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Review Article

A brief review on therapeutic approaches for face and non-face recognition disorders: summarising recent clinical developments

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ABSTRACT

Face recognition is considered as an important phenomenon in our everyday life. In 19th century cognitive science got introduced with a new term 'prosopagnosia' (face recognition disorder) for the first time by Joachim Bodmer. The term is derived from Greek word prosopon (face) and gnosis (knowledge), and refers to a condition which was first observed as a consequence of brain lesions (acquired prosopagnosia). Initially it was believed that prosopagnosia results due to brain injury but later congenital or hereditary form of face recognition disorder was also reported. The therapeutic modalities of this rare disorder are still unclear but with the advancement of scientific understanding different diagnostic procedures as well as therapeutic strategies are developed. These treatment procedures impart an impactful result among the individuals suffering from this disorder. Here in this article, we reviewed about various treatment approaches of acquired prosopagnosia and development prosopagnosia.

Keywords: Prosopagnosia, f-MRI, Rehabilitation, Remedial training, Let's face it

INTRODUCTION

Prosopagnosia has been largely regarded as an untreatable rare disorder by the clinicians. However, few studies have attempted several types of training methodologies to remedy face processing deficits in individuals with acquired prosopagnosia (AP) and developmental prosopagnosia (DP). While face recognition broadly involves perceptual representation, mnemonic processes; prosopagnosia refers to the inabilities to process facial identity whereas rest of the information related to face (i.e., facial expression and emotion) can be processed.[1] It has been argued that the main aim of neuropsychological rehabilitation is to reduce the impact of impairments on everyday living, whether through restoration of function or the adoption of coping strategies. In context to face recognition, rehabilitation encourage an individual with the deficit to develop compensatory strategies that aid person recognition or attempt to restore, or extensive visuo-cognitive training referred to as remedial training is performed to enhance face processing mechanism.[2] Apart from compensatory and remedial approaches several other training methods have been documented for both AP and DP. The different approaches of treatment strategies for the prosopagnosics' are summarised below.

Treatment for AP

According to compensatory strategies in case of APs, the treatment seeks to teach patients ways to work around their face recognition deficits, either by using intact

systems in perceptual face processing domain (attending to facial features), semantic processing (encoding a face in conjunction with details about their profession), using verbal strategies or using intact implicit face recognition mechanisms. Though these studies show some impressive benefits for the individuals with deficits, it is still an unsolved question how much of these treatments are beneficial in context of improvement of the novel face stimuli which are not used during the training period. The available evidences suggest that there are no particular generalized compensatory strategies for APs and it show variability from individual to individual. It is also important to note that the therapeutic benefits from compensatory treatment approach is more successful in patients with bilateral lesions in comparison to the patients with unilateral lesions.[3-6]

While compensatory strategies utilize to work around face recognition deficits in APs, the remedial training targets the underlying deficits of prosopagnosia i.e., the holistic face processing. The remedial approach was applied to an 8-year-old prosopagnosic child KD with diffuse meningococcal meningitis by Ellis et al for 18 months but no significant evidence of improvements was found in context to face discrimination and from this it can be inferred that once the face processing system is damaged cannot be remediated even in a young, plastic brain.[7]

In addition to these compensatory and remedial prospects in APs, researchers have also investigated about the beneficial aspects of some other treatment strategies such as galvanic vestibular stimulation, Greebles training.[8,9] The galvanic vestibular stimulation was applied on a 61 year old AP from extensive damage to the right hemisphere including entire temporal lobe, inferior frontal gyrus and superior parietal lobe. Electrical currents were administered via the left and right vestibular nerves during a forced choice face matching task as the researchers believed that electrical stimulation of vestibular systems may restore aspects of face perception. The accumulative evidences suggested that the individuals with deficits showed a better performance in standardized face recognition test. The accuracy level of the result was significantly improved from chance level to 70% after switching the stimulation polarity from either right to left or left to right.[8] Though the objective of Greeble training was to engage visual expertise mechanisms for the face like novel objects which may enhance the face perception among the APs, no marked evidence of face perception improvements was found. Henceforth, an interpretation can be stated that the training approach should be performed with faces only in case of APs during training period.[9]

The therapeutic strategies in DP

The current evidences suggested that treatment related face processing exhibited some improvement in case of DP in comparison to AP. A very famous compensatory approach feature naming training was applied in case of DP where the patients were taught to perceive, discuss and remember five distinctive facial characteristics of 17 familiar faces. The first two characteristics were always age and gender and the remaining were distinctive facial features such as long thin face, wide nostrils, high curved eyebrows, wrinkles around the face, and freckles. The patients showed significant improvement with proper pattern of visual scanning after 14 practice sessions over 1 month and it is also important to mention that this compensatory approach was also applicable for novel or untrained faces.[4] In addition to the success of compensatory approach, the remedial approach appears to be much more beneficial in comparison to compensatory approach in case of DP as it is more automatically implemented, which may better promote generalization.[10,11] The significant results of different case study reports suggest that, remedial training which targets the holistic face processing of prosopagnosic to enhance the ability to perceive internal feature spacing information across a greater spatial extent of face. To accomplish the above-mentioned objective, a particular training task was designed where the participants made category judgements based on integrating two vertical feature spacings: the distance between the eye and eyebrows and between the mouth and nostrils. It was observed that after thousand trials the DPs were able to allocate their attention indices to both feature spacings simultaneously, resulting in greater sensitivity to configural information across the inner components of the face (greater holistic processing). Additionally, the DPs show normal pattern of N170 in response to faces than objects, and enhanced fMRI connectivity within right hemisphere face selective regions during face viewing along with the improvements in standardized face recognition tests of face perception/recognition (Benton face perception test).[12,13] In contrast of this positive reports of training holistic face processing in DPs ,some other reports of adolescent DP come up with a failure of remedial approach and from this an interpretation can be drawn that there are some limitations to improvements in face processing in young brain. Together, these studies provide compelling evidence that face processing system in DPs is at least partially remediable rather than permanently deficient.[2]

Apart from compensatory and remedial approach towards DPs', researchers have also attempted some other therapeutic strategy such as intranasal administration of a neuropeptide, oxytocin. Oxytocin is correlated with prosopagnosia in that the eye region is highly diagnostic for face recognition and that processing of the eye region has been shown to be particularly impaired in case of prosopagnosic.[14,15] After the administration of intranasal oxytocin and placebo spray in DPs show better performances in novel version of the Cambridge face memory test (CFMT) and a simultaneous face matching task.[14]

From the above illustration on different therapeutic approaches towards APs and DPs, a conclusion can be drawn that the DPs can show substantially greater capacity for improvement from several types of treatment in comparison to APs. One explanation for this limited capability to restore normal face processing in APs is, because face processing relies on specific cognitive and neural mechanisms and the restoration of the intact face processing infrastructure to a normal level is almost impossible in case of APs. Another explanation for limited treatment related improvements in APs is that to some degree, face processing sub regions in the core (FFA, OFA, p-STS) and extended networks (anterior temporal lobes) represent distinct, independent functions and are not redundant. This lack of redundancy within face processing network could reduce the capacity for reorganization amongst intact regions and make it a difficult proposition for rehabilitation and therapy.[16,17]

Programming approach as a treatment

On the basis of current prospective of treatment strategies for the face recognition deficits among the patients of autism spectrum disorder (ASD), two valuable computer-based intervention programs were established, face expertise training project and let's face it (LFI) with the following objectives.[3,18] Firstly, both the studies used a randomized clinical trial design, in which a homogeneous control group was used to contrast the effects of the training and secondly both studies focused on the training of relatively large number of unfamiliar faces recognition rather than the familiar faces recognition and it was assumed that both the studies can reflect on the increased efficiency level in novel face processing in comparison to a particular subset of familiar face processing. In case of face expertise training participant had to learn three levels of category: general level category of gender (male, female), intermediate level category of age (old, young), and the specific level category of identity. Due to the verbal deficiency in the ASD patients, unique colour and pattern are used instead of the names. After familiarizing with the category classification of a target face, the participants have to put the face in the proper category. From the previous studies it was found that the participants after multiple sessions developed face expertise as reflected by their speeded classification, although the holistic face processing was not significantly improved.[19]

LFI program is based on the hierarchy of face processing involved in the attention to faces (domain 1), recognition of facial identity and emotion (domain 2), understanding faces in social context (domain 3) and different kinds of game platforms have been developed which can suffice these prospects of face recognition.[19] For example, in a domain 1 game 'find a face', the attentional skills of a child can be strengthened by the ability of spotting a hidden face in a complex scene. The domain 2 game 'face maker', the face constructive abilities (holistic processing) of a child can be improved by the construction of face from individual eyes, nose and mouth parts. Apart from 'face maker', other established domain 2 games are 'search party' (players have to select a target face that corresponds to the study face but the faces can differ in terms of their expression, viewing perspectives or clothing), 'two of kind' (players are asked to match face cards with similar identity or expressions), 'splash' (players are asked to find the face with target identity or expression among a number of faces fading in and out of the screen), 'zap' (an action game where players launch face tokens and connect tokens sharing similar identity or expressions). In domain 3 game 'eye spy', a central face is presented inside a circular array of objects and the player's objective is to click on the object that is the focus of the person's gaze. The LFI has been established as an effective therapeutic tool for the children and adolescents with ASD which show significant improvements in their analytical recognition of the mouth region, holistic processing of faces based on eye features and it was confirmed after the randomized clinical trial.[18]

CONCLUSION

Therapeutic options for prosopagnosia are limited as of now. Treatment strategies work better in case of DP rather than AP. This is because of the lack of redundancy in the face recognition system inside the brain. Computer based programs for treating face recognition disorders are in the process of evolution at the moment.

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