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Computer-based Cognitive and Socio-emotional Training in Psychopathology

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1. Introduction

Recent years have witnessed a growing interest of psychopathology for therapeutic uses of Information and Communication Technologies (ICT). Researchers and clinicians are carrying out interdisciplinary projects and empirical investigations of computer-based treatments dedicated to the rehabilitation of psychiatric patients. Some projects gave rise to practical implementations in clinical settings, a quite publicized example being the use of virtual reality for treating various forms of phobias and anxiety disorders. Companies specialized in developing software intended for psychotherapy are starting to emerge. Academic networks are being formed to exchange ideas and results, with international conferences organized regularly for the purpose of bringing together researchers from various disciplines including computer sciences, psychology and psychiatry. Examples of the multiple aspects of this new and dynamic field of research will be provided throughout the present chapter.

Literature mentions several potential advantages of computers for clinical interventions in psychopathology. Patients seem to adhere to treatments based on computer usage: computers are thought to be stimulating and entertaining (Field et al., 1997; Medalia, 2001). In the same time, they are non-judgmental in case of failure (Bellucci et al., 2002) and their virtual environment is free from danger (Moore et al., 2005). The user has total control over the computer and can repeat any action as many times as she or he wishes (Field et al., 1997; Panyan, 1984). Moreover, the computer offers rich multisensorial stimuli (Bosseler & Massaro, 2003; Medalia, 2001; Panyan, 1984) with precise and immediate feedback (Bellucci et al., 2002; Bosseler & Massaro, 2003; Burda et al., 1994). Computers are considered adequate for implementing treatment procedures as they provide structured and standardized tasks (Bellucci et al., 2002), while enabling the tasks to be personalized (Medalia et al., 2001). Automatic online recording of the patient's performances is also seen as an advantage (Field et al., 1997; Panyan, 1984). Moreover, literature emphasizes the economical advantages of computers. There usage appears to be cost effective in terms of reducing therapist time (Burda et al., 1994). However, authors also suspect problems could arise from computer-based treatments, such as difficulties to generalize learning acquired on the computer to everyday life (Bernard-Opitz et al., 2001).

This chapter intends to illustrate the interdisciplinary approaches of computer-based treatments for psychiatric rehabilitation. It starts with a brief overview of issues regarding treatment in psychopathology and distinguishes three paradigms guiding computer-based approaches: compensation, desensitization and training. The present chapter is especially devoted to computer-based treatments that adhere to the training paradigm. It then reviews the literature on computer-based cognitive and socio-emotional training in psychopathology. The literature survey is illustrated by two specific categories of psychopathological disorders: schizophrenia and autism. Computer-assisted cognitive remediation is described for schizophrenia where it has been evaluated by a number of studies. Socio-emotional training examples are presented for autism, where an emerging body of literature addresses computerized training of social interactions and emotional processing. Following the literature review, the chapter describes a longitudinal pilot study that investigated both cognitive and socio-emotional computer-based training in the case of autism. The interconnections between cognitive remediation and socio-emotional training are discussed in the light of this exploratory investigation and relevant literature. Finally, the chapter concludes with future research directions.

2. Treatment issues in psychopathology

2.1 From symptoms to social dysfunction

Computer-based treatments target a wide range of deficiencies, from neurocognitive functioning to social and emotional regulation. As described by Craig (2006), psychopathological disorders imply difficulties permeating the whole life of the individual. Symptoms may be regarded as the basic impairments, as they form the core features of the disorder. Functional disabilities occur in the process of performing everyday tasks for which individuals experience difficulties as a consequence of their symptoms. For instance, shopping or cooking can be a challenging activity for people with memory losses or poor concentration. Commuting by public transportation can be very stressful for a person having agoraphobia. Symptoms and disabilities most often result in a serious handicap, exposing the concerned individual to social stigma and impeding social and professional integration. Professional outcomes seem to be especially compromised and the trend appears to be worsening. For example, Craig (2006) indicates that the employment rates for people with severe psychiatric illnesses in the UK are lower now than they use to be fifty years ago. There may be various explanations for this state of fact. Current jobs are more demanding in terms of cognitive performances, while opportunities for low skilled manufacturing jobs are decreasing. The wide use of computers in modern economy may be a drawback for some impaired individuals as it requires high level cognitive skills and rapid adaptation. Another important reason may derive from the medication side-effects, for instance sedation. Obviously, the various aspects of psychiatric disorders that were just described are closely intertwined: symptoms and cognitive impairments are determinant factors influencing functional disabilities and social incapacities, reversely social exclusion can have devastating effects on mood and self-esteem, eventually leading to depression or anxiety that worsen the symptomatic profile. Potential targets for computer-based approaches are thus threefold. Firstly, they may address the basic impairments including symptoms and cognitive deficiencies. Secondly, they can be used for helping the individual in everyday tasks, thus decreasing disabilities. Thirdly, they can assist in overcoming social

and professional obstacles. Research projects usually aim mainly at one of these three targets, while acknowledging the possible influence on the other two.
Computer-based interventions in psychopathology depend on the critical issue of adapting the features of computer technology to the specificities of psychopathological disorders. The fact that psychopathological disorders are permeating every aspect of the individual's life without being easily associated with a specific functional capacity makes it all the more complex to define suitable technology. This contrasts with many physical disabilities, as for example lower limbs palsy that hinders locomotion but leaves rather unaltered the skills necessary for deskwork. In the latter case, the functional incapacity appears to be more clearly defined and can therefore be more readily addressed by technology with various types of high-tech wheelchairs for instance. As for psychopathological disorders, researchers experience difficulties in circumventing the functional implications and the treatment needs to cover altogether symptoms and cognitive alterations, functional disabilities and social withdrawal. Another limiting factor that complicates the work of defining suitable technology is the lack of knowledge about the etiology of various psychopathological disorders. Reviews on autism (Happé & Frith, 1996) and on schizophrenia (Walker et al., 2004) reveal that the causes of these disorders have still not been fully uncovered by research. The contemporary perspective in many psychiatric disorders assumes that a single syndrome may encompass different subgroups with various possible etiologies. Hence, specialists tend to consider psychiatric disorders as spectrums rather than as uniform entities. Multiple explanatory theories for the same syndrome coexist and frequently compete. Their predictions about the impact of various therapeutic approaches can be contradictory, thus complicating the task of researchers trying to design appropriate computer-based interventions. Adapting computer technology for treatment of psychiatric disorders is an adventurous endeavor requiring thorough interdisciplinary understanding of both psychopathology and computer sciences.

2.2 Paradigms of computer uses

Current computer-based treatments in psychopathology seem to follow mainly three paradigms: compensation of disabilities, desensitization to anxiety or addictive craving and training of cognitive, social and emotional functioning. The compensation approach seeks to alleviate the disabilities provoked by the symptoms and cognitive deficiencies through the use of assistive technological devices. In a review of the matter, LoPresti and colleagues (2004) underline the analogy with prostheses in physical or sensorial handicaps. Compensation proceeds by providing a device designed to assist the individual in performing cognitive tasks for which she or he encounters difficulties. Examples may be found in neurology. For instance, Wilson and colleagues (2001) developed a paging system that was tested with 143 patients having neurological disorders. The paging system would compensate for memory losses by sending reminders at the right date and time about tasks that had to be carried out. Results of a randomized control trial showed a substantial increase in task completion due to the pager system. The desensitization paradigm is used extensively for phobias, anxiety disorders and addiction. Desensitization relies on the classic biological principle of habituation, according to which the neural response to a stimulus is attenuated by repeated exposure to this stimulus (Castellucci et al., 1978). In psychotherapy, desensitization to an anxiety provoking stimulus or an addictive craving is achieved by gradual exposure of patients to the critical stimulus. Virtual reality appears especially appropriate for this therapeutic paradigm as it enables exposure to fake stimuli that are realistic enough for habituation to occur. Virtual reality's role in clinical practice is rapidly expanding. For instance, virtual reality therapies are used for treating victims of terrorist attacks having post stress disorders (Difede et al., 2002; Josman et al., 2006). Some companies have specialized in virtual reality development for psychopathology, as for instance „Virtually Better©" (www.virtuallybetter.com) that design virtual environments intended for exposure to addictive craving. Lastly, the cognitive and socio-emotional training paradigm refers to teaching methods based on the active participation of the patient and repeated practice of specific tasks. The rest of the present chapter is devoted to describing in more details the computer-based approaches that adhere to this paradigm. The following sections start by presenting training programs focusing on basic cognitive functions, also known as cognitive remediation. Programs intended for social and emotional enhancement are described latter on.

3. Computer Assisted Cognitive Remediation (CACR)

3.1 Rationale

Cognitive remediation refers to teaching methods aiming at helping patients acquire or regain basic cognitive abilities. These techniques were initially devised for patients with neurological disabilities such as cerebral palsy or stroke. For the last two decades, they have been progressively introduced in psychiatric settings as well. These teaching methods target fundamental cognitive skills such as attention, memory and executive functions. The term "executive functions" traditionally refers to a set of cognitive functions that encompasses planning, working memory, impulse control, inhibition, shifting set as well as the initiation and monitoring of action (Hill, 2004). During cognitive remediation therapy, patients are required to complete sets of cognitive tasks. Attention remediation typically involves exercising vigilance and the ability to select among multiple stimuli. Tasks targeting memory can for example train the ability to remember lists of items over a short period of time. Remediation of executive functions often employs problem-solving tasks such as the Towers of Hanoi (Bracy, 1981). Cognitive remediation approaches often include individual coaching by a therapist. The role of the therapist can vary from merely encouraging the patient (Bellucci et al., 2002) to guiding the patient through efficient use of relevant cognitive strategies (Medalia et al., 2001). As often in psychopathology, there are various models for applying cognitive remediation. Models vary depending on the theoretical background that supports their psychological validity. The reader may consult (Wykes & van der Gaag, 2001) for a review on the different theories employed in cognitive remediation. Computer-based approaches are especially convenient for training models relying on repeated practice of standardized tasks. These approaches are based on the premise that intense and regular training on tasks involving deficient cognitive functions can help in improving these functions although they are altered. Two theoretical arguments support this view. Firstly, literature states that computer exercises hold opportunities for learning novel strategies that enable bypassing impaired abilities (Kurtz et al., 2007). Secondly, repeated practice in a multimedia environment is believed to hasten cortical reorganization (Butti et al., 1998).

Neurobiological research supports the idea that exercise and stimulation in a rich environment accelerates neural plasticity. Kandel (1998) illustrates neural plasticity with the example of separate maps of the surface of the body contained in the postcentral gyrus of the primary somatic sensory cortex. These cortical maps are dynamic and not static. Their expansion or retraction depends on the particular use of the associated area of the body. Experiments on animals have shown the influence of external stimulation on synaptic plasticity. For instance, Knott and colleagues (2002) investigated the effect of whiskers' stimulation in adult mice and found that after 24 hours of continuous stimulation, the synaptic density in the cortical zone associated with the whiskers had increased by 36%. Similarly to synaptic plasticity, exercise and environmental stimulation appear to favor the increase of neurogenesis, associated with improved memory function (Van Praag et al., 2002). Neurogenesis refers to the generation of new functional neurons in adult animals, which has been especially observed in the hippocampus of the mouse (Van Praag et al., 2002). This corpus of research agrees with the framework for psychiatry introduced by Kandel (1998) according to whom learning mechanisms involving epigenetic regulation of neural processes are the basic principles underlying psychotherapy.

Computer-Assisted Cognitive Remediation (CACR) is supported by neurobiological observations of the positive effect of repeated practice on neural plasticity. However, as emphasized by Wykes and van der Gaag (2001), continued practice on a particular cognitive task may not impact performances on other tasks, even if they rely on the same type of cognitive operations. This CACR model of cognitive remediation could therefore bear the potential drawback that acquired skills would not generalized to untrained tasks.

3.2 The example of schizophrenia

This section focuses on schizophrenia to illustrate computer-assisted cognitive remediation in psychopathology. The prevalence of schizophrenia is estimated at around 1% of the total population (Walker et al., 2004). Schizophrenia is a disorder characterized by at least two of the following symptoms that must be present for at least one month: delusion, hallucination, disorganized speech, grossly disorganized or catatonic behavior and negative symptoms such as affective flattening, alogia, avolition (APA, 1994). Moreover, the diagnosis includes a decline in social and occupational functioning since the onset of illness. Schizophrenia is subdivided into five types: paranoid, disorganized, catatonic, undifferentiated and residual. The paranoid type is characterized by preoccupation with delusions or hallucinations. The disorganized type includes disorganized speech, disorganized behavior and flat or inappropriate affect. In the catatonic type, the following symptoms predominate: motor immobility or excessive motor activity, negativism or mutism, peculiar movements and bizarre posturing, echolalia or echopraxia. The undifferentiated type refers to patients who cannot be classified in any other types. Finally, the residual type is used when positive symptoms (delusion, disorganized speech, disorganized or catatonic behavior) are not prominent anymore, although some attenuated symptoms are still present.

Beside symptoms listed in the diagnosis, schizophrenia is associated with a broad cognitive impairment involving every domain of functioning. Heinrichs and Zakzanis (1998) report that between 61% and 78% of people with schizophrenia exhibit a cognitive deficit. Individuals show a high heterogeneity of cognitive performances with some having mild or no deficit and others being profoundly impaired. A recent consensus (Nuechterlein et al., 2004) has been established for classifying cognitive deficiencies into the following categories: Speed of Processing, Attention/Vigilance, Working Memory, Verbal Learning and Memory, Visual Learning and Memory, Reasoning and Problem Solving, Verbal Comprehension and Social Cognition. Although these cognitive domains may be impaired in individuals with schizophrenia, they are considered liable to improve given an appropriate treatment. The only exception is Verbal Comprehension, which is considered resistant to change.

3.3 Clinical evaluations

As mentioned earlier, a major possible drawback of CACR is suspected to be the lack of generalization of acquired skills on untrained tasks. Hence, the studies presented here have been selected on the basis that they employ assessment tasks that are different from tasks used during training.

Several randomized controlled trials have been conducted to evaluate the effectiveness of CACR in schizophrenia (Bell et al., 2001; Bellucci et al., 2002; Burda et al., 1994; Field et al., 1997; Greig et al., 2007; Hogarty et al., 2004; Kurtz et al., 2007; Medalia et al., 2000; Medalia et al., 2001; Sartory et al., 2005; Vauth et al., 2005). Most have reported improvements of cognitive performances, with some exceptions as for example Field and colleagues (1997) and Medalia and colleagues (2000). Studies report improvements in various cognitive domains such as: speed of processing (Bellucci et al., 2002; Burda et al., 1994; Hogarty et al., 2004; Kurtz et al., 2007; Sartory et al., 2005), attention (Vauth et al., 2005), working memory (Bell et al., 2001; Burda et al., 1994; Hogarty et al., 2004; Kurtz et al., 2007), verbal memory (Bellucci et al., 2002; Burda et al., 1994; Hogarty et al., 2004; Kurtz et al., 2007; Sartory et al., 2005; Vauth et al., 2005), visual memory (Kurtz et al., 2006), reasoning and problem solving (Bell et al., 2001; Hogarty et al., 2004; Kurtz et al., 2007; Medalia et al., 2001) and social cognition (Bell et al., 2001; Hogarty et al., 2004).

Bellucci and colleagues (2002) investigated the effect of CACR on symptoms. Their experiment included 34 adults with schizophrenia randomly assigned to either a CACR group or a wait list control group. The CACR group received biweekly half-hour computer sessions for 8 weeks. They employed "Capitain's Log" software (Sandford & Browne, 1988), which is specialized for cognitive remediation. Results indicated that the CACR group had improved on measures of verbal learning and memory, concentration and executive functions. Moreover, patients receiving CACR demonstrated greater reduction of negative symptoms compared to the control group. The study of Bellucci and colleagues (2002) thus suggests that CACR could have an influence beyond cognitive impairments and impact symptoms as well.

Researchers have also investigated if CACR could combine with other therapies so as to increase positive outcomes. Given that cognitive impairments are limiting factors for occupational functioning and professional integration, the combination of CACR with vocational rehabilitation raises interest. Bell and colleagues (2001) combined Work Therapy (WT), which is based on adapted employments including coaching and counseling, with Neurocognitive Enhancement Therapy (NET), which includes computer-assisted cognitive remediation, social information processing groups and work feedback groups. NET relies on PSSCogRehab software (Bracy, 1981) that was initially design for the rehabilitation of neurological patients. In a randomized controlled trial, 65 patients were assigned either to NET combined with WT or to WT only. The treatment lasted 26 weeks, on the basis of 2 or 3 computer sessions par week. The authors found that the combination of NET with WT showed greater improvements on measures of executive functions and working memory. These results were replicated in a latter study that also investigated NET combined with a vocational therapy (Greig et al., 2007). Following a similar path, Vauth and colleagues (2005) tested the combination of a computer-assisted cognitive training with vocational rehabilitation. They compared this combination with vocational rehabilitation alone in a randomized controlled trial including 138 participants with schizophrenia. The group receiving the combined therapies showed greater improvement on attention and verbal memory. Moreover, this group had a higher rate of successful job placement in a follow-up assessment 12 month after the end of the treatment. The three just mentioned studies suggest that CACR can help to improve vocational outcomes, which seems extremely relevant given the functional disabilities and occupational decline associated with schizophrenia.

The influence of CACR on social cognition is yet less obvious. As described above, trials assessing CACR report positive outcomes concerning cognitive impairments, symptoms and occupational disabilities. Few studies evaluated the possible impact on social abilities. Bell and colleagues (2001) report a progression of affect recognition, but this result was not replicated in a latter study (Greig et al., 2007). Hogarty and colleagues (2004) assessed social competencies in a two years randomized controlled trial including 121 patients. The treatment intervention they were experimenting is called cognitive enhancement therapy and includes CACR combined with social cognitive group exercises. Their results showed improvements on measures of social cognition and social adjustment after two years of treatment. Such improvements were not observable at the end of the first year. Computer-based training programs especially dedicated to social cognition have recently been developed (Silver et al., 2004; Wölwer et al., 2005). They essentially focus on emotion recognition and management. Wölwer and colleagues (2005) evaluated a computerized training program called “Tackling Affect Recognition” (TAR) in a randomized controlled trial involving 77 patients with schizophrenia. They compared this program with a traditional form of CACR. According to their results, remediation of emotional recognition was achievable with the TAR program but not with classical CACR. Silver and colleagues (2004) conducted a pilot study of a brief training intervention using software developed for teaching children with autism about emotions. Participants with schizophrenia improved on measures of emotion recognition. The next section describes computer-based social and emotional training in more details, based on the example of autism.

4. Computer-based socio-emotional training

4.1 The example of autism

Autism is defined as a pervasive developmental disorder (APA, 1994). The diagnosis is determined on the basis of the following triad of criteria: qualitative impairment in social interaction; qualitative impairment in communication; restricted, repetitive and stereotyped patterns of behavior, interests and activities. First signs leading to diagnosis appear before the age of 3 years. Both verbal and non-verbal communications are altered. The disorder strongly affects social interactions. Individuals’ cognitive profiles vary considerably along the autism spectrum, despite the general common impairments defined in the diagnosis. Autism is frequently but not necessarily paired with intellectual retardation (Happé & Frith, 1996). Autism associated with normal or high IQ (Intelligence Quotient) is referred to as high functioning autism. People with high functioning autism may have a well-developed vocabulary but nevertheless have profound difficulties to understand social norms and sustain reciprocal social interactions (Volkmar, 1987).

Nadel and colleagues (2000) conducted an experiment showing that despite profound social disorders, people with autism could develop social expectations from others. Moreover, people with high functioning autism are reported to hold average performances in recognizing basic emotional facial expressions (Baron-Cohen et al., 1997), although their cerebral activity might differ from people without autism on such tasks (Critchley et al., 2000). The social dysfunctions arise when emotions are associated with a dynamic context. People with autism often fail to use perceived social and emotional information to self-regulate their own behaviour with an ongoing social situation (Loveland, 2005). Contextualizing problems pervade the entire social disorder in autism.

4.2 Empirical investigations

Computer science projects are being carried out and experimented to provide educational software for people with autism in the fields of emotional and social interactions. Bernard-Opitz and colleagues (2001) studied 10 sessions of training based on software used for social behavior education. Children had to find a solution to different scenarios involving characters in problematic social conflicts, for example two children arguing over who can use a slide first. They compared a group of 8 children with autism and a group of 8 children without autism. While the performances of both groups improved, the progression of the group without autism was steadier. Generalization of the acquired social skills to real life appeared to be possible when real situations were similar to those that had been trained on the computer. Leonard and colleagues (2002) designed a virtual reality system aimed at teaching social skills to people with high functioning autism. They evaluated the system with 6 adolescents. The virtual reality environment simulated a coffee house. Participants had to perform several social tasks inspired from real life situations, such as finding a place to sit without disturbing other clients. Results showed progression in dealing with the social situation that had been simulated. Generalization of learning was effective in real situations similar to the virtual environment but failed when the context differed. These experiments highlight the difficulties of transferring skills acquired during training to other contexts.

Collaborative use of educational software has also been explored. Rajendran and Mitchell (2000) conducted two case studies where the experimenter and the participant played together using a software game designed to foster adequate social responses. The game consisted of cartoons featuring two characters. The speech and thought bubbles of each character had to be filled in by the players. The experimenter played one character and the participant played the other one. Results showed no evidence of social skills improvement, but participants' performances increased on measures of executive functions. The authors suggested that, although the game they used targeted social skills, it could additionally involve various executive functions for planning dialogues and flexibility for alternating between thought and speech bubbles.

Several software projects focus on the use of Animated Conversational Agents (ACA) for teaching social skills to people with autism. ACA are considered relevant for practicing social and emotional skills because they communicate through modalities such as speech, facial expressions and gesture that are inspired from human communication. Moreover, while resembling human characters, researchers believe ACA can enable to control the interactions at a suitable level for people with autism. Bosseler and Massaro (2003) developed a language-learning tool based on a virtual 3-D talking head. The virtual head could realistically simulate the articulary movements of the mouth and tongue during speech. Eight children with autism were trained during 6 month with this tool. Pre-tests, post-tests and follow-up tests revealed that children acquired new vocabulary and that learning was maintained 30 days after the end of the training. Tartaro and Cassell (2006) designed an ACA used for training children with autism in collaborative storytelling. The ACA looked like a child and could communicate through speech, gesture and gaze. Moreover it was authorable, which means the child could specify and plan its interactions and control it during storytelling sessions with another person.

In an attempt to investigate the competencies of people with high functioning autism in understanding the emotions displayed by an ACA, Moore and colleagues (2005) conducted an experiment where participants were required to associate the facial expressions of virtual characters (happy, sad, angry, and frightened) with emotions or emotionally connoted social situations. The results showed some evidence that people with high functioning autism could assign the appropriate emotional facial expressions to the ACA, coherently with the social context. Golan and Baron-Cohen (2006) designed and evaluated a multimedia application to train recognition of complex emotions (such as embarrassment, insincerity, etc.) in both visual and auditory channels for people with high-functioning autism. Their application presented series of emotions in silent films of faces, faceless voice recordings and videos of emotionally connoted situations. Nineteen participants with high-functioning autism were trained with the software during 10-15 weeks. Participants improved in emotion recognition of faces and voices separately, but there was no evidence of progression concerning the holistic tasks involving videos that required integrating information from facial, vocal and contextual sources. The next section presents a study that addressed the latter point by exploring the ability to use facial expressions in the context of a dialogue.

5. Study on parallel training of cognitive and socio-emotional skills in autism

5.1 Training objectives

The goal of the study presented here was to explore a computer-based approach combining cognitive remediation and socio-emotional training for high-functioning autism. In the socio-emotional field, the training tackled contextualization difficulties attributed to autism with a specific focus on pragmatics. The main communication deficiency in autism relates to pragmatics (Paul, 1987). Authors report that people with high functioning autism have a tendency to interpret speech literally rather than in reference to a context (Attwood, 1998). They experience difficulties in interpreting pragmatic speech that conveys irony and metaphors (Happé, 1993). Jolliffe and Baron-Cohen (1999) carried out an experiment where participants had to understand a short text containing a semantically ambiguous word that required the context to be correctly interpreted. Participants had to choose between three possible interpretations of the ambiguity: the contextually correct interpretation, a literal and out of context interpretation and an erroneous non-literal interpretation. Results showed that participants with autism chose the literal interpretation more often than healthy controls. They tended to omit context although it was necessary for interpreting the text.

The main neurocognitive deficit targeted by the computer-based training described in this section was the executive dysfunction attributed to autism (Russell, 1996). The executive dysfunction theory in autism derives from analogies with patients sustaining brain injuries in the frontal lobes regions. As explained earlier, executive functions refer to cognitive constructs considered responsible for controlling behaviour, planning activities, inhibiting inappropriate responses and taking initiatives (Hill, 2004). People with autism are considered having difficulties with tasks involving inhibition of an appropriate response and flexibility of attention (Hughes & Russell, 1993). The training software designed for the present study consisted of a visuospatial planning game.

5.2 Experimental protocol

The study presented here was part of a broader experimental protocol that used a pre-post test design to assess a three months training using software games. The entire experimentation comprised 13 sessions. The first and the last sessions were dedicated to assessment. The training program was composed of the 11 in-between sessions. The training comprised three phases: a preparatory phase to introduce the software tasks (sessions 1 to 3), a mass training phase (sessions 4 to 8) and a final phase testing particular interface modalities described below (sessions 9 to 11). The focus here is on the final phase and especially on the last two sessions (sessions 10 and 11) for which participants were assumed to have acquired experience on the usage of the tested interface modalities.

As recruiting school students with high functioning autism is a complex procedure, the study was restrained to a small number of participants. Two groups took part in the experiment: a clinical group including 10 teenagers diagnosed with high functioning autism according to the DSM IV criteria (APA, 1994), and a typical group of 10 children without autism. The typical group served as a reference base for the clinical group. The groups were matched on developmental age and academic level. Participants attended the training individually and were assisted by an experimenter. They managed the software games using the mouse, on personal computers running Windows®. Participants were volunteers and their parents' written informed consent was requested and obtained. For more details about the experimental protocol, see (Grynszpan et al., 2007a).

5.3 Software games

An experimental software platform was developed to explore training with computer games. A software game (called "What to choose?") was designed for training pragmatics. It presented series of social scenarios displayed as written dialogues between two characters. Dialogues contained semantically ambiguous phrases that could be disambiguated only by taking into account the context. Pragmatic ambiguities relied on irony or metaphors. The game's interface prompted the user to select one of three assertions about each dialogue. Those three assertions followed a similar pattern to the one used in the experiment of Jolliffe and Baron-Cohen (1999): one assertion was a contextually correct interpretation of the pragmatic ambiguity, one was an out of context literal interpretation of the ambiguity and one was an erroneous non-literal interpretation.

To examine the impact of emotional facial expressions as pragmatic cues, the game included an interface modality which bounded each utterance of the dialogue to a 3-D image of the character's facial expression. When the user clicked on an utterance in the dialogue, the associated facial expression was displayed. For example, in Fig. 1, the 4^{th} utterance in the dialogue is a metaphor and should not be interpreted literally. This utterance is associated with a facial expression of happiness so as to emphasize the contrast between what the character says literally and what she feels. The characters could display five emotional facial expressions (joy, sadness, fear, surprise, anger) as well as a neutral facial expression. These facial expressions were based on Ekman's descriptions (2003) and designed with Poser 5® from Curious Lab. The dialogue was displayed textually on the screen and uttered by a synthetic voice (IBM ViaVoice®).

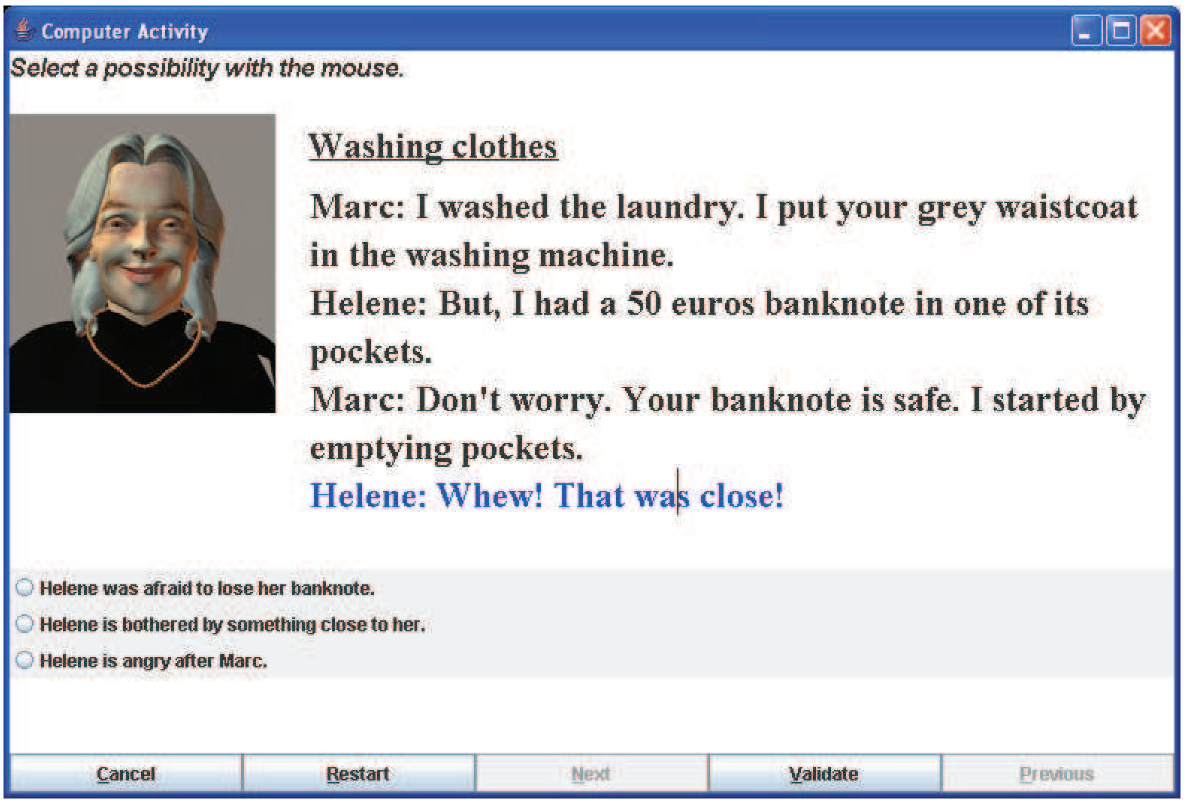

Figure 1. An example of the "What to choose" game with the facial expressions modality. The facial expression of "happiness" was displayed when the user clicked on the 4th utterance. This example is an English translation of the French dialogue that was actually used

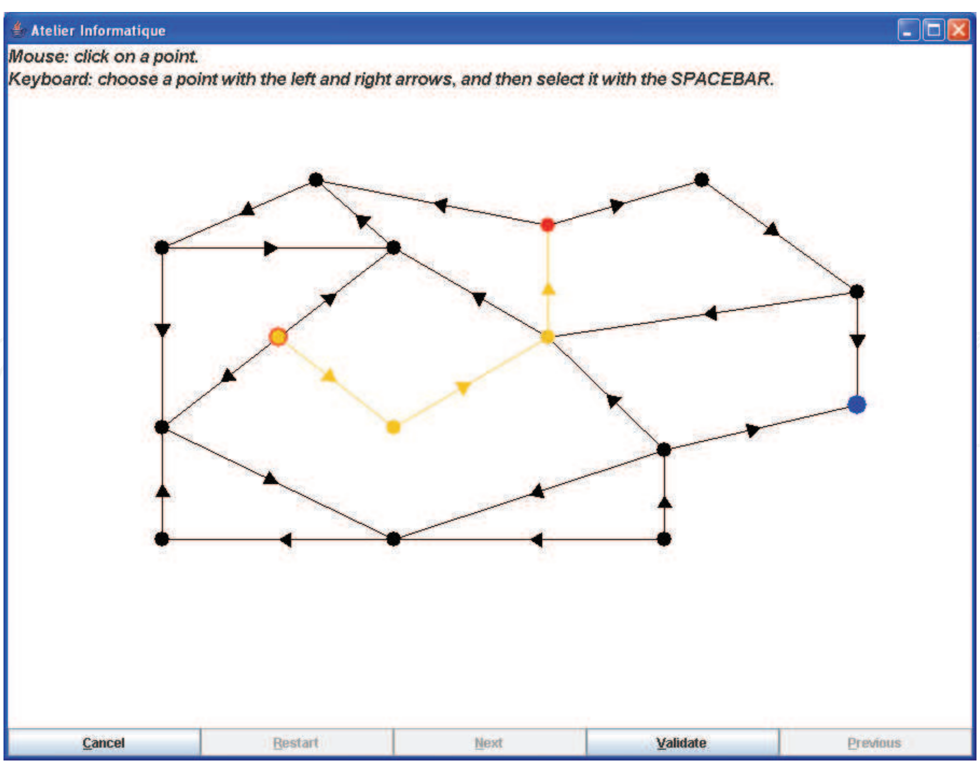

Figure 2. An example of the "Labyrinth" game. Participants would trace a route by clicking on successive nodes of the graph. The route that participants traced appeared in yellow

The game used for training visuospatial planning was called “Labyrinth” (Fig. 2). It displayed graphs where participants had to find a path between two nodes. Graphs were either directed or non-directed, although the main focus was on directed graphs. The directions of the edges were represented by arrows. The rule induced by directed edges was reinforced by the interface: an edge could not be crossed in the direction opposite to its arrow. Participants would click on successive nodes of the graph to trace a route. The route they traced appeared in a lighter colour than the rest of the graph. The interface enabled participants to come back to the previous node of the route, by clicking on the “Cancel” button. The route would not be modified on the interface if the participant tried to click on a node that was not connected to the route’s current node by an edge with the appropriate direction. Indeed, these clicks were considered illegal in the context of the game’s rules. The user’s clicks were recorded in log files with a flag indicating whether they were legal or illegal.

5.4 Results and discussion

The pre-post tests assessing the entire training indicated that participants with autism had improved in the pragmatic domain whereas progressions in the spatial planning domain were less obvious. The overall evaluation of the training is discussed in another paper. It reveals that participants with autism experienced difficulties that could be linked to the executive dysfunction attributed to autism (Grynszpan et al., 2007a).

The results presented here focus on the peculiarities shown by participants with autism in handling of the above presented software. The typical group had significantly higher success rates than the clinical group on the “What to choose?” game. The details of the statistical analysis and the subsequent discussion may be found in (Grynszpan et al., 2008). The disambiguation cues provided by the facial expressions did not seem to help overcome the contextualizing deficiency of participants with autism. Qualitative observations and quantitative analysis suggest that participants with autism did not use facial expressions appropriately. Using facial expressions along with the text of the dialogue required users to shift their attention from one source of information to another, thus involving attention set-shifting skills considered linked to the executive dysfunction in autism (Hughes & Russell, 1993).

The executive dysfunction appears to impact performances in the visuospatial planning game as well. The results on the “Labyrinth” game show that the clinical group made significantly more illegal moves and backtracked significantly more than the typical group (Grynszpan et al., 2007b). This suggests that the clinical group relied to a greater extent on a trial and error strategy, which is the least demanding strategy in terms of planning and inhibiting inappropriate responses. Hence, the influence of the executive dysfunction attributed to autism was apparent in the two training games.

6. Conclusion

The present chapter reviewed two types of computer-based training approaches in psychopathology: cognitive remediation and socio-emotional training. The example of schizophrenia was employed for illustrating cognitive remediation and socio-emotional training was described in experiments involving autism. Following the literature review, this chapter described a longitudinal pilot study that investigated both cognitive remediation and socio-emotional computer-based training in the case of autism. The analysis of data from this study suggests that the executive dysfunction attributed to autism could account for results in both types of training. Developers need to take into account the particular cognitive dysfunction attributed to a psychopathological disorder when designing training software intended for this disorder. These outcomes emphasize the need for further research on the specific software design principles in psychopathology that differ from design premises based on typical users.

The influence of computer-assisted cognitive remediation on social cognition has recently received increased attention. Several research projects presented in this chapter are closing the gap between cognitive remediation and socio-emotion training. Future research should explore these treatments for other psychopathological disorders, such as depression or anxiety.

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8. References

APA (American Psychiatric Association) (1994) *Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV)*, American Psychiatric Association, Washington D.C.

Attwood, T. (1998) *Asperger syndrome, A guide for Parents and Professionals*, Jessica Kingsley, London

Baron-Cohen, S., Jolliffe, T., Mortimore, C., Robertson, M. (1997). Another advanced test of theory of mind: evidence from very high functioning adults with autism or asperger syndrome, *Journal of Child Psychology and Psychiatry*, 38, 7, 813-822

Bell, M., Bryson, G., Greig, T., Corcoran, C., Wexler, B.E. (2001) Neurocognitive enhancement therapy with work therapy: effects on neuropsychological test performance, *Archives of General Psychiatry*, 58, 8, 763-768

Bellucci, D.M., Glaberman, K., Haslam, N. (2002) Computer-assisted cognitive rehabilitation reduces negative symptoms in the severely mentally ill, *Schizophrenia Research*, 59, 225-232

Bernard-Opitz, V., Sriram, N., Nakhoda-Sapuan, S. (2001) Enhancing Social Problem Solving in Children with Autism and Normal Children Through Computer-Assisted Instruction, *Journal of Autism and Developmental Disorders*, 31, 4, 377-384

Bosseler, A., Massaro, D.W. (2003) Development and evaluation of a computer-animated tutor for vocabulary and language learning in children with autism, *Journal of Autism Developmental Disorders*, 33, 6, 653-672

Bracy, O. (1981) *PSSCogRehab Software*, Psychological Software Services Inc., Indianapolis, IN, USA, available at: http://www.neuroscience.cnter.com/pss/psscogrehab.html

Burda, P.C., Starkey, T.W., Dominguez, F., Vera, V. (1994) Computer-Assisted Cognitive Rehabilitation of Chronic Psychiatric Inpatients, *Computers in Human Behavior*, 10, 3, 359-368

Butti, G., Buzzelli, S., Fiori, M., Giaquinto, S. (1998) Observations on Mentally Impaired Elderly Patients Treated with THINKable, a Computerized Cognitive Remediation, *Archives of Gerontology and Geriatrics*, 26, 5, 49-56

Castellucci, V.F., Carew, T.J., Kandel, E.R. (1978) Cellular analysis of long-term habituation of the gill-withdrawal reflex of Aplysia californica, *Science*, 202, 4374, 1306-1308

Craig, T. (2006) What is Psychiatric Rehabilitation? In: *Part1. Enabling Recovery: The Principles and Practice of Rehabilitation Psychiatry*, Glenn Roberts, Sarah Davenport, Frank Holloway & Theresa Tattan (Ed.), 3-17, Gaskell (Royal College of Psychiatrists), Cromwell Press Limited, ISBN: 1-904671-30-6, Trowbridge, UK.

Critchley, H.D., Daly, E.M., Bullmore, E.T., Williams, S.C.R., Van Amelsvoort, T.V., Robertson, D.M., Rowe, A., Phillips, M., McAlonan, G., Howlin, P., Murphy, D.G.M. (2000), The functional neuroanatomy of social behaviour – Changes in cerebral blood flow when people with autistic disorder process facial expressions, *Brain*, 123, 11, 2203-2212

Difede, J., Hoffman, H., Jaysinghe, N. (2002) Innovative Use of Virtual Reality Technology in the Treatment of PTSD in the Aftermath of September 11, *Psychiatric Services*, 53, 1083-1085

Ekman, P. (2003) *Emotions Revealed*, Weidenfeld & Nicolson, London

Field, C.D., Galletly, C., Anderson, D., Walker, P. (1997) Computer-aided cognitive rehabilitation: possible application to the attentional deficit of schizophrenia, a report of negative results, *Perceptual and motor skills*, 85, 3 Pt 1, 995-1002

Golan, O., Baron-Cohen, S. (2006) Systemizing empathy: Teaching adults with Asperger syndrome or high-functioning autism to recognize complex emotions using interactive multimedia, *Development and Psychopathology*, 18, 591-617

Greig, T.C., Zito, W., Wexler, B.E., Fiszdon, J., Bell, M.D. (2007) Improved cognitive function in schizophrenia after one year of cognitive training and vocational services, *Schizophrenia Research*, 96, 156-161

Grynszpan, O., Martin, J.C., Nadel, J. (2007a) Exploring the influence of task assignment and output modalities on computerized training for autism, *Interaction Studies*, 8, 2, 241-266

Grynszpan, O., Martin, J.C., Nadel, J. (2007b) What influences Human Computer Interaction in Autism? *Proceedings of the 6th IEEE International Conference on Development and Learning*, July 11-13th, London, UK

Grynszpan, O., Martin, J.C., Nadel, J. (2008) Multimedia interfaces for users with high functioning autism: an empirical investigation, *International Journal of Human-Computer Studies*, 66, 628-639

Happé, F. (1993) Communicative competence and theory of mind in autism: A test of relevance theory, *Cognition*, 48, 101-119

Happé, F., Frith, U. (1996) The neuropsychology of autism, *Brain*, 119, 1377-1400

Heinrichs, R.W., Zakzanis, K.K. (1998) Neurocognitive Deficit in Schizophrenia: A Quantitative Review of the Evidence, *Neuropsychology*, 2, 3, 426-445

Hill, E.L. (2004) Evaluating the theory of executive dysfunction in autism, *Developmental Review*, 24, 189-223

Hogarty, G.E., Flesher, S., Ulrich, R., Carter, M., Greenwald, D., Pogue-Geile, M., Kechavan, M., Cooley, S., DiBarry, A.L., Garrett, A., Parepally, H., Zoretich, R. (2004) Cognitive enhancement therapy for schizophrenia: effects of a 2-year randomized trial on cognition and behavior, *Archives of General Psychiatry*, 61, 9, 866-876

Hughes, C., Russell, J. (1993) Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism, *Developmental Psychology*, 29, 498-510

Jolliffe, T., Baron-Cohen, S. (1999) A test of central coherence theory: linguistic processing in high-functioning adults with autism or Asperger syndrome: is local coherence impaired? *Cognition*, 71, 2, 149-185

Josman, N., Somer, E., Reisberg, A., Weiss, P.L., Garcia-Palacios, A., Hoffman, H. (2006) BusWorld: Designing a Virtual Environment for Past-Traumatic Stress Disorder in Israel: A Protocol, *CyberPsychology & Behavior*, 9, 2, 241-244

Kandel, E.R. (1998) A New Intellectual Framework for Psychiatry, *American Journal of Psychiatry*, 155, 4, 457-469

Knott, GW., Quairiaux, C., Genoud, C., Welker, E. (2002) Formation of dentritic spines with GABAergic synapses induced by whisker stimulation in adult mice, *Neuron*, 34, 265-273

Kurtz, M.M., Seltzer, J.C., Shagan, D.S., Thime, W.R., Wexler, B.E. (2007) Computer-assisted cognitive remediation in schizophrenia: What is the active ingredient?, *Schizophrenia Research*, 89, 1-3, 251-260

Leonard, A., Mitchell P., Parsons S. (2002), Finding a place to sit: a preliminary investigation into the effectiveness of virtual environments for social skills training for people with autistic spectrum disorders. *Proceedings of the 4th International Conference on Disability, Virtual Reality and Associated Technology*, pp. 249-258, ISBN 0704911434, Veszprém, Hongrie.

LoPresti, E.F., Mihailidis, A., Kirsch, N. (2004) Assistive technology for cognitive rehabilitation: State of the art, *Neuropsychological Rehabilitation*, 14, 1/2, 5-39

Loveland, K.A. (2005) Social-emotional impairment and self-regulation in autism spectrum disorders, In: *Emotional Development: Recent research advances*, J. Nadel & D. Muir (Ed.), 365-382, Oxford University Press, Oxford

Medalia, A., Revheim, N., Casey, M. (2000) Remediation of memory disorders in schizophrenia, *Psychological Medicine*, 30, 1451-1459

Medalia, A., Revheim, N., Casey, M. (2001) The Remediation of Problem-Solving Skills in Schizophrenia, *Schizophrenia Bulletin*, 27, 2, 259-267

Moore, D., Cheng, Y., McGrath, P., Powell, N.J. (2005) Collaborative Virtual Environment Technology for People with Autism, *Focus on Autism and Other Developmental Disorders*, 20, 4, 231-243

Nadel, J., Croue, S., Mattlinger, M.J., Canet, P., Hudelot, C., Lecuyer, C., Martini, M. (2000). Do children with autism have expectancies about the social behaviour of unfamiliar people? *Autism*, 4, 2, 133-145

Nuechterlein, K.H., Barch, D.M., Gold, J.M., Goldberg, T.E., Green, M.F., Heaton, R.K. (2004) Identification of separable cognitive factors in schizophrenia, *Schizophrenia Research*, 72, 29-39

Panyan, M.V. (1984) Computer Technology for Autistic Students, *Journal of Autism and Developmental Disorders*, 14, 4, 375-382

Paul, R. (1987) Communication. In: *Handbook of Autism and Pervasive Developmental Disorders*, D.J. Cohen, A.M. Donnellan & R. Paul (Ed.), 61-84, John Wiley & Sons, New York

Rajendran, G., Mitchell, P. (2000) Computer mediated interaction in Asperger's syndrome : the Bubble Dialogue program, *Computer & Education*, 35, 189-207

Russell, J. (1996) *Agency Its Role in Mental Development*, Taylor&Francis, Erlbaum, UK

Sandford, J.A., Browne, R.J. (1988) Capitain's *Log Cognitive System*, Brain Train, Richmond, VA, USA, available at: http://www.braintrain.com/educators/captains_log/captainslog_educator.htm

Sartory, G., Zorn, C., Groetzinger, G., Windgassen, K. (2005) Computerized cognitive remediation improves verbal learning and processing speed in schizophrenia, *Schizophrenia Research*, 75, 2-3, 219-223

Silver, H., Goodman, C., Knoll, G., Isakov, V. (2004) Brief emotion training improves recognition of facial emotions in chronic schizophrenia. A pilot study, *Psychiatry Research*, 128, 2, 147-154. Erratum in: *Psychiatry Research* 2004 Nov 30, 129, 1, 113

Tartaro, A., Cassell, J. (2006) Authorable Virtual Peers for Autism Spectrum Disorders, *Proceedings of the Workshop on Language-Enabled Educational Technology at the 17th European Conference on Artificial Intelligence (ECAI06)*, Riva del Garda, Italy

Van Praag, H., Schinder, A.F., Christie, B.R., Toni, N., Palmer, T.D., Gage, F.H. (2002) Functional neurogenesis in the adult hippocampus, *Nature*, 415, 1030-1034

Vauth, R., Corrigan, P.W., Clauss, M., Dietl, M., Dreher-Rudolph, M., Stieglitz, R.D., Vater, R. (2005) Cognitive Strategies Versus Self-Management Skills as Adjunct to Vocational Rehabilitation, *Schizophrenia Bulletin*, 31, 1, 55-66

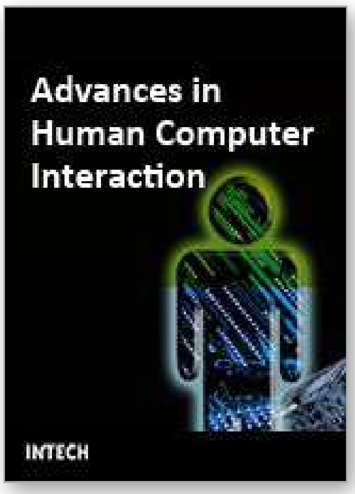
Volkmar, F.R. (1987). Social Development. In: *Handbook of Autism and Pervasive Developmental Disorders*, D.J. Cohen, A.M. Donnellan & R. Paul (Ed.), 61-84, John Wiley & Sons, New York.

Walker, E., Kestler, L., Bollini, A., Hochman, K.M. (2004) Schizophrenia: Etiology and Course, *Annual Review of Psychology*, 55, 401-430

Wilson, B.A., Emslie, H.C., Quirk, K., Evans, J.J. (2001) Reducing everyday memory and planning problems by means of a paging system: a randomised control study, *Journal of Neurology, Neurosurgery and Psychiatry*, 70, 477-482

Wölwer, W., Frommann, N., Halfmann, S., Piaszek, A., Streit, M., Gaebel, W. (2005) Remediation of impairments in facial affect recognition in schizophrenia: efficacy and specificity of a new training program, *Schizophrenia Research*, 80, 2-3, 295-303

Wykes, T., van der Gaag, M. (2001) Is it time to develop a new cognitive therapy for psychosis – Cognitive Remediation Therapy (CRT)?, *Clinical Psychology Review*, 21, 81, 1227-1256



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In these 34 chapters, we survey the broad disciplines that loosely inhabit the study and practice of human-computer interaction. Our authors are passionate advocates of innovative applications, novel approaches, and modern advances in this exciting and developing field. It is our wish that the reader consider not only what our authors have written and the experimentation they have described, but also the examples they have set.

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