. (Body Listening, Factor Loading = .82) 2. *At present, I can refocus my attention from thinking to sensing my body*. (Attention Regulation, Factor

Loading = .73) 3. *Right now, I feel my body is as a safe place*. (Trusting, Factor Loading = .88) 4. *Right now, I can bring awareness to my body and feel a sense of calm*. (Self-Regulation, Factor Loading = .734) 5. *At this moment, I can reduce tension by focusing on my breathing*. (Self-Regulation, Factor Loading = .73).

All items of the trait and state questionnaire have been added to the application with the use of a 6-Likert scale as single answer choices. However, we have changed the scale values from 'Never' - 'Always', to 'Strongly agree' – 'Strongly disagree' to have a more adequate description for the participants to choose from.

Ethica Application

Ethica is an application that can be used by researchers to conduct technological research. The license for the research was provided by the University of Twente. The application can be downloaded for free on any smartphone so that participants can engage in the studies as they go around their daily activities. This is why the application was chosen for this study as well. The questionnaires have been repeatedly presented on the mobile screens of the participants, where they had the opportunity to answer the questions in their natural environment. For this study, the Ethica version: 230 has been used (Ethica data, 2019).

With help of the application, two separate surveys were designed that were constituted for the experimental and control group. After publishing the finished studies, the application provided an identification code and a website link for the surveys, with which participants can access the questionnaires. Finally, the scores of the questionnaire were stored with the application and can be directly downloaded via the website "www.ethicadata.com". It was therefore possible, to see the real time progress of the participants as they completed the survey.

Procedure

This study was approved by the Ethics committee of the University of Twente on the 25-03-2020 with the request number of 200402 and research lasted one month. Before taking part in the study, participants were asked to agree to the consent form (see Appendix A). After receiving some general instructions from the SONA system or the researchers, all participants had to agree to the content form. Both studies that had been uploaded on Ethica, could be found via the internet weblink or the Study ID, which was provided via SONA or personal social media platforms. Following, all participants had to download the Ethica application on their smartphone and sign into the app. The application then, provided the participants with further information on how to use the questionnaire. That information stated the importance

of answering the questionnaire as soon as possible as the daily questionnaires were accessible only for a duration of one hour. The questionnaires were selected to expire after that time period and cannot be filled out anymore. For Android users, it was necessary to ensure that they turn on the notification of the app in their settings by themselves. Therefore, instructions were given on how to change those settings into the general information of the studies in the Ethica application as well. The researchers of this study also provided them with their email address in case of emergencies or questions. Also, in the beginning of the pre-test, all participants had to fill in their demographic information, regarding their age, gender and nationality.

In general, the control group had to fill in the trait questionnaire of the pre- and post-measurements of the MAIA-2 in the Ethica application on the first and sixth day of participation. Participants could fill in the pre-test immediately after signing in. If not, they were reminded again after two hours to fill in the questionnaire in case they did not notice the first notification. The pre-test would expire the next day, so participants were told to fill in the questionnaire during the 24 hours. On the sixth day of participation, all participants would get a notification at 10am to fill out the last questionnaire. Here, the same conditions were applied as to the pre-test. Participants had one day to fill in the questionnaire.

The experimental group had the same fulfilment criteria for the pre- and post-measurements of the MAIA-2 as the control group. Further, they were asked to answer the six daily state questions, starting on the first full day of participation. The participants of the experimental group would receive their first notification at 10am in the morning from the Ethica application. Following, notifications were sent at 1pm, 4pm and 7pm. The repetition of this schedule was triggered for four days. Therefore, the experimental group had to fill in the pre-measurement right after signing into the study, followed by four days of answering to the state trait questionnaire and finishing the study on the sixth day with the post-measurement of the MAIA-2.

Data Analysis

For the Data Analysis, the measurements of the MAIA-2 pre- and post-questionnaire of the control group as well as the same MAIA-2 pre-and post-questionnaire and the five daily repetition questions for the experimental group were used. The data analysis and statistical calculations were done with SPSS version 25.

Data preparation

First, cases were removed from the final dataset that did not fulfil the criteria of completing both the pre- and the post-test in both control and experimental group. Second, the negative loadings of items of the MAIA-2 were reversed accordingly.

Descriptive statistics

Demographic information of all participants has been analysed in terms of mean (M) scores, standard deviation (SD), minimum and maximum values for the variable "*age*" and total percentage scores for the variables of "*gender*" and "*nationality*". For the interoceptive awareness scores, frequency tables were computed with the mean scores of the pre- and post-measurements for the control and experimental group. Mean difference scores between IA pre- and post-measurements are also calculated. Further, minimum and maximum of IA scores in both tests are added. Finally, IA pre-score of the dropouts have been calculated regarding their mean and standard deviation, as well as minimum and maximum scores.

Inferential statistics

For the first and fourth hypothesis, a paired t-test will be used to compare the scores of pre- and post-measures. This paired t-test will analyse whether there was a significant change in scores between pre and post-measures of IA scores for the first hypothesis and change in subscale scores between pre- and post-measurements for the fourth hypotheses. For this analysis to be used, the data needs to be linear and normal distributed (see Appendix C). If those assumptions hold not true, the non-parametric analysis of the Wilcoxon signed-ranked test will be used as a substitute.

For the second hypothesis, an independent t-test will be used to test for the difference between means in the control and experimental group. With this, it can be determined, whether the experimental group has a higher pre-post-difference compared to the control group. Therefore, the data needs to be normal distributed (see Appendix C). The non-parametric analysis of Mann-Whitney U test will be used as alternative if the assumptions hold not true.

The third and fifth hypothesis will be tested with a linear regression analysis, to test for the significance in higher score difference between pre- and post-measurements due to the amount of reactivity in the experimental group. Here, the linear regression analysis will be used to predict the difference in IA scores (dependent variable), based on the numbers of daily completed questionnaires (independent variable) for the third hypothesis. Also, linear regression will examine whether the amount of filled in questionnaires (independent variable) has an effect on the subscale pre- and post-measurements (dependent variable) in the fifth

hypothesis. To test for the linearity of the data, a scatterplot will be built. In case of no linearity, a Spearman's rank-order correlation for non-parametric data of will be used (see Appendix C).

Results

Descriptive Statistics

Interoceptive Awareness

In general, mean score for the experimental group were found lower than mean scores for the control group in both pre- and post-measures. However, mean difference scores for the experimental group are found to be positive and higher for the post-test, while the control group does not show any positive differences. Due to the high number of dropouts, pre-measurement IA scores were calculated. The results show, that dropouts have the lowest mean value in interoceptive awareness. All scores can be found in Table 3.

Table 3

Descriptives of the Multidimensional Assessment of Interoceptive Awareness in Control and Experimental Group

Group	Scores	N	Min	Max	Mean	SD
Experimetal						
	Pre-	37	2.7	4.76	4.05	.38
	Post-	37	2.84	4.86	4.21	.42
	Dif-	37	-.41	.73	.157	.25
Control						
	Pre-	9	3.92	4.57	4.24	.28
	Post-	9	3.68	4.51	4.22	.25
	Dif-	9	-.30	.16	-.018	.16
Dropout	Pre	28	3.14	5.00	3.86	.42

Inferential

Main effect in experimental group

Since the assumptions for a paired t-test were not met (see Appendix C), the non-parametric Wilcoxon signed-rank test was used for the first and second hypothesis. For the first hypotheses, the Wilcoxon signed-rank test was performed to analyse for an effect of time in scores from pre- to post-measurements in the experimental group. For the experimental

group, the higher difference from post-measurement scores (M = 4.86, SD = .42) to pre-measurement scores (M = 4.05, SD = .38) have been found to be significant (Z = -3.188, p = .001).

Score difference in experimental and control group

For the second hypothesis, the Mann-Whitney U test was, since the assumptions for parametric analysis could not be met (see Appendix C). The analysis was used to examine whether the experimental group has a higher score difference in pre- and post-measures than the control group. From this analysis, it can be concluded, that pre- and post-score differences are significantly higher in the experimental than control group (U = 93.5, p = .043).

Relationship between number of completed questionnaires and IA pre- and post-difference

Since the assumptions for linear regression were not met (see Appendix C), the non-parametric Spearman's rank-order correlation was used. For the third hypotheses, a Spearman's rank-order correlation was done to test for the strength and the direction of association of the IA scores and the amount of filled in surveys. There was a moderate, positive correlation between difference of IA scores and the amount of filled in surveys ($r_s(37) = .467$, $p = .004$). All total scores of IA pre- and post-tests for the experimental group can be found in Appendix C. For 26 participants, the interoceptive awareness score increases, while for ten participants the interoceptive score decreased and one participant obtained the same scores. Further, the relationship of difference in scores and completed surveys can also be found in Figure 1.

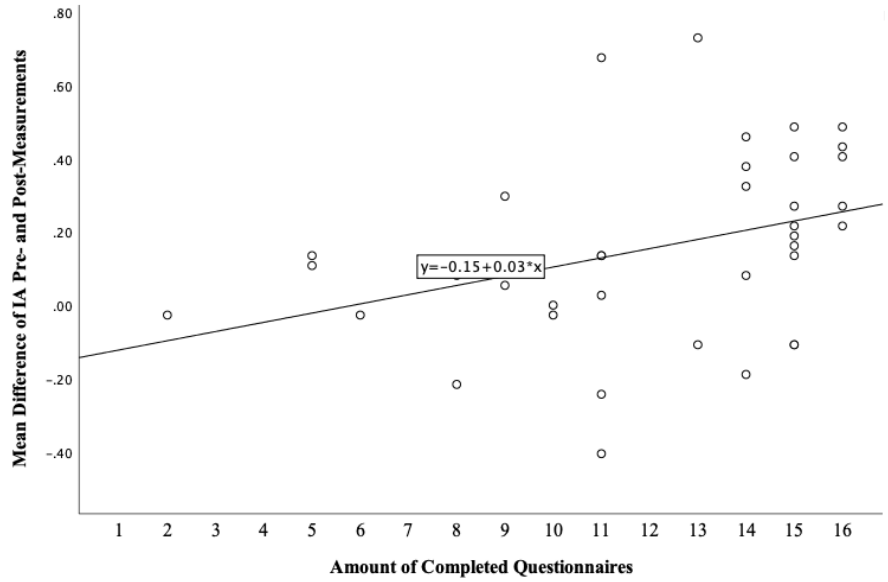

Figure 1

Interoceptive Awareness Pre- and Post-Measurement Difference Scores by the Amount of Completed Questionnaires

Subscale differences from pre- to post-measurement

Again, the assumptions for a paired t-test were not met (see Appendix C). For the analysis of the subscale, the Wilcoxon signed-rank test was used to show the difference in pre- and post-measurements. Further, Table 4 shows mean and standard deviation scores of each scale in the pre- and post-measurement and significant scores for each difference in scores between pre-and post-measurements. The results indicate, that items that have been used in the daily questionnaires of this study, have a higher significant score and a higher change in mean scores from pre- to post-measurement. This is accountable at least for the items of 'Self-Regulation', 'Body Listening' and 'Trusting'. In general, 'Body Listening' showed the highest changes in mean scores and 'Noticing' showed lowest changes in mean scores from pre- to post-test. The subscale of 'Attention Regulation' did not obtain any significant scores. Further, all subscales that have not been used for the daily questionnaires obtained non-significant scores as well.

Table 4

Descriptive of Each MAIA-2 Subscale in Experimental Group for Pre- and Post-measurements with Differential Significant Z Scores

Subscale	Pre-Test		Post-Test		Differential Score		
	Mean	SD	Mean	SD	Mean	Z	p
Noticing	4.37	.61	4.36	.98	-.006	-.707	.480
Not Distracting	3.98	.82	3.82	.74	-.162	-1.36	.173
Not Worrying	3.74	.37	3.81	.47	.064	-.754	.451
Attention Regulation	4.0	.61	4.20	.66	.204	-1.82	.067
Emotional Awareness	4.56	.76	4.72	.87	.162	-1.62	.105
Self-Regulation	3.91	.65	4.19	.78	.277	-2.46	.014
Body Listening	3.42	1.14	3.97	.97	.549	-3.77	.001
Trusting	4.39	.99	4.90	1.0	.504	-4.0	.001

Relationship between number of completed questionnaires and subscale pre- and post-difference

Again, the assumptions for linear regressions were not met (see Appendix C). Therefore, for the fifth hypotheses, the spearman's rank order correlation was used for the previous found significant subscales of 'Trusting', 'Body Listening' and 'Self-Regulation', The analysis has indicated the strength and direction of correlation of those subscales in regard to number of completed questionnaire. Here, no significant relation was found between the filling out of daily questionnaires and change in subscale scores for 'Self-Regulation' ($r_s(37) = .240$, $p = .152$), 'Body Listening' ($r_s(37) = -.081$, $p = .633$), and 'Trusting' ($r_s(37) = .110$, $p = .516$).

Discussion

The purpose of this study was to gain a better understanding of the concept of interoceptive awareness in regard to the reactivity effect. Here, it was assumed, that the level of IA would increase when participants would repeatedly answer daily MAIA-2 questionnaires in their daily lives.

Overall, the findings of this study provide support for the first three hypotheses. Therefore, the results have shown a main effect of time in the experimental group. Further, the analysis concludes for a significant higher difference in IA scores between pre- and post-measurements in the experimental group, indicating a slight improvement in body awareness in this group compared to the control group. Also, the mean scores of Interoceptive Awareness for the experimental group were overall higher in the post- than pre-test, suggesting, that IA scores enhanced over time. Strikingly, the results of this research did find supporting analysis for the effect of reactivity. Our findings highlighted that the amount of completed surveys did explain the level of Interoceptive Awareness to a moderate extent. Hence, the overall amount of Interoceptive Awareness increased with the total number of completed surveys. Further, the fourth hypothesis can only be partially accepted, while the fifth hypothesis needs to be rejected. Here, subscales that have been used in the daily questionnaires of the study, have a significant change in score in the post-measurement, while subscales that have not been used in the daily questionnaires, show no significant change. However, the subscale of 'Attention Regulation' has shown no significant effect. Hence, repeatedly answering the items of 'Attention Regulation' does not seem to have an effect of the individual understanding of said attention regulation. However, the analysis of relationship between post-scores of subscales and amount of completed questionnaires has

shown no significant results for the remaining subscales of 'Body Listening', 'Self-Regulation' and 'Trusting' either. Therefore, the number of filled out questionnaire does not influence the post-measurement score of the subscales. Taken altogether, our findings indicate a significant change in scores for the experimental group due to the moderate cause of reactivity in experience sampling.

Theoretical reflections and implications

The results have shown that interoceptive awareness can be increased with the use of repeatedly asked self-reported questionnaires. Therefore, the effect of reactivity can be seen as helpful when one wants to enhance personal levels of bodily awareness. This is also in line with the research of Ainley et al. (2013), and Critchley et al. (2004). The enhancement of IA is also partially explained by Critchley et al. (2004) who tested interoceptive awareness on the heartbeat level via biofeedback. Patients were able to understand their heartbeat level in different situations with repeated practice and feedback. In turn, their IA level also increased as they learned to comprehend the origin of those feelings and thoughts due to the heartbeat level and the situation. In this study, it can be assumed that participants enhance their IA with the completing of the daily questionnaire only, which is also in line with the findings of Putnam and Wilson (1982). Participants of the control group did not obtain a higher level of IA, as they were not being exposed with their interoceptive awareness on a daily basis. For them, the effect of reactivity was not present. As is was also assumed by Quinlan Cutler et al. (2018), the body awareness of the control group did not increase because they were not dealing with their emotions, feelings and thoughts in a conscious manner daily, compared to the experimental group. For the experimental group of this study, the number of filled in questionnaires is influencing the body awareness of the participants. Hence, people who filled out a lot of daily questionnaires had the highest increase in IA levels, while people who did not fill out a lot of daily questionnaires had the lowest rise in IA levels. Consequently, the effect of reactivity could explain the increase in IA, where participants react to the measurements of interoceptive awareness, which adds to the studies of Bornemann et al. (2015); Kotozaki et. al. (2014) and Derks et al. (2019).

Further, this research analysed four subscales of the MAIA-2 for the daily questionnaires, which describe the significant increase in three of those subscales. Hence, the individual level of 'Bodily Listening', 'Trusting', and 'Self-Regulation' was increased by most participants from the pre- to post-questionnaire. Since 'Attention Regulation' did not obtain any significant changes, it can be stated that the level of attention regulation was not

increased from pre- to post-questionnaire. However, the item of ‘Attention Regulation’ did obtain high factor loadings and was described to analyse interoceptive awareness thoroughly (Mehling et al., 2018). Multiple other studies on ‘Attention’ did find out that the process of attention requires skills for the monitoring of attention focus and distraction. Attention involves several brain processes that were found to be changeable with cognitive training, for example, meditation (Lutz, Slager, Dunne, & Davidson, 2008). Hence, regulating one’s attention does seem to include more extensive practises than filling out questionnaires. Also, further analysis on ‘Trusting’, ‘Body Listening’ and ‘Self-Regulation’ has shown that the increase in those scales are not related to the number of filled out questionnaires. Therefore, is can be stated, that the subscales were not influenced by reactivity and might have increased due to other unknown factors. Conclusively, it can also be questioned whether more subscales of the MAIA-2 are also not influenced by repeatedly completing questionnaires. In turn, this might also affect the overall level of interoceptive awareness differently in the long run, especially for items with lower factor loadings. One possible explanation for the increased scores in the post-measurements could be the priming effect arising from the daily questionnaires. As can be seen by the results, the same subscales that have been used for the daily questionnaires, show the highest increases in the post-measurements. This effect cannot be significantly explained by the total number of completed questionnaire but might be caused by the mere exposure towards the same items, day after day. Studies have found that the exposure towards several stimuli facilitates and primes people’s responses. The exposure towards the information helps storing said information and leads to repeatedly activate that stored knowledge at a later time (Molden, 2014). Hence, when the participants answered those daily questions, they might have been influenced towards higher scores in the post-test.

Another exciting finding can be seen in the dropouts of this study. Demographics and mean scores have shown that mostly females with lower IA scores were prone to drop-out. Results of other studies concerning interoceptive awareness have proven, that low IA scores cause higher self-objectification. Especially women that are high in self-objectification tend to see their innate stimuli as less salient and mostly view themselves out of the third-person perspective (Ainley & Tsakiris, 2013). Hence, their attention is more prone towards outward stimuli, which is why they might have not felt as comfortable in filling out the questionnaire. In comparison, people who have higher levels of interoceptive awareness are more likely to turn inwards and are therefore, also more comfortable in analysing their inner experiences. Thus, drawing causal inference from number of completed questionnaires to higher awareness

scores seems dangerous, as people might even be more likely to fill out more surveys, when they are high in IA.

As already mentioned, multiple studies worked with help of either biofeedback or psychological training besides the IA questionnaire to get feedback to the client. Feedback or communication with the participants was not present in this study, wherefore it can be questioned whether interoceptive awareness is actually possible to enhance solely by self-report and individual work. This study speaks for the possibility; since Mehling et al. (2018) have worked on a valid and reliable questionnaire that was opted to have credibility on its own. Hence, the MAIA-2 questionnaire used in this research does seem to help individuals in increasing the level of their body awareness.

This research was conducted to see whether it is able to enhance interoceptive awareness. In a world, where there is overstimulation every day, it seemed essential to have a sound knowledge and understanding of one's own body. As Boden et al. (2013) have stated, having a high level of body awareness is likely to decrease adverse events and stress. Since this study has achieved the slight enhancement of IA levels in students, it can also be assumed that their stress level decreased. Nevertheless, further measurements should be added to have more certainty, as this study did not include tests of the concepts of stress.

Strong points and limitations of the study

A first strong point of the study is the setup in regard to the experimental sampling method. With help of the Ethica application, participants were able to partake in this research from home without taking any efforts to join any meetings or trainings. Further, we were able to measure their natural moods in their own environments without them being biased by lab settings. Therefore, the study's setup can be highlighted for its unobtrusiveness.

Further, research on reactivity and Interoceptive Awareness in combination is not well studied yet, wherefore this study tries to find novel results in this area. Also, another strong point represents the good psychometric properties of the MAIA-2 questionnaire, which is high in validity and reliability. Therefore, it can be concluded that the measurement of interoceptive awareness is accurate and stable.

Another strong point is the number of participants this study gathered. Compared to other studies, the overall numbers of participants (45) exceeds the participants of Critchley et al (2004) and Morris et al. (2010), who collected 15 and 8 participants. Adding to the participants, this study has collected the target group of students for testing the effect of IA for several reasons. As already mentioned, the overload of stimuli in every person's daily life

can lead to increased negative feelings and emotions and body dissociation. Negative emotions of especially stress, have been found to be high in students, as they are exposed to a lot of academic and personal pressure (Putwain, 2007). Boden et al. (2013) found the importance of acceptance and regulations of emotions in college students, where a high understanding of one's own emotions is the key in maintaining well-being. Therefore, the target group of students can be seen as an excellent fit for this study to analyse their introspective awareness. On the other hand, any group that experiences stress in their daily life could benefit from this study. This includes many factors, for example, individuals that suffer from severe diseases, individuals of old age, early childhood traumas or occupational stress (Chandraiah, Agrawal, Marimuthu, & Manoharan, 2003). Results for those groups could be of significant interest in light of this study and compared to this target group of students.

A final strong point of this study is the duration of the experiment. This study only consisted of four days which can be stated as adequate considering the significant results. In comparison, other studies have used an overall duration of several weeks or even months, where effects could be higher (Morris et al., 2010). Hence, it can be criticized whether a longer duration of several weeks is necessary in a setting of experience sampling, as a few days are already changing the individuals IA level.

Further, this study contains some study limitations that concern the results of the study. First, the control group can be criticized in size. The study of Hutchins, Brown, Mayberry, and Sollecito (2015) have examined the diverse effects of difference in control and experimental group and have opted for a higher number in control group to ensure more power for the study. Preferably, most studies aim for a low difference in number of participants in groups. In the end, the difference between experimental and control group of this study were three folded. Therefore, this study should have opted for a random assignment to obtain a larger control group and ensure the reliability and power of the research.

Finally, to ensure that people really understand their bodily needs, some sort of communication medium should have been added. With this sort of analysis, it can be further analysed, what people thought about the helpfulness of this experiment. As the level of understanding action of participants in this study is not clear, it cannot be answered whether people are able to incorporate their increased IA level in their daily lives. The extent of using that knowledge of one's bodily needs was not examined in this study but was proven to be important by other researchers (Ainley et al., 2013; Boden et al., 2013; Critchley et al., 2004).

Suggestions for further research and final statement

So far, not a lot of studies were found on reactivity testing in interoceptive awareness, leaving lots of room for further analysis and criticism. As can be seen in this study, the increase in interoceptive awareness was only moderate and it seems therefore necessary to test this further to assure the reliability of this study. For future research, and as already mentioned in the limitations of this study, a larger control group and the communication with the participants might change the results of studies on IA. Especially the opinion of participants could have been analysed further, for example, with the integration of a follow-up questionnaire about participant's thoughts and their opinion about their bodily awareness.

Until now, most studies have examined IA with biofeedback or with help of psychological training. Many studies have examined the impact of biofeedback devices, and most of them have not only concluded the importance of feedback for individual's psychological well-being. (Craske, Lang, Tsao, Mysthkowski, & Rowe, 2001; Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002). As this study does reach an increase in interoceptive awareness with the sole use of IA questionnaires, the importance of biofeedback can be criticized. Therefore, experience sampling with the use of questionnaire seems to be another suitable method, besides biofeedback.

Finally, this study is one of the first to analyse and enhance individual's interoceptive awareness in regard to the MAIA-2 questionnaire. The findings of this study claim that reactivity to Interoceptive Awareness increases the overall level of IA in students. The experience sampling method can therefore be described as helpful for students to enhance their understanding of their body's needs. Hence, implementing experience sampling with IA questionnaires into the daily lives of people shall cause more body awareness, but further research is needed.

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Appendices

Appendix A

10. 04.2020 University of Twente, Enschede, Netherlands

Consent Form

Informed Consent for the research 'Testing Reactivity of Interoceptive Awareness in the daily life of Students'

Your participation in this survey is completely voluntary and all your responses are treated anonymously. None of the responses will be connected to identifying information. Data will only be used for statistical analyses.

However, you can withdraw from the study at any time if you feel uncomfortable or stressed! By simply stopping answering the daily questions.

Appendix B

Below you will find a list of statements. Please indicate how often each statement applies to you generally in daily life.

.	Circle one number on each line					
	Never					Always
1. When I am tense I notice where the tension is located in my body.	0	1	2	3	4	5
2. I notice when I am uncomfortable in my body.	0	1	2	3	4	5
3. I notice where in my body I am comfortable.	0	1	2	3	4	5
4. I notice changes in my breathing, such as whether it slows down or speeds up.	0	1	2	3	4	5
5. I ignore physical tension or discomfort until they become more severe.	0	1	2	3	4	5
6. I distract myself from sensations of discomfort.	0	1	2	3	4	5
7. When I feel pain or discomfort, I try to power through it.	0	1	2	3	4	5
8. I try to ignore pain	0	1	2	3	4	5
9. I push feelings of discomfort away by focusing on something	0	1	2	3	4	5
10. When I feel unpleasant body sensations, I occupy myself with something else so I don't have to feel them.	0	1	2	3	4	5
11. When I feel physical pain, I become upset.	0	1	2	3	4	5
12. I start to worry that something is wrong if I feel any discomfort.	0	1	2	3	4	5
13. I can notice an unpleasant body sensation without worrying about it.	0	1	2	3	4	5
14. I can stay calm and not worry when I have feelings of discomfort or pain.	0	1	2	3	4	5
15. When I am in discomfort or pain I can't get it out of my mind	0	1	2	3	4	5
16. I can pay attention to my breath without being distracted by things happening around me.	0	1	2	3	4	5
17. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.	0	1	2	3	4	5
18. When I am in conversation with someone, I can pay attention to my posture.	0	1	2	3	4	5

How often does each statement apply to you generally in daily life? Circle one number on each line

	Never					Always
19. I can return awareness to my body if I am distracted.	0	1	2	3	4	5
20. I can refocus my attention from thinking to sensing my body.	0	1	2	3	4	5
21. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.	0	1	2	3	4	5
22. I am able to consciously focus on my body as a whole.	0	1	2	3	4	5
23. I notice how my body changes when I am angry.	0	1	2	3	4	5
24. When something is wrong in my life I can feel it in my body.	0	1	2	3	4	5
25. I notice that my body feels different after a peaceful experience.	0	1	2	3	4	5
26. I notice that my breathing becomes free and easy when I feel comfortable.	0	1	2	3	4	5
27. I notice how my body changes when I feel happy / joyful.	0	1	2	3	4	5
28. When I feel overwhelmed I can find a calm place inside.	0	1	2	3	4	5
29. When I bring awareness to my body I feel a sense of calm.	0	1	2	3	4	5
30. I can use my breath to reduce tension.	0	1	2	3	4	5
31. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing.	0	1	2	3	4	5
32. I listen for information from my body about my emotional state.	0	1	2	3	4	5
33. When I am upset, I take time to explore how my body feels.	0	1	2	3	4	5
34. I listen to my body to inform me about what to do.	0	1	2	3	4	5
35. I am at home in my body.	0	1	2	3	4	5
36. I feel my body is a safe place.	0	1	2	3	4	5
37. I trust my body sensations.	0	1	2	3	4	5

Appendix C

Assumptions for using parametric test were tested for the first and second hypotheses and showed that, (1) the dependent variable is continuous, (2) there is a linear relationship between the pre- and post-scores in interoceptive awareness in the experimental but not the control group, (3) the data of the experimental group consist of one outlier (4) and the Shapiro-Wilk test showed that the data of interoceptive awareness is not normally distributed in post-measurements in the experimental (W (37) =.945, p = .068) and control group (W (9) =.895, p = .224) and in the pre-measurements in the control group (W (9) =.870, p = .124). However, normality was found for the pre-measurements in the experimental group (W (37) =.940, p = .047). As the requirements could not be fully met, a non-parametric test for the first hypotheses has been chosen.

Assumptions for using parametric test were tested for the third hypotheses and showed that, (1) the dependent variable is continuous, (2) the data in the experimental shows no linear relationship, (3) the data of the experimental group consist of one outlier, (4) and the Shapiro-Wilk test showed that the data of interoceptive awareness is not normally distributed (W (37) =.990, p = .958). As three out of the four requirements could not be met, a non-parametric test has been chosen.

Assumptions for using parametric test for the fourth and fifth hypotheses were tested and have shown that, (1) the dependent variable is continuous, (2) the data of ‘Trusting’, Self-Regulation’ and ‘Body Listening’ show a linear relationship but not the data of ‘Attention Regulation’, and (3) and the Shapiro-Wilk test indicated that the data of the subscales ‘Trusting’ (W (37) =.836, p = .001) and ‘Self-Regulation’ (W (37) =.912, p = .006) are normally distributed, but the subscales of ‘Attention Regulation’ (W (37) =.984, p = .847) and ‘Body Listening’ (W (37) =.952, p = .111) are not normally distributed.

Appendix D

Interoceptive Awareness Scores Pre- and Post-Measurement per Participant of Experimental Group

Participant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
IA-pre	4.49	4.24	4.19	3.54	4.16	4.08	3.62	3.86	4.24	3.97	4.14	4.76	3.62	4.76	3.76	4.03	4.14	4.41	3.84
IA-post	4.65	4.65	4.86	4.00	4.43	3.84	3.59	4.00	4.43	4.05	4.11	4.73	3.95	4.35	3.95	4.11	4.03	4.81	4.27

Participant	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
IA-pre	4.03	2.7	3.78	4.43	3.97	3.78	3.86	3.7	4.49	4.27	4.38	3.86	4.08	4.32	4.62	3.81	3.81	4.32
IA-post	4.41	2.84	3.57	4.32	3.86	3.81	4.35	3.7	4.59	4.49	4.68	4.59	4.14	4.14	4.76	3.95	4.08	4.81