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**Sensory, Cognitive, and Behavioral Considerations**

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| **REV** | **DESCRIPTION** | **AUTHOR** | **Date** |
| 1.0 | Content migration and reduction | Luke Steuber | 1/17/22 |
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**Abstract: T**his document provides a detailed guide on behavioral considerations, potential risks, and implications for individuals with ALS, CP, and other conditions using the Cognixion ONE device with brain-computer interface technology. The guide emphasizes the importance of skilled professionals in other domains, and presence of a caregiver, to assist with behavioral considerations. Some conditions are contraindicated.

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## I. Introduction and Executive Summary

Brain-Computer Interface (BCI) and wearable technologies, such as the Cognixion ONE, can significantly benefit individuals with neurological disorders like Amyotrophic Lateral Sclerosis (ALS) and Cerebral Palsy (CP), as well as other literate adult populations with various disabilities. However, behavioral considerations play a vital role in the effective use of these technologies. This comprehensive document provides an extensive guide on behavioral considerations, potential risks, and implications for individuals with ALS, CP, and other conditions using the Cognixion ONE device with brain-computer interface technology.

## II. Behavioral Considerations

### A. Amyotrophic Lateral Sclerosis (ALS)

* **Depression and Anxiety**: Individuals with ALS may experience depression and anxiety, which could impact their ability to use BCI technology effectively. Addressing mental health concerns through counseling, medication, and support groups can help improve the overall experience for these users.
* **Pseudobulbar Affect (PBA**): Some ALS patients may experience Pseudobulbar Affect, characterized by involuntary laughing and crying. This emotional instability can create challenges when using BCI technology. Proper support and understanding from caregivers can help manage this condition and enhance the BCI experience.
* **Cognitive Decline**: While ALS primarily affects motor neurons, some individuals may experience mild cognitive decline, such as difficulties with memory, attention, and problem-solving. Customizing the BCI experience to accommodate these cognitive challenges can help ensure successful use of the technology.
* **Social Functioning:** ALS can impact social functioning as the condition progresses, leading to potential isolation and frustration. Designing BCI technology that facilitates social interaction and communication can help improve the quality of life for individuals with ALS.

### B. Cerebral Palsy (CP)

* **Mood Disorders**: People with CP may be at an increased risk of developing depression, anxiety, and other mood disorders that may affect their ability to use BCI technology effectively. Addressing these conditions through appropriate interventions, such as medication, therapy, and support groups, can improve the overall experience for CP users.
* **Sensory Processing Issues**: Some individuals with CP may experience sensory processing issues, causing difficulties in processing and interpreting sensory information. Customizing the BCI device to minimize sensory overload and adapting the technology's interface to accommodate sensory preferences can improve the overall experience for users with CP.
* **Cognitive Impact**: Many people born with Cerebral Palsy also have some cognitive and language impact depending on the extent to which they were originally impacted.

### C. Older Adults and Cognitive Impairments

For many of our ALS patients in particular, disease of aging will be a factor.

* **Dementia**: Older adults may experience cognitive decline, including various forms of dementia, which can affect their ability to use BCI technology effectively. Tailored approaches to accommodate cognitive impairments are necessary to ensure a positive experience for these users.
* **Aphasia**: Aphasia, or the loss of ability to understand or express speech, can be a challenge for older adults using BCI technology. Customizing the BCI device to accommodate communication difficulties can improve the overall experience for users with aphasia.
* **Memory Loss**: Memory loss, often associated with aging, can impact an individual's ability to learn and use new technology like BCI devices. Customizing the user interface and providing simple, clear instructions can help accommodate memory challenges and enhance the user experience.
* **Sensory Decline**: Aging can lead to a decline in sensory abilities, such as vision and hearing. BCI technology should be designed to accommodate these sensory changes, using larger text, adjustable audio settings, and other visual or auditory aids.

### D. Other Behavioral Considerations

* Huntington's Disease: Patients with Huntington's Disease may experience a wide range of psychiatric comorbidities, including depression, anxiety, irritability, and inappropriate behavior. Addressing these conditions through proper interventions, such as medication, therapy, and support groups, can help improve the BCI experience for these users. Additionally, the cognitive decline often associated with Huntington's Disease should be considered when customizing the BCI experience.
* Myasthenia Gravis: Anxiety and panic attacks are significant concerns for individuals with Myasthenia Gravis. The presence of a medical professional during the initial BCI fitting may help mitigate these risks. Addressing anxiety through appropriate interventions, such as medication or relaxation techniques, can also help manage anxiety levels and improve the BCI experience.
* Locked-In Syndrome (LIS): Despite mental health disorders like depression and anxiety being common among individuals with LIS, they typically retain full mental capacity. Therefore, they may still benefit from BCI technology. Customizing the BCI device to accommodate communication difficulties and providing proper support can improve the overall experience for users with LIS.
* Rett Syndrome: Users with Rett Syndrome may experience unusual physical behaviors, cognitive disabilities, and autistic-like behaviors. Customizing the BCI device to accommodate these unique needs can help ensure a positive experience. Providing additional support and understanding from caregivers and clinicians can also help manage some of the challenges associated with Rett Syndrome.
* Spinal Cord Injuries (Quadriplegia): Individuals with spinal cord injuries may experience mental health comorbidities like depression and anxiety. However, they often retain full mental capacity, making them suitable candidates for BCI technology. Customizing the BCI device to accommodate communication challenges and providing proper support can improve the overall experience for users with spinal cord injuries.
* Duchenne Muscular Dystrophy: Patients with Duchenne Muscular Dystrophy may display behavioral issues associated with autism, ADHD, and OCD. While these conditions should be considered, they do not necessarily disqualify patients from using BCI technology. Customizing the BCI device to accommodate communication challenges and providing proper support can help improve the overall experience for users with Duchenne Muscular Dystrophy.
* Multiple System Atrophy (MSA): MSA patients may experience cognitive impairments and progressive intellectual deterioration. A window of prime candidacy may exist for most patients, but mental deterioration may progress to a point of disqualification as the disease advances. Customizing the BCI experience to accommodate these cognitive challenges can help ensure successful use of the technology for as long as possible.

### E. Additional Conditions and Concerns

1. Pseudobulbar Affect (PBA): Pseudobulbar affect can impact users with various neurological conditions, causing involuntary laughing and crying. Customizing the BCI device to accommodate communication challenges and providing proper support can help improve the overall experience for users with PBA.

2. Stroke: Individuals who have experienced a stroke may face various cognitive and physical challenges, including aphasia, memory loss, and motor function difficulties. Customizing the BCI device to accommodate these challenges can help ensure a positive experience for stroke survivors.

3. Parkinson's Disease: Patients with Parkinson's disease may experience cognitive decline, motor function difficulties, and emotional challenges such as depression and anxiety. Customizing the BCI device to accommodate these challenges and providing proper support can improve the overall experience for users with Parkinson's disease.

## III. Potential Risks and Implications

A. Understanding the Device's Purpose: It is essential to ensure that the user understands the purpose and benefits of the BCI technology. If the patient cannot comprehend how the device is helping them, they may need to be excluded from using the technology, as it can potentially do more harm than good.

B. Uncontrolled Behavioral Incidents: The monetary cost of an uncontrolled behavioral incident resulting in the destruction of the device should be considered. Due to the fragile nature of BCI technology, repeated outbursts causing damage to the device may exclude certain patients.

C. Discomfort with Augmented Reality: If a user experiences discomfort or anxiety when using a BCI device with augmented reality, they may need to be excluded. These negative feelings can lead to an increased risk of panic attacks or other behavioral incidents that can cause harm to the patient or the device.

D. Device Customization and Adaptability: Ensuring proper customization and adaptability of the BCI device for each user's unique needs is crucial to avoid potential risks and implications. Inadequate customization may lead to discomfort or ineffective use of the technology, reducing the overall benefits for the user.

E. Training and Support: Proper training and support for both users and caregivers are essential in mitigating potential risks and implications. Ensuring that the user can fully utilize the BCI technology, and that caregivers understand how to assist the user, can significantly reduce potential issues and enhance the overall experience.

F. Ethical Considerations: The use of BCI technology raises several ethical considerations, such as privacy, consent, and autonomy. Ensuring that users understand the implications of using BCI technology and addressing any ethical concerns is crucial to avoid potential risks and implications.

G. Psychological Adjustment: The use of BCI technology may necessitate a psychological adjustment for users, particularly those with significant disabilities. Providing counseling and support can help users adapt to the technology, improve their overall experience, and reduce potential risks.

H. Interactions with Other Devices and Treatments: BCI technology should be compatible with other assistive devices and treatments used by the individual. Failure to consider compatibility may lead to potential risks and implications, such as reduced effectiveness or interference with other treatments.

I. Maintenance and Durability: The durability and maintenance requirements of BCI devices can pose potential risks and implications for users, particularly if they are unable to access necessary repairs or replacement parts. Ensuring the device is built to withstand daily use and providing support for device maintenance can reduce these risks. Damage to a device is much more likely when sensory and behavioral concerns are present.

## IV. Recommendations for Addressing Behavioral Considerations and Potential Risks

A. Tailored Approach: Designing and implementing BCI technology should involve a tailored approach for each user, considering their unique needs, challenges, and preferences. This approach can help ensure the safety, compliance, and effectiveness of the technology for users with different needs.

B. Collaboration with Healthcare Professionals: Collaborating with healthcare professionals, such as neurologists, therapists, and counselors, can provide valuable insights into the user's specific needs and challenges. This collaboration can help ensure that the BCI technology is customized effectively and used safely.

C. User and Caregiver Training: Providing comprehensive training and support for users and their caregivers is essential to ensure the effective use of BCI technology. Training should cover device operation, maintenance, troubleshooting, and strategies for addressing behavioral considerations.

D. Ongoing Monitoring and Evaluation: Regular monitoring and evaluation of the user's experience with BCI technology can help identify potential risks and implications early on, allowing for prompt intervention and adjustment of the device or approach as needed.

E. Advocacy and Policy Changes: Advocating for policy changes that support the accessibility, affordability, and ethical use of BCI technology can help mitigate potential risks and implications. This includes advocating for insurance coverage of BCI devices, ensuring data protection regulations are in place, and promoting ethical guidelines for the use of BCI technology.

## V. Conclusion

Behavioral considerations play a critical role in the effective use of BCI technology for individuals with ALS, CP, and other literate adult populations with various disabilities. Ensuring a tailored approach to designing and implementing assistive technology devices is vital for ensuring safety, compliance, and effectiveness for users with different needs. Addressing potential risks and implications, collaborating with healthcare professionals, providing training and support, and advocating for policy changes can help create a positive experience for users with different behavioral considerations.