RAAT - Reading Attention Assessment Tool usage in the Healthcare

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RAAT - Reading Attention Assessment Tool - applies the method of "beneficial error seeding" (3) for reading attention level assessment. Tool itself is the web-based application where original text is written, pasted, linked or uploaded and then automatically mutated with randomly added misplaced words. This mutated text is then sent out to examinees (patients, physicians, nurses) according to the distribution list. They read such mutated text in the web-application display service and urged to mark such planted errors (doubleclicked). After completing this process, web-application compares the errors marked and mutated aimed to report the "text owner" as well as to the individual examinee. Web-application is controlled by parameters defined by "text-owners": number of errors generated, character and placement of words used, time allowed for completing the reading, success threshold level, distribution lists, default messages etc. "Text-owner" can be any healthcare organization or individual who needs to check to what extent their texts (informed consent inquiries, prescriptions relevant to medication adherence, medical guidelines, manuals, scientific articles, internal procedures, terms of healthcare service, medical textbooks, ...) are read with due attention.If we only take into account medication adherence, global problem is huge: 50% patients do not adhere to the prescriptions, causing poor treatment, adverse reactions, readmissions and eventually deaths. Of course, causes of non-adhered behavior are numerous, but one of highly observed is low level of patients reading of instructions and prescriptions. Research focused strictly on reading attention level influence on non-adherence in taking drugs could not be found in scientific databases.

Keywords: attentive reading; beneficial error seeding; informed consent; medication adherence; medical guidelines; medical education

Introduction

This paper describes proposed solution of one general problem in with the method that is known and used in other areas. As far as it was researched (e.g. Google search of "beneficial error seeding/planting" and "reading attention" queries in different variations) and came to the author's knowledge, there is no such solution in the problem area described (text reading attention assessment). This applies especially in the area of healthcare and medical education. Preliminary paper published on Reserchgate platform (7) encouraged the readers to discuss the method application on text reading novelty, as well as the statement about usability of solution. No such comment in that direction was submitted. For the purpose of intellectual property protection, prior to development and marketing of pertinent application, this method and its application have been also filed as a patent request to Croatian patent office, dated Apr. 13th 2018. Confirmation of acceptance of legitimacy of this patent application was received from Croatian patent office dated Apr, 17th, 2018.

Material (Existing Problem and Opportunity)

Technical problem in the field of healthcare, which solution is required:

Patients, employees in the healthcare sector and medical students and other categories of individuals do not read (important) texts with the necessary attention. Reading attention span varies sharply the tendency of deteriorating due to different factors, as elaborated in the study (8). Main finding was that in 10 years this span shrunk from 12 to 5 minutes of continuous reading. This problem affects the original "owners" of the texts, who are, as a rule, healthcare and education organizations, other public institutions and governmental

bodies on different levels. Quality control in this area is very demanding and apparently doesn't exist. This is due to the fact that reading attention level assessment requires a lot of extra manual work, and the existing methods are unreliable (e.g. as quizzes after completion the text reading).

Hypothesis (Possible Solution)

Hypothesis: New process proposed here can effectively and efficiently solve the problem of insufficient reading attention level as well as meet the opportunity of gaining substantial better understanding of the texts read.

General concept of solution proposed is relatively simple: intentional errors are "seeded" ("planted") in the text. During reading, the reader is urged to mark (by doubleclick or other user interaction method) obvious errors found. The ratio of errors found / seeded indicates the level of reading attention.

This principle is known in other areas for centuries as "diamond seeding" or "diamond planting", with the aim of assessing how careful the diamond finding was in the excavated raw earth from diamond mine. The continuation of this method is in "error seeding" ("fault seeding" or "bebugging") in order to measure test coverage in programming (1, 2).

In the following, two aspects of solution proposed are described: process and technological one. As shown on the BPMN scheme in Fig 1, obvious errors are automatically (by software, according to parametrized rules) introduced in original text. The errors are exclusively in the form of added words existent in actual text, but "seeded" randomly. These words have to obey only one simple rule, should be longer than in parameters set value (usually 4-5 characters). This "mutated" text is sent to the reader with the request of marking errors detected in given time. In such manner "corrected" text is analyzed by the backend application, and the ratio of the found and the really inserted errors indicates the attention level with which the text was read. In the case of a rating lower than the threshold defined by the parameter set, the reader is required to re-read the same text, but with different (newly generated) mutations. The entire evaluation process is fully automatic and applicable to a large number of readers, always with different mutations of the original text, so it is practically impossible to "cheat" during rewriting.
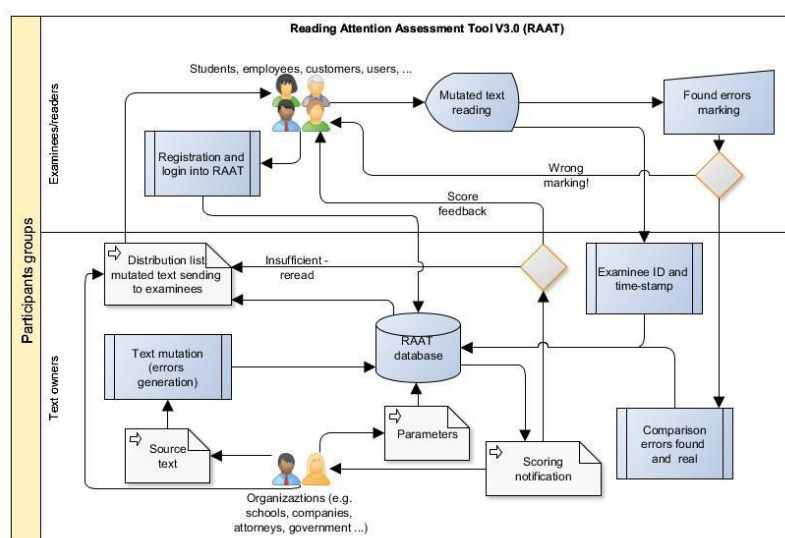

Fig 1: Process diagram of RAAT – method for Reading Attention Assessment Tool

The implementation of this process can be accomplished as a web application that provides the following functionality:

1. Creation/copying/linking of the original text whose reading attention is evaluated (including of "speech-to-text" feature, or OCR feature if scanned),

2. Creating distribution lists for readers whose attention will be evaluated,

3. Entering the parameters needed to mutate the text (process profiles):

   a. the amount of input errors (percentage of words),

   b. special rules for generating errors (e.g. length, placement),

   c. the method of random mutations generation,

   d. special rules for retrieving errors (e.g. feedback of faulty marking),

   e. scoring groups (percentage spans)

   f. the level of success in text reading (percentage or score),

   g. the time for reading and marking inserted errors,

4. Messages to readers, delivering mutated texts available to readers,

5. Assessment of level of attention based on the rules

6. Requests for reading repetition in case of insufficient score,

7. Preserving results and informing the reader and text owner about the outcome.

Problem/solution analysis (5W2H)

"5W2H" method is well known good practice for both brief problem solving (5), as well as for explaining and initial assessment of strategic endeavors. Each and every of seven questions stated (What, Why, Who, Where, When, How, How much) describes one of the problem/solution area:

Introduction

In the healthcare and education areas, there is a substantial problem checking whether someone (patient, student, employee) has read some text at all and carefully enough. The problem is actually solved by reading confirmations, quizzes, repetitions, writing abstracts, and the like. The term "Reading Attention" is found on the Internet in over 50,000 documents. So far no method has been published and found that allows efficient and effective assessment of the reading attention level, especially in the healthcare or education field. The proposed "RAAT" method is thus novel and promising problem solution.

WHAT?

RAAT is a method realized through the web application that generates mutated text based on the source text with randomly "seeded" errors. Within the web application, the respondent (patient, employee, medical student) should mark all the words he/she finds as erroneous within the text. Based on automatic comparison with the original text mutations performed by the software, the "Reading Attention Level Score" (RALS) is calculated.

WHY?

The first step in the problem of meaningful reading is whether the respondent (patient, medical student, employee such as physician, nurse, clerk) reads the text at all. The second degree is the attention and completeness of reading, and the third is genuine understanding the meaning (comprehension). Evaluation of "reading yes/no" resides mostly on "reading confirmation" or opening the text file and mostly has no assessment value. Second degree (attention and completeness of reading) is the procedure which is time consuming and substantively (professionally) very demanding. It is practically impossible to implement these methods in larger groups in restricted time frame with limited human resources. The purpose of the automatic tool is to achieve high efficiency (many respondents in a short time) and effectiveness (that assessment correctly points to the reading attention level). Of course, this method doesn't tackle the assessment of "understanding". Nevertheless, without reading, that can be no understanding. In that manner, this method is aimed to reading attention, which is necessary precondition for understanding.

In the healthcare, there is special need for attentive reading of different kind of texts, here some examples, without claiming on completeness:

- Drugs instructions, including contraindications and adverse reactions, aimed to attaining higher medication adherence

- Other procedures instructions, especially when performed by the patient him/herself

- All kind of medical guidelines, which are read superficially, due to the time pressure on the medical personnel

- Internal procedures in the healthcare institutions

- Terms and conditions for healthcare insurance

- Manuals for sophisticated medical equipment

- Medical textbooks for medical students

- Medical reports and records

- Patient consent documents

WHY NOT? (This is the 8th question that can be advantageously added in the 5W2H scheme: Are there some possibly negative outcomes of proposal's application?)

There are some legitimate concerns about readability of mutated text ("reader's distraction"), expressed by psychologists. This arises as a problem provided too many erroneously generated words are seeded. If their percentage stays under 3-4%, then only one such word appears in one or two lines of text and doesn't distract the examinee in excess. After marking erroneous words the examinee can in case of remained time reread the text without words marked. This issue has to be additionally investigated in further research.

WHO?

This tool applies to all individuals who have the task of reading a text with due attention. These can be: patients, medical students in the classrooms, physicians, nurses, hospital administration and other employees, citizens who receive information

from public healthcare organizations, etc. Emitting bodies are healthcare institutions including insurance and governmental bodies, etc.

WHERE?

Educational institutions in medicine, healthcare institutions, medical schools, etc.

The application is intended for the global market, because it is language neutral: the seeded error-generating rules can be applied to text in any language. Applied on desktop and mobile platforms, it would be advantageous to have a client app for mobile.

HOW?

This method and tool developed can be used in all stages of the life cycle of a text, from the first drafts that are given to the review, to the finished textbooks, instructions, regulations, contracts etc. In the education, tool can serve as a learning help and to some extent as a basis for assessing learning success.

The process of use is clearly defined: the text whose reader's attention is intended to be assessed the "owner" (company, teacher, salesperson, manufacturer, parent, manager ...) uploads/links/pastes to the application and defines the parameters to generate artificial errors (the rate of the wrong words, the constraints in the selection, duration of reading, "grading" groups ...). Text owner has to define the target group whose read attention will be checked (distribution list). These individuals get notification with personalized random errors that need to be read through the web application and the wrong words marked (by doubleclick). Finally, the application uses a "rating" (% found / existing errors) and, depending on the rules, repeats the generating and reading request or reports the success of attentive reading. The randomization serves to personalize the test texts, in order to avoid "cheating" by the subjects. (As depicted in Fig. 1)

HOW MUCH?

This application is relatively simple, the pilot can be made with a predictable consumption of up to 6 programmer/months (excluding dedicated smartphone app development, which would take additionally approx. 3 months). More significant funds should be invested in marketing and intellectually property protection.

Discussion

First of discussion points is the level of novelty of the procedure proposed. Thorough research in www.researchgate.net yield no similar approaches in publication database. Queries were:

- "attentive reading"
- "reading attention"
- "reading understanding"
- "meaningful reading"
- "error seeding"

Similar results yields the query on Google: most of documents listed relate to psychology of reading as well as to error seeding procedures in SW development.

Only similar approaches are published in the patents of Microsoft and CISCO afore mentioned, as well as in the reference (3). This paper deals with principles of beneficial error seeding, but the application in text attention level assessment was mentioned not at all.

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Of course, further research would be valuable aimed to find some other earlier sources of implementation of same or basically similar approach or solution.

Second discussion point relates to the possible side-effects of such method application ("adverse reactions"). One of early recognized is the possible distracting the reader with excessive number of intentional errors seeded. Of course, if tool parameter is set to 30%, about 25% of words would be erroneous. The text generated in that way is very hard to be read with memorizing and understanding. On the contrary, if frequency parameter is set under 5%, every 20th or even less frequent word is erroneously seeded, what distracts the reader on minimal level. In addition, marking the erroneous words with visible marks gives the possibility of re-reading clear text by the examinee.

Third discussion point is the feasibility: The procedure was tested with the prototype mentioned in a way where the users checked mutated text and after the reply with the errors marked, received a feedback on the number (percentage) of the detected errors, which is an assessment indicator the level of reading attention. In this respect the validation of the hypothesis set can be estimated as follows:

> *This procedure is at TRL level 3 ("Analytical and experimental review of the concept of critical functions and / or peculiarities"), see details in the reference (4).*

An experimental check of the procedure proposed in manual way can be seen here with the following short text copied from the reference (3), screenshot from the prototype itself:
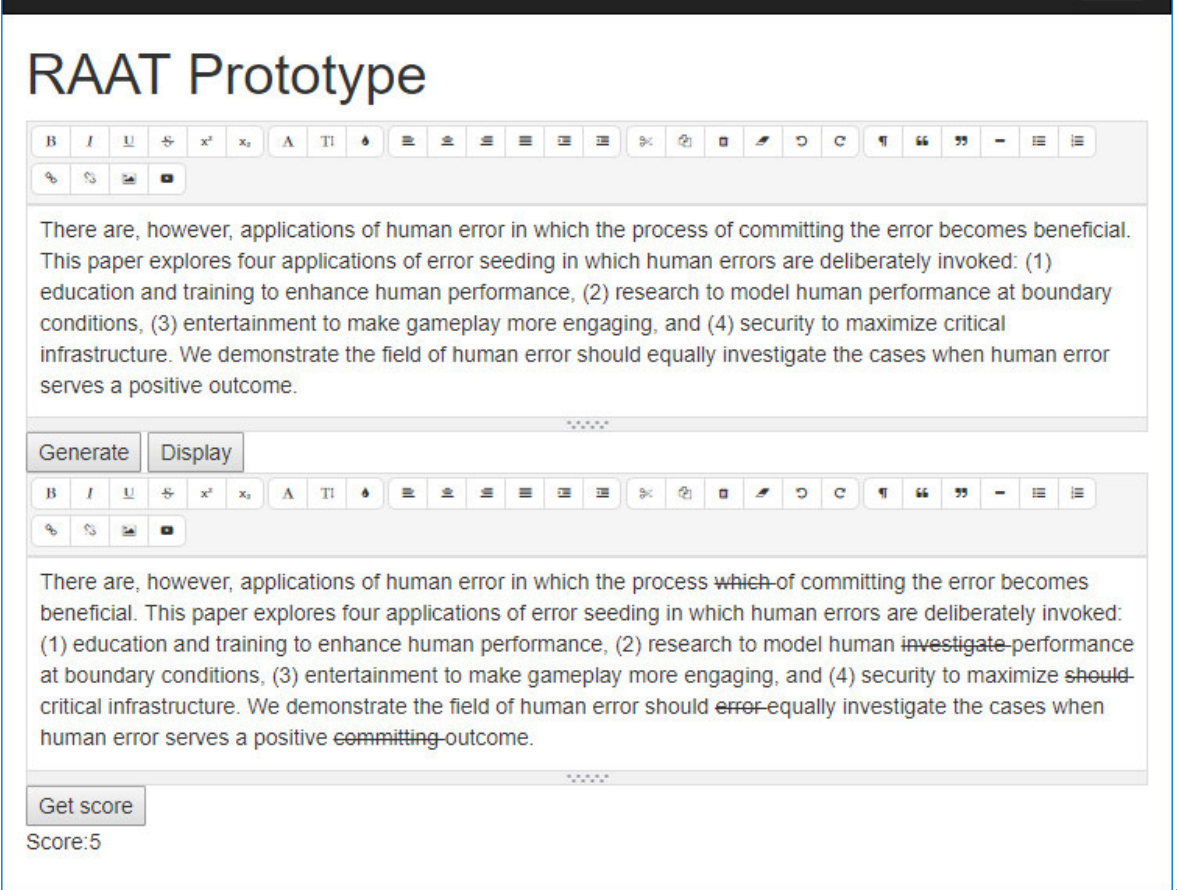

Figure 2: RAAT prototype user interface

Everyone can do the experiment by him/herself: read the text generated with mutations (seeded errors) and find / highlight them. Be aware that in practice the reader doesn't have

original text disclosed, so in time defined he/she should find >90% of errors seeded to reach ""Score: 5" as the level of reading attention.

Fourth discussion point are the resources needed for productive implementation in organization. RAAT should be incorporated in exiting DMS (Document Management System) or other system for texts distribution. In that case the invoking of RAAT for specific text doesn't yield more work than one click. Analysis of reading success with due attention happens also automatically for authorized users.

Fifth discussion point is the most important one: the reach of interested users of the solution proposed. The use of this solution is global for healthcare and educational organizations as "text owners". This solution is used in relations of these organizations with their customers (patients, students, managers). It can be applied over the Internet using the web application aimed to perform the assessment of the level of reading attention. The attention itself is necessary, but not sufficient also sufficient indicator for text understanding, or "meaningful reading", which has to be clearly stated in some "marketing" communications. It is to be mentioned that this solution is language neutral, i.e. text written or spoken in every language can be processed without translation. In this respect, the usage of this solution finds outmost broad "customer base" in global reach.

Conclusion

Inattentive reading can be considered as a general problem in almost all human intellectual activities, personal and professional. Nowadays is this problem addressed with complex, unreliable and time consuming manual procedures, such as quizzes after reading. Feasible solution to this problem is suggested method of beneficial error seeding applied to assessment of reading attention level measurement. Substantial concern has to be paid on possible side-effects of pertinent tool, such as distracting the reader with excessive number of intentional errors seeded or real method efficiency – correlation between RALS and understanding/memorizing..

Tool developed based on this method is web-application for both desktop and mobile usage. It is applicable to global distribution due to the fact that the method is language unspecific.

Technical solution that ensures full process automation seems feasible with reasonable resource usage. Prototype mentioned in the text demonstrates the technological feasibility of the method. Experiment with this prototype performed on number of examinees and yield positive outcome. In addition, innovation level estimation was performed, showing positive outcome in all five innovation components: novelty, attractivity, feasibility, cost and compliance.

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Sažetak

Procjena pažnje pri čitanju uporabom alata RAAT – primjena u sustavu zdravstva

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RAAT - alat za procjenu pažnje kod čitanja - primjenjuje metodu "korisnog sijanja pogrešaka" (3) za procjenu razine pažnje prilikom čitanja. Alat je web-aplikacija u koju se originalni tekst unese, dodaje, povezuje ili prenosi, a zatim automatski mutira sa slučajnim dodavanjem pogrešno postavljenih riječi. Ovaj mutirani tekst šalje se ispitanicima (pacijentima, liječnicima, medicinskim sestrama) prema unaprijed načinjenom popisu. Ispitanici čitaju takav mutirani tekst pomoću web aplikacije pri čemu ih se potiče da označe takve zasebne pogreške (doubleclicked). Nakon završetka ovog postupka, web-aplikacija uspoređuje označene pogreške i one mutirane s ciljem da ih prijavi "vlasniku teksta" kao i samom ispitaniku.

Web aplikacija se kontrolira parametrima koje definiraju "vlasnici teksta": broj generiranih pogrešaka, karakter i položaj korištenih riječi, vrijeme dopušteno za završetak čitanja, razina praga uspjeha, distribucijske liste, zadane poruke i sl. "Vlasnik teksta" može biti bilo koja zdravstvena organizacija ili pojedinac koji želi provjeriti u kojoj se mjeri njihovi tekstovi (informirani pristanak, propisi koji su relevantni za pridržavanje propisane terapije, medicinske smjernice, priručnici, znanstveni članci, interni postupnici, uvjeti zdravstvene zaštite, medicinski udžbenici ...) čitaju s dužnom pažnjom.

Ako uzmemo u obzir samo pridržavanje propisane terapije lijekovima, globalni problem je ogroman: 50% pacijenata ne pridržava se recepta, uzrokujući loš ishod, nuspojave, ponovni

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prijam i konačno smrt. Naravno, uzroci nepridržavanja ponašanja su brojni, ali jedan od visoko promatranih je niska razina pažnje pri čitanju uputa i recepata. Istraživanja usmjerena isključivo na utjecaj razine pažnje pri čitanju na nepridržavanje uputa pri uzimanju lijekova nisu nađene u znanstvenim bazama podataka.