

“McGurk Effect” in Pediatric Dental Practice - A review

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Abstract- Background: *In Pediatric Dentistry, Fear and anxiety associated with dental treatment are a well recognized factor which has a negative impact on the child's willingness towards dental treatment. The role of a dentist in managing a child is to treat the problem with which the child report with anxiety and to modify and shape the behavior of a child towards a positive dental response.*

Aim: *This review article aims to discuss the development of dental anxiety, various coping strategies and whether the newer psychological approach of McGurk Effect in Attention Focused Coping Strategy can be acceptable at the reduction of dental anxiety in children in near future.*

Methods: *An electronic search was performed using databases such as Google Scholar, PubMed, PubMed Central, Science Direct, and Scopus by using keywords such as (“McGurk Effect”) AND (“Coping Strategy” OR “Coping Style” OR “Distraction”) AND (“Fear” OR “Anxiety”) AND (“Behavior” OR “Behavior management”) AND/OR (“Pediatric Dentistry” OR “dentistry”). The last search was performed in March 2020. Exclusion criteria included studies published in a language other than English and abstracts from congress.*

Results: *The McGurk Effect based Attention focused coping style with incongruent audiovisual stimuli can be an innovative behavioral technique in pediatric dentistry in reducing the child's anxiety regarding dental drill.*

Conclusion: *It seems that the highly structured McGurk Effect based Attention focused coping style can be effective in managing the internal perceptions and emotions (e.g., anxiety, fear) that are aroused during the dental restorative procedure and can guide favorably the child's behavior in the dental setting.*

However, more evidence is required regarding the clinical outcome of applying this new coping strategy in behavioral pedodontics in near future.

Keywords: *McGurk effect, Coping strategy, Coping style, Distraction, Fear, Anxiety, Behavior, Behavior management, Pediatric dentistry, Dentistry*

1. INTRODUCTION

Fear and anxiety associated with dental treatment are well recognized factors in pediatric dentistry which has a negative impact on child's willingness towards dental treatment.^[1] The pediatric patient with his/her first visit to dentist are mostly found anxious because of dental equipments and the newness of the experience.^[2] The nature of a child's dental anxiety can vary significantly. Some children present with fears in relation to specific dental stimuli (e.g. needle or drill), other children report more generalized anxiety.^[3,4] The role of a dentist in managing a child is to control and treat the problem with which the child report with anxiety, so as to make the child a co-operative patient and to modify and shape the behavior of a child towards a positive dental response. Various methods of reducing patient anxiety have been used in dentistry.

The American Academy of Pediatric Dentistry (2011)^[5] adopted recommendations regarding the behavior guidance techniques to educate the pediatric dentist that may result in a co-operative child in the dental chair. The guideline suggests that among other techniques, the coping strategies used by children receiving dental care should be mapped and finally the effective ones should be accepted and supported. According to Versloot et al. (2004)^[6] and Curry (1985),^[7] during dental visits, coping strategies used are very specific. In pediatric dentistry, they are determined by their mental, social and emotional development and dependent on intellectual abilities of particular children; actually it's different from adult's coping strategies.^[8]

The McGurk effect is a perceptual phenomenon that demonstrates an interaction between hearing and vision in speech perception. The visual information a person gets from seeing a person speak changes the way they hear the sound.^[9, 10] The McGurk effect proves that what you see is what you hear. It proves how much we rely more on visual cues, while almost ignoring what we hear. This is referred to as visual dominance.^[11]

This article will consider children's anxiety in the dental setting and will discuss the McGurk Effect and its implications for the child patient and the dental team. It will also describe a variety of coping strategies, based on a theoretical framework of anxiety, and discuss the newer psychological approach of McGurk Effect in Attention Focused coping Strategy and evaluate if it can be acceptable at the reduction of dental anxiety in children in near future.

2. METHODS

An electronic search was performed using databases such as Google Scholar, PubMed, PubMed Central, Science Direct, and Scopus by using keywords such as ("McGurk Effect") AND ("Coping Strategy" OR "Coping Style" OR "Distraction") AND ("Fear" OR "Anxiety") ("Behavior" OR "Behavior management") AND/OR ("Pediatric Dentistry" OR "dentistry"). The last search was performed in March 2020. Inclusion criteria were all, original studies, case reports or series, and review articles about McGurk Effect and/or Audio Visual integration and/or coping strategies and/or anxiety and/or management of anxious child in Pediatric dentistry. Exclusion criteria included studies published in a language other than English and abstracts from congress. The articles were selected to address the following research question: Can the newer psychological approach of McGurk Effect in Attention

Focused coping Strategy can be acceptable at the reduction of dental anxiety in children in near future ?

3. RESULTS

A total of 181 articles were identified after elimination of duplicates and articles in languages other than English by our search strategy. After evaluation of the titles, abstracts, and full texts, 163 were excluded as they did not apply directly to the research question. A total of 17 full text articles were obtained and assessed. Of these 17 papers, only 4 met the inclusion criteria and were directly related to the aim of the literature search.

4. DISCUSSION

Development of dental anxiety

There is no single explanation for the development of dental anxiety and a variety of different mechanisms have been applied to understanding the etiology of dental anxiety. Rachman^[12] proposed three different possible mechanisms of fear acquisition which included i) exposure to threatening information ii) vicarious learning (e.g. observing significant others displaying anxious behaviors) and iii) direct experience. Among this, direct experience such as sound of a dentist's drill is a big cause of child's anxiety when it comes to visiting the dentist. The dental drill noise is so distinctive the brain recognizes it and the child hear it, such is the anxiety. Whilst there are a range of interventions available to assist the dental team, successful management of a dentally-anxious child usually entails considerable additional time, effort and expertise.^[13] Over recent years it has been increasingly recognized that greater effort should be directed towards behavior management and psychological interventions which can reduce the patient's anxiety in the long-term without the need for pharmacological support.^[14, 15]

McGurk Effect

The multiple sensory channels in humans typically perceive and integrate.^[16, 17, 18, 19] A significant example of multisensory integration is audiovisual (AV) speech perception and^[11] AV speech perception in noisy acoustic conditions.^[20] Congruent and incongruent AV speech stimuli have been used widely in behavioral studies^[21, 22, 23] with relatively little investigation into the nature of the physical stimuli being combined. These stimuli had elicited various behavioral and brain activation patterns, but interpretation of these results is limited by our understanding of the physical stimuli.

Harry McGurk and John MacDonald 1976 were the first to describe McGurk effect. McGurk is a perceptual phenomenon that demonstrates an interaction between hearing and vision in speech perception.^[24] It proves that what you see is what you hear. The effect centers around an observation that when you hear a sound and see the lip movements making that sound, you hear it correctly, but if you see the lips making a sound but hear a different sound, simultaneously, your brain would still prefer to process what you see, irrespective of what you hear. The McGurk effect proves how much we rely more on visual cues, while almost ignoring what we hear. This is referred to as Visual dominance.^[25]

There are many variants of the McGurk effect.^[26] The best-known case is when dubbing a voice saying [b] onto a face articulating [g] results in hearing [d]. This is called the fusion effect since the percept differs from the acoustic and visual components and integration

results in the perception of a third consonant, obviously merging information from audition and vision.^[27, 28,29] The other incongruent audiovisual stimuli produce different types of percepts, a reverse combination of the consonants, A[g]V[b], is heard as [bg], i.e., the visual and auditory components one after the other, hearing according to the visual component, e.g., acoustic [b] presented with visual [d] is heard as [d]. The different variants of the McGurk effect represent the outcome of audiovisual integration. Thus, when the McGurk effect occurs, the observer has the subjective experience of hearing a certain utterance, even though another utterance is presented acoustically.

During experiments, the task is to report what was heard by the observer i.e the conscious auditory percept evoked by the audiovisual stimulus. Based on the relative weighting of audition and vision, the outcome for McGurk stimuli can range from hearing according to the visual component (when vision is more reliable than audition) to fusion and combination percepts (when both modalities are informative to some extent) to hearing according to the acoustic component (when audition is more reliable than vision). Thus the McGurk effect is an excellent tool to investigate multisensory integration in speech perception.^[30]

Sudhin Karuppali et al^[31] conducted a research in 2012 to study the accuracy of the identification of intended emotions in the Kannada language using the auditory and/or visual modality; and also to study its perception using the McGurk paradigm. The results stated the over-reliance of visual over auditory modality when the subjects were presented with the McGurk stimuli thereby also perceiving a new different emotion. A wider range of incongruent AV speech stimuli were examined by Jintao Jiang et al in 2005 and the distance measures were found to be related to visual influence. Visual influence on the acoustic /ba/ tokens was mainly of the McGurk-type while visual influence on the acoustic /la/ tokens was mainly of the combination type (/ba/ +/la/ = /bla/).^[32]

The 5-month-old English-exposed infants were tested for the McGurk effect and the results suggested that the infants were visually influenced in the same way as English speaking adults are visually influenced.^[25]

Further, the studies on children with Autism demonstrated lower rates of intersensory fusion (McGurk effect) than children with Asperger syndrome (AS) and AS children showed similar rates of McGurk effect to typically developing peers.^[33]

Coping

Coping refers to the cognitive and behavioral efforts made by individuals to master, tolerate, or reduce a stressful situation. The dental visit may be considered a stressful event for many children, engendering a variety of anxiety reactions.^[34,35] Coping efforts may be behavioral or cognitive in nature. Behavioral coping efforts are physical or verbal activities in which the child engages to deal with the stressful event.^[36] Cognitive coping efforts involved the manipulation of cognitions or emotions. In the dental setting, the silent coping strategies (e. g., those that are emotionally and cognitively based) would tend to be the most effective for children.^[37] According to Siegel and Peterson the preschool children in the dental setting, taught coping skills such as relaxation, pleasant imagery, and calming self-talk, in addition to receiving sensory information, demonstrated significantly less distress during restorative procedures than a control group."^[38]

Three categories of behavioral coping were identified: information-seeking; support-seeking; and direct efforts to maintain control. In addition, five categories of cognitive coping were identified: reality-oriented working through; cognitive reappraisal; emotion-regulating cognitions; behavior- regulating cognitions; and diversionary thinking.^[39, 40]

Cognitive coping strategies were found to be significant predictors of adjustment (e.g., low self-reported distress, and low anxiety, as observed by the dentist). In terms of the specific types of cognitive coping strategies elicited, and their relative effectiveness, reality-oriented working through (Realistic and accurate thoughts about the dental procedures, and planning efforts) was the most frequently employed strategy, followed by cognitive reappraisal (Attempts to reduce the aversive aspects of the situation via purposeful cognitive restructuring (e.g. attention to positive features or minimization of negative features) and emotion-regulating cognitions (Self-statements or thoughts reflecting attempts to alleviate fear and discomfort)). Behavior-regulating cognitions (e.g. 'I've got to sit still') and diversionary thinking (e.g., counting the dots on the ceiling) were the least frequently reported.^[41,42]

Coping Versus Distraction

Coping and Distraction-Both are not the same and they both have a specific function. When we think of the word "coping skill", we primarily think of distractions reactions on, for example "when the child is anxious about the dental drill, allowing them to watch the T.V or playing videogame will make them feel better. But whatever anxiety about the specific instrument remains the same. Furthermore, the lack of ability to process the fear remains.

Coping is successfully dealing with overcoming a problem. Distraction definitely has a place in coping skills to process their thoughts. At a level of fear 10/10 they may watch a movie or listen to music for a few minutes, when the fear is reduced to perhaps a 5/10 by utilizing this distraction, and then they can access and utilize the coping skill in a more complicated situation.

Distraction aims to create distance from the source of emotional distress so that it helps to process the uncomfortable feelings. Coping that qualify as distraction requires that a child go from an emotionally driven story that his/her mind can spin, and shift into the present distraction.

The idea that people are predisposed to favor a particular coping style is not new^[43] several authors have used interchangeable terms to categorize coping styles as being essentially an avoiding/distraction style or a confronting/monitoring style.^[44,45]

Individuals who are described as Blunters typically cope with threat by distracting themselves and avoiding threatening cues^[46] while Monitors are more likely to attend closely to threatening material and seek out additional cues.

Lisa fox et al in 2015 revealed that in reducing the pain intensity and situational anxiety in people with chronic pain, the Monitors' level of anxiety decreased following a Attention/sensation- Focused intervention. For blunters, however, their perceived levels of anxiety and pain did not attenuate following a distraction-focused intervention and finally concluded those with a high level of monitoring—may enhance the benefit of psychological approaches to management of anxiety.^[47]

McGurk Effect and Coping Strategy in Pediatric Dentistry

Considering, the changing expectations of the children and parents and to advance the area of behavioral guidance strategies, this review attempts to present a novel incongruent audiovisual stimuli and for the first time combining McGurk Effect and Attention-focused Coping Strategy in Pediatric Dentistry in reducing the children anxiety and creating a positive dental attitude.

An experiment to demonstrate the McGurk Effect

The experiment needs a minimum of three people. Let us consider one as an observer(O), another one as speaker (S) and the third one as the voice over (V). (fig., 1)

Let "O" stand facing towards "S" so that the 'observer' can view the 'speaker' directly. Place the 'Voice-over' behind "O" so that "O" is hidden. Take a pair of words, such as "Face" and "Base". Ask "S" to continuously but silently mouth the word "Face". In tandem with lip movements of "S", let "V" loudly utter the word "Base". After a few repetitions, ask the 'observer' what was heard. As per the McGurk effect, the observer should hear "Face" although the word he actually hears is "Base" repeated by the hidden voice-over.

An experiment to demonstrate the McGurk Effect in Dentistry

In the attention-focused coping strategy, an euphemism based video is created to depict the real restorative situation using cartoon characters (Tom as Dentist, Jerry as child patient) drilling the carious tooth with the drill that is symbolically represented as dragon fly.

During the restorative procedure the child is allowed to watch this video. Observer "O" is the child sitting in the dental chair. Speaker "S" is the dragonfly sound delivered through the video presentation. Voice-over "V" is the real drill sound. (fig., 2)

Here the incongruent AV stimuli is used. The auditory stimulus is the real drill sound. The incongruent visual stimulus is the dragon fly ssss sound. After the procedure, ask the observer what was heard. As per the McGurk effect, observer should hear the dragon fly ssss sound although he/she actually hears the real drill sound. In this scenario, the strength of the McGurk effect is the conscious auditory percept heard during the procedure. Here the anxious drill sound is overcome by the non anxious dragonfly sound. If we apply the distraction based coping strategy in this aspect, watching the cartoon play alone can help the child to feel better but the anxiety regarding the dental drill remains the same. But the influence of McGurk effect in attention focused coping strategy can increase the confronting/monitoring style of the child to manage the anxiety regarding the dental drill in near future.

5. CONCLUSION

Auditory-visual integration in speech perception has been a well-researched area right from the time of McGurk and MacDonald in the 1970s. The implication of McGurk Effect in behavioral pedodontics is relatively a new area of research. A comprehensive understanding of audiovisual integration in McGurk Effect can open the door to new intervention in managing the child's dental anxiety. The next step is to identify the coping strategies used by children in actual stressful situations, and to determine the effectiveness of such strategies in helping children to adjust to the particular demands of that situation. One such stressful situation is the fearful drill sound heard during dental procedure. The highly structured McGurk Effect based Attention focused coping style can be effective in managing the internal perceptions and emotions (e.g., anxiety, fear, threat) that are aroused during the dental restorative procedure and can guide favorably the child's behavior in the dental setting. The present coping strategy first of its kind in pediatric dentistry will be undertaken to innovate the area of behavioral pedodontics and will provide clear evidence regarding the clinical outcome of applying this newer strategy in near future.

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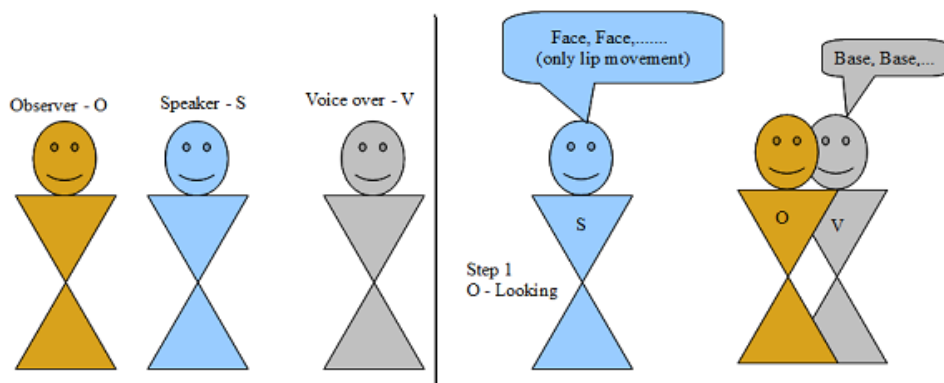
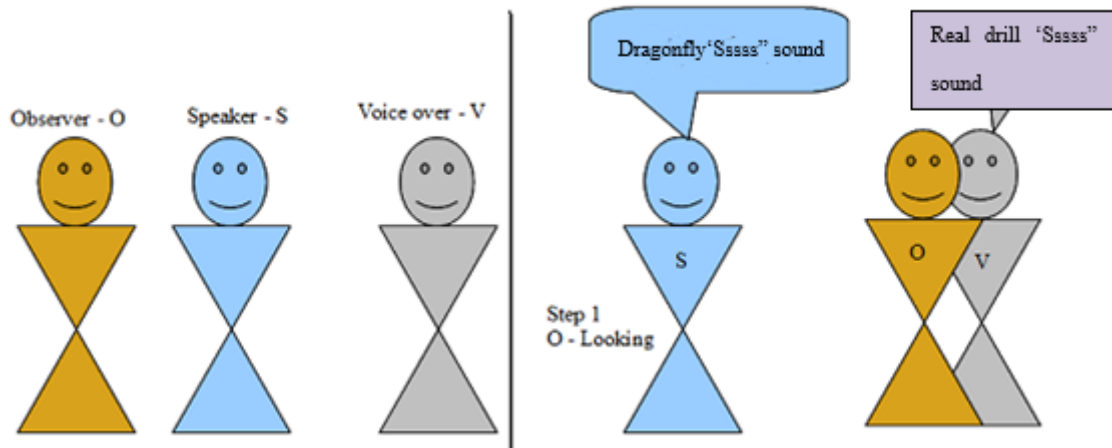


Figure 1: An experiment to demonstrate the McGurk Effect



Observer "O" is the child sitting in the dental chair. **Speaker "S"** is the dragonfly sound delivered through the video presentation. **Voice-over "V"** is the real drill sound.

Figure 2: An experiment to demonstrate the McGurk Effect in Pediatric Dentistry