The application of computer assisted technologies (CAT) in the rehabilitation of cognitive functions in psychiatric disorders of childhood and adolescence

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Summary

First applications of computer-assisted technologies (CAT) in the rehabilitation of cognitive deficits, including child and adolescent psychiatric disorders date back to the 80's last century. Recent developments in computer technologies, wide access to the Internet and vast expansion of electronic devices resulted in dynamic increase in therapeutic software as well as supporting devices. The aim of computer-assisted technologies is the improvement in the comfort and quality of life as well as the rehabilitation of impaired functions. The goal of the article is the presentation of most common computer-assisted technologies used in the therapy of children and adolescents with cognitive deficits as well as the literature review of their effectiveness including the challenges and limitations in regard to the implementation of such interventions.

Key words: computer-assisted technologies, cognitive functions, child and adolescent psychiatric disorders

Introduction

The presence of cognitive deficits of varied intensity is characteristic of psychiatric disorders of childhood and adolescence such as autism spectrum disorders, mental retardation, disorders of attention, learning disorders but also CNS damage related conditions.

Rapid development of computer technologies and wide access to electronic devices resulted in intensification of interdisciplinary research on methods of rehabilitation of

cognitive deficits observed in neurodevelopmental disorders. The increase in research also stems from wider access to individualized psychotherapeutic interventions.

The models of interventions and related therapies are aimed at the rehabilitation of cognitive functions such as: memory, thinking, attention, concept formation, problem solving skills, inference skills and reactions to emotional stimuli.

One of the most important CAT-based domains of intervention is communication. Mikołajewska and Mikołajewski [1] list potential benefits of communication devices addressed for people with disabilities, seriously ill and aged, dividing them in three groups: health, social and economic.

Cognitive rehabilitation includes many approaches which define both type and underlying assumptions behind specific intervention. Assistive technologies in the form of supportive devices aimed at the improvement of quality of life within the existing deficit are one the most important types of intervention (communication devices or devices which improve computer accessibility such as alternative keyboards) [2].

The separate category of CAT includes applications and devices used as a part of therapeutic process in the rehabilitation of cognitive deficits of different etiology.

Aim

The goal of this article is the presentation of possibilities and scopes of computer-assisted technologies in the rehabilitation of cognitive deficits observed in psychiatric disorders of childhood and adolescence. The article also describes Polish contribution to the development of computer-assisted technologies in cognitive disorders.

Support and cognitive rehabilitation in executive functions, memory and attention disorders

Computer-assisted technologies are used in memory disorders, especially in the rehabilitation of executive functions and mixed memory disorders related to the integration of executive functions e.g. working memory disorders. Executive functions are defined as cognitive processes engaged in the intentional control of thoughts and actions which serve effective adaptation to ever changing environmental conditions. The tasks are realized as a result of basic cognitive skills integration such as planning, sequencing, prioritizing, tasks switch, auto-observation, problem solving, activity initiation, but also prospective memory defined as the ability of memorizing things still to be done. In a wider understanding, memory processes include attention, including attentional control. Deficits of memory, executive functions and attention are observed in many child and adolescent psychiatric disorders, including attention

deficit/hyperactivity disorder (ADHD), autism spectrum disorders (ASD), learning disabilities and acquired or congenital CNS injuries [3, 4].

Working memory deficit is characteristic of the majority of neurodevelopmental disorders. Working memory is defined as cognitive function which allows the storage of information for the time needed to process this information, whilst simple storage of information within visual or auditory modality is defined as short-term memory or attention capacity. In Baddeley's multimodal model of working memory [5] the capacity of attention is an integral part of working memory separated from central executive. The results of meta-analysis on working memory in ADHD have confirmed the presence of deficits in this domain [6].

The available supportive technologies developed for patients with deficits of memory and attention serve more as a prosthetics rather than rehabilitation devices and software. An enormous number of time management software such as planners, organizers or calendars is available on the internet. Localization software is available for patients with massive memory disorders which can identify the location of a person and give instructions about actions (e.g. bathroom – wash your hands). An interesting offer for patients with ADHD is WatchMinder® – a supportive and training device in the form of wristwatch which, among many other functions, helps concentrate during pre-defined time intervals by vibrating and reminding about the need to concentrate.

Some studies suggest the possibility of working memory training with designed software. One of the most popular working memory training software is Cogmed Robo-Memo® [7]. The online application consists of 25 sessions, 30 to 45 minutes each and is made up of 13 customized mini-games. The tasks include letter and number reversal and visual-spatial tasks (e.g. dynamic tasks where the user has to identify the primary location of a rotating object) presented within auditory and visual modality. The application is supported by motivational system through access to attractive computer game. The results of studies on the efficacy of the training have revealed its limited impact on core symptoms of ADHD. On the other hand, an improvement was observed in psychomotor speed as well as reading and counting skills [8]. Polish software is also available for the rehabilitation and support of individuals with ADHD (Cognitomniac series – ADHD module) [9]

The use of computer-assisted technologies in autism spectrum disorders

Computer-assisted technologies create great therapeutic opportunities in autism spectrum disorders, due to the specificity of cognitive deficits (theory of mind deficit). A continual and greatest increase in the number of software applications, reflected in the number of scientific publications is noted in this domain. Between last century

seventies and eighties the number of publications ranged from 3 to 10 a year, with 30–40 studies a year published from 2005 [10].

Computer-assisted technologies used in therapy and support of autism spectrum disorders are applied both on commercial and scientific level. Lewandowska et al. [11] list the following categories of applications: communication, social skills and emotional intelligence trainings and applications developing specific skills: mathematical, linguistic and motor skills. As an example authors give www.iautism.info website which includes about 600 supportive applications, out of which only 8 were available in Polish.

Many authors list potential benefits of computer-assisted technologies for patients with ASD, which include: well defined structure, clear formulation of expectations, predictability of action schemas, minimization of distracters and control over associated problems such as overselectivity [12]. Another argument for the use of CAT is the possibility of immediate reinforcement delivery and withdrawal, the collection of data on trainee's reactions and usefulness in school environment. The main focus of studies on the application of computer-assisted technologies in ASD is on face processing skills, understanding of emotions, theory of mind, and rehabilitation of social skills.

In a very interesting article about the application of robots in neurological rehabilitation Mikołajewska and Mikołajewski [13] have described the possibilities of utilization of robots in the therapy of ASD. The authors have quoted the results of studies confirming that robots can make a good source of social behavior stimulation in ASD and have listed existing therapy supporting machines (e.g. KeepOn and RoboPanda). The authors have stated that therapeutic robots may be an important complement of other forms of therapy.

Rehabilitation of face processing skills, understanding of emotions
and theory of mind

Faces form homogenous class of visual stimuli (similar structure: identical group of elements within the same configuration). Holistic perception and decoding process observed in healthy individuals allows reliable face recognition from the group of faces, despite obvious similarities. Individuals with ASD process faces by concentrating on concrete details with no holistic processing of configuration of details (e.g. relationships and connections between elements of faces). The deficit does not imply the total lack of face recognitions and can be observed in more challenging tasks which require identification of emotional meaning to particular elements. Joseph and Tanaka [14] observed that holistic processing in ASD takes place if the critical emotional information is localized around mouth area. Similar results were observed by Hopkins and Basani [15] in a study on children with ASD. What is more, both authors pointed

out to significant problems with face recognition based on photographs of eyes. Face processing deficits are linked to emotion recognition problems [16] which, according to many authors are a reflection of a broader information processing deficit or deficit of identification of relationships, characteristic for ASD [17]. Emotion recognition deficits (own and others') are pronounced if an emotion requires mentalization skills (ability to identify whether someone is for example sarcastic, jealous or confused). It is acknowledged that face processing and emotion identification deficits are a basis of social problems in ASD thus computer-assisted technologies mainly address these deficit domains.

Let's Face It (LFI!) is an interactive application designed for the rehabilitation of face processing deficits (mainly omission of eye gaze in the process of information processing), identification of identity [18, 19] as well as deficits of holistic processing [14, 20]. The domains trained by the application include recognition of faces as source of information, identification of facial expression/identity, identification of face in social context. On the other hand, Mind Reading: The Interactive Guide to Emotions™ [21] is software designed for rehabilitation of understanding of emotions. The software uses the library of 400 emotions (presented in the form of photos or short films), training segment (in the form of quiz games which teach how to match face expressions and tone of voice with different emotions) and interactive games (which require skills such as guessing and matching emotions). The results of research on child population are promising and have shown improvement in identification of complex emotional based faces and tone of voice as well as generalization of acquired skills [22]. Another application designed to improve emotion recognition based on faces and evoked by specific situations as well as identification of mental states is Emotion Trainer [12]. Silver and Oakes [12], in their study with a control group, observed that children with ASD trained with the software had shown improvement in the recognition of emotional states. Moore et al. [23] developed rehabilitation software in the form of three dimensional human-like avatar which simulated participation in real life experiences and acting out four different emotions: sadness, anger, happiness and fear. Training participants had to identify emotions presented, attempt to predict them in various situations but also identify situations which could evoke a given emotion. According to the authors, the improvement observed in children with ASD was mainly due to interactive virtual environment.

Attempts are made to develop a tool addressing theory of mind skills. One of the first computer programs to help stimulate theory of mind was developed by Swettenham [24]. The software is based on false beliefs scenarios. The effectiveness of the intervention has not been proved. Charlop-Christy and Daneshvar [25] used video modeling to teach "taking somebody else's perspective" as an important component

of the ToM. Children participants were trained by watching videos presenting familiar adults who modeled appropriate behavior which took into account the perspective of other person and explained cues which helped them understand the perspective. The method significantly improved ASD children skills in the trained domain.

Social skills development

Social skills and non verbal aspects of communication deficits are observed in all individuals with ASD although their intensity may vary. Most often observed problems include inadequate eye contact, inadequate reaction to and identification of needs of others and inadequate responses to verbal and non-verbal interactions. Therapeutic interventions, including computer aided technologies may directly address the deficits although they mainly reflect ToM problems. Two technological domains are applied in the therapy of social skills in individuals with ASD: virtual reality and video modeling.

Virtual reality defined as three dimensional simulation of real or imaginary world allows the user to interact with others with the use of avatar (computer representation of the self). Churchill and Snowdon [26] have listed five elements of virtual environment which make it potentially useful in the therapy of individuals with ADS: shared context, the awareness of the existence of others, the need to negotiate and maintain communication and access to different "points of view". In practice the technology allows participation in everyday situations (such as going shopping or spending breaks in school) and multiple practice of social skills in realistic "here and now" format [27]. What is more, training can be organized in safe and controlled conditions which eliminate stressors which may influence learning process and help to avoid negative outcomes resulting from failure [28]. The method also helps to develop the theory of mind by allowing emotional expression and enforcing interpretation of emotions of interlocutors. The effectiveness of interventions based on virtual technology in ASD has been confirmed, for example in the therapy of social problems solving skills [29] or play interactions [30].

The main goal of video modeling-based interventions is to increase the intensity and diversity of social behaviors. Taking into account communication limitations of some patients with ASD visuo-non verbal models of intervention are often used. The majority of studies on video modeling interventions have revealed positive outcomes in learning new and key social skills. Charlop-Christy et al. [31] showed improvement in emotion expression, spontaneous greeting, conversation skills, cooperation-based play maintenance and everyday life skills. Nikopoulos and Keenan [32] described positive outcomes in the initiation of social interactions, decrease of self isolation and associated increase in time spent on shared play. The study made by Sansosti and

Powell-Smith [33] has shown the effects of newly acquired skills which included toy sharing, greetings and joining play in two week follow up.

The Polish application Mówik [34] with speech synthesis based on the Polish system Ivona for individuals with speech disorders of varied etiology, including autism spectrum disorders, is commercially available. The producer also delivers software for individuals with severe speech disorders – Gadaczek [35] which enables text message recording which, depending of version, can be accompanied by Mówik system symbols.

A nonprofit website developed by an IT engineer – a father of an autistic boy contains a large number of applications aimed at the stimulation of expressive and receptive speech skills, arithmetic, geometry and clock reading [36]. Cognitomniac series [37] also offers stimulation software for children with austim (Cognitomniac series – Autism module).

"Autilius – unearthly support of therapy" is a computer system for the therapy of ASD children which helps develop social attention, imitation, cognitive and social skills and other domains. The project is currently being developed in cooperation with the Department of Psychology of University of Warsaw. The project is financed by The National Centre for Research and Development [38].

The limitations of computer-assisted technologies in ASD

According to some authors the application of computer-assisted technologies may increase problems characteristic for ASD [39]. The limitation of interactions with therapeutic and educational environments may lead to even greater social isolation. The "rigidity" observed in some patient with ASD may be reinforced or increased as well as the number of challenging behaviors related to denial of computer access or obsessive compulsive behaviors. A very important question related to the application of both computer-assisted technologies and traditional approaches is generalization of skills acquired by individuals with ASD onto other environments (the improvement is observed and only limited to concrete task activity)

The application of computer-assisted technologies in learning disorders

Visuo-spatial, auditory, language and sensory deficits are characteristic of learning disorders and supported by computer aided therapies. In several studies on patients with dyslexia speech identification and dynamic modification of text software was used (e.g. SeeWord®) [40]. In particular, the software addressed difficulties with visual decoding of letters, numbers, punctuation marks or complete words which contained similar shape letters. Supporting software (e.g. Inspiration®) which helps to create

concept maps of a written text (defined as the categorization of information in visual mode) and present written text through auditory modality is also available.

Polish software market offers a wide range of therapeutic software and supporting devices for children with learning disabilities, speech disorders as well as hearing and communication problem (applications: Logopedia 2.0 [41], MatŚwiat, Dysleksja [42], Cognitomniac series – learning disabilities module [43], Eduterapeutica therapeutic software [44]).

The application of computer-assisted technologies in mental retardation

Individuals with mental retardation form a highly heterogeneous group due to etiological complexity and unique clinical presentations. The choice of computer-assisted technologies should remain in close relationship with diagnosed cognitive and communication deficits. The computer-assisted technologies have been developed within early intervention, stimulation of cognitive functions (e.g. Abrakadabra – an application stimulating cause and effect reasoning) as well as stimulation of more complex skills such as reading or writing.

Communication deficits are addressed by VOCA (voice output communication aids) speaking devices (e.g. QuicTalker communicator) [45] and other augmentative and communication technologies (e.g. application Mówik) [34].

Computer-assisted technologies are also used in optimization of activities of daily living (ADL) and increase of independence (e.g. BJ TOYBOX device which enables control over many toys or other devices or Comfy keyboard for easier computer use [46]).

In terms of supporting children with mental retardation software there is available software to support early childhood development. One of the most powerful Polish application is Wczesne Wspomaganie Rozwoju – Z Tosią przez Cztery Pory Roku (Early Development Support – Four Seasons with Tosia) and Tosia i Przyjaciele (Tosia and Friends) [47]. The application, complemented by the application of the therapist, is designed for the early treatment of cognitive, perceptual and motor functions disorders, multi-sensory stimulation and comprehensive child development support.

Recapitulation

The application of computer-assisted technologies in the rehabilitation of cognitive deficits observed in neurodevelopmental disorders is a very promising supplement of traditional therapies due to high customizability and universality. It seems that technology-based intervention may take lead in the therapy of ASD in the future. A lot of studies have confirmed the effectiveness of technology-based interventions

in neurodevelopmental disorders. Unfortunately, the lack of strictly defined control conditions and comparisons with evidence-based treatments is a serious limitation of most of the studies.

References

1. Mikołajewska E, Mikołajewski D. *Komunikacja dla osób niepełnosprawnych w środowiskach nowych mediów*. Lingua ac Communitas 2012; 22: 89–112 .

2. Pilch A. *Technologia wspomagająca – wprowadzenie do bloku tematycznego*. Bulletin of the Association "Mówić bez Słów" 2007; 1(14): 2–3.

3. Gross H, Kling A, Henry G, Herndon C, Lavretsky H. *Local cerebral glucose metabolism in patients with long-term behavioral and cognitive deficits following mild traumatic brain injury*. J. Neuropsychiatry Clin. Neurosci. 1996; 8: 324–334.

4. Chappell PB, Riddle MA, Scahill L, Lynch KA, Schultz R, Arnsten A. et al. *Guanfacine treatment of comorbid attention-deficit hyperactivity disorder and Tourette's syndrome: preliminary clinical experience*. J. Am. Acad. Child. Adolesc. Psychiatry 1995; 34: 1140–1146.

5. Baddeley A. *Working memory*. Curr. Biol. 2010; 20: 136–140.

6. Rogers, M, Hwang H, Toplak M, Weiss M, Tannock R. *Inattention, working memory, and academic achievement in adolescents referred for attention deficit/hyperactivity disorder (ADHD)*. Child Neuropsychol. 2011; 17: 444–458.

7. Cogmed RoboMemo. Pearson Education. Upper Saddle River, NJ.

8. Zach S, Kenny LH, Randall WE. *Cogmed working memory training: Does the evidence support the claims?* J. App. Res. Mem. Cogn. 2012; 1: 185–193.

9. http://www.harpo.com.pl/index.php?prtlid=1098&kat_id=175&art_id=840 [retrieved: 20.08. 2015].

10. Ploog BO, Scharf A, Nelson DS, Brooks PJ. *Use of Computer-Assisted Technologies (CAT) to enhance social, communicative and language development in children with Autism Spectrum disorder*. J. Autism Dev. Disord. 2013; 43: 301–322.

11. Lewandowska A, Kołakowska A, Anzulewicz A, Jarmołkowicz E, Rewera J. *E-technologie w edukacji i terapii dzieci z autyzmem w Polsce*. EduAkcja Magazyn edukacji elektronicznej 2014; 2(8): 42–48.

12. Silver M, Oakes P. *Evaluation of a new computer intervention to teach people with autism or Asperger Syndrome to recognize and predict emotions in others*. Autism 2001; 5: 299–316.

13. Mikołajewska E, Mikołajewski D. *Roboty terapeutyczne w rehabilitacji neurologicznej dzieci*. Neurol. Dziec. 2012; 42(21); 59–64.

14. Joseph RM, Tanaka J. *Holistic and part-based face recognition in children with autism*. J. Child Psychol. Psychiatry 2003; 44: 529–542.

15. Hopkins KB, Basani L. *Children with fragile X syndrome and children with autism show distinct impairments in emotional understanding*. New York: American psychological society conference; 2005.

16. Bölte S, Hubl D, Feineis-Matthews S, Prvulovic D, Dierks T, Poustka F. *Facial affect recognition training in autism: can we animate the fusiform gyrus?* Behav. Neurosci. 2006; 120: 211–216.

17. Humphreys K, Minshew N, Leonard GL, Behrmann M. *A fine-grained analysis of facial expression processing in high-functioning adults with autism*. Neuropsychologia 2007; 45: 685–695.

18. Rutherford MD, Clements KA, Sekuler AB. *Differences in discrimination of eye and mouth displacement in autism spectrum disorders*. Vision Res. 2007; 47: 2099–2110.

19. Wolf JM, Tanaka JW, Klaiman C, Cockburn J, Herlihy L, Brown C. et al. *Specific impairment of face-processing abilities in children with autism spectrum disorder using the Let's Face It! skills battery*. Autism Res. 2008; 1: 329–340.

20. Gauthier I, Klaiman C, Schultz RT. *Face composite effects reveal abnormal face processing in Autism spectrum disorders*. Vision Res. 2009; 49: 470–478.

21. Golan O, Baron-Cohen S. *Systemizing empathy: teaching adults with Asperger syndrome or high-functioning autism to recognize complex emotions using interactive multimedia*. Dev. Psychopathol. 2006; 18: 591–617.

22. Golan O, Baron-Cohen S, Hill JJ, Rutherford MD. *The 'reading the mind in the voice'-test-revised: A study of compex emotion recognition in adults with and without autism spectrum conditions*. J. Autism Dev. Disord. 2007; 37: 1096–1106.

23. Moore D, Cheng Y, McGrath P, Powell NJ. *Collaborative virtual environment technology for people with autism*. Focus Autism Other Dev. Disabl. 2005; 20: 231–243.

24. Swettenham J. *Can children with autism be taught to understand false belief using computers*. J. Child Psychol. Psychiatry 1996; 37: 157–165.

25. Charlop-Christy MH, Daneshvar S. *Using video modeling to teach perspective talking to children with autism*. J. Posit. Behav. Interv. 2003; 5: 12–21.

26. Churchill EF, Snowdon D, Munro A. *Collaborative virtual environments: Digital places and spaces for interaction*. London, UK: Springer Verlag; 2001.

27. Cobb S, Kerr S, Glover T. *The AS Interactive Project: Developing virtual environments for social skills training in users with Asperger syndrome*. In: Dautenhahn K. ed. *Robotic and virtual interactive systems in autism therapy* (Communications of the Adaptive Systems Research Group, University of Hertfordshire, Report No. 364). Hatfield, UK: University of Hertfordshire; 2001.

28. Beardon, L, Parsons S, Neale H. *An interdisciplinary approach to investigating the use of virtual reality environments for people with Asperger syndrome*. Educ. Child Psychol. 2001; 18: 53–62.

29. Bernard-Opitz V, Sriram N, Nakhoda-Sapuan S. *Enhancing social problems solving in children with autism and normal children through computer-assisted instructions*. J. Autism Dev. Disord. 2001; 31: 377–384.

30. Farr W, Yuill N, Raffle H. *Social benefits of a tangible user interface for children with Autism Spectrum Conditions*. Autism 2010; 14; 237–252.

31. Charlop-Christy MH, Le L, Freeman KA. *A comparison of video modeling with in vivo modeling for teaching children with autism*. J. Autism Dev. Disord. 2000; 30: 537–552.

32. Nikopoulos CK, Keenan M. *Using video modeling to teach complex social sequences to children with autism*. J. Autism Dev. Disord. 2007; 37: 678–693.

33. Sansosti FJ, Powell-Smith KA. *Using computer-presented social stories and video models to increase the social communication skills of children with high-functioning autism spectrum disorders*. J. Posit. Behav. Interv. 2008; 10: 162–178.

34. Markuc E. *Wspomaganie niezależności komunikacyjnej dziecka niemówiącego w rodzinie za pomocą programu MÓWik*. Annales Universitatis Paedagogicae Cracoviensis, Studia Pedagogica III. Krakow; Pedagogical University Press, 2014; 119-127.

35. www.gadaczek.pl [retrieved: 20.08.2015].

36. www.autyzmsoft.pl [retrieved: 20.08.2015].

37. http://www.harpo.com.pl/index.php?prtlid=1098&kat_id=175&art_id=839 [retrieved: 20.08.2015].

38. www.ncbir.pl/gfx/ncbir/pl/defaultaktualnosci/640/2977/1/lista_projektow_dofinansowanych_w _ii_konkursie_innotech_sciezka_hi-tech.pdf [retrieved: 29.03.2016].

39. Bernard-Opitz V, Ross K, Tuttas ML. *Computer assisted instruction for autistic children*. Ann. Acad. Med. Singapore. 1990; 19: 611–616.

40. Gregor P, Dickinson A, Macaffer A, Andreasen P. *SeeWord-a personal word processing environment for dyslexic computer users*. Br. J. Educ. Technol. 2003; 34: 341–355.

41. Walencik-Topiłko A, Draczyńska L, Godlewska K, Elmanowska J, Szady K, Zielińska M. *Logopedia. Multimedialne oprogramowanie do diagnozy i terapii logopedycznej z wyposażeniem pomocniczym. Poradnik metodyczny*. Gdynia: Wydawnictwo Young Digital Planet SA; 2011.

42. Domaradzka-Grochowalska Z, Zielińska M. *Ryzyko dysleksji, dysleksja, wady wymowy a współczesne możliwości technologiczne*. In: Brejnak W, Wolnicz-Pawłowska E. ed. *Logopedia a specjalne potrzeby edukacyjne w obliczu reformy szkolnej*. Vol. 2. Warsaw: Cardinal Stefan Wyszyński University; 2011. p. 34–41.

43. http://www.harpo.com.pl/index.php?prtlid=1098&kat_id=175&art_id=841 [retrieved: 25.08.2015].

44. Kopiela-Koperek A. *Logopedia z komputerem, skuteczny duet w diagnozie i terapii wad wymowy u najmłodszych dzieci*. Bliżej przedszkola 2014; (114): 94.

45. http://www.harpo.com.pl/index.php?prtlid=1098&art_id=852 [retrieved: 25.08.2015].

46. http://www.harpo.com.pl/index.php?prtlid=1098&art_id=527 [retrieved: 25.08.2015].

47. Szady K. *Wykorzystanie autorskich programów multimedialnych w terapii logopedycznej dzieci niepełnosprawnych*. In: Milewski S, Kaczorowska-Bray K. ed. *Logopedia. Wybrane aspekty teorii i praktyki*. Gdańsk: Wydawnictwo Harmonia; 2012. p. 403–406.

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