

Abstract

Autism spectrum disorder is a neurodevelopmental condition that often co-occurs with sensory processing differences. Individuals with those conditions often display sensory-seeking behaviors and sensory understimulation that lead to distress or unintended self-harm. While existing fidget devices are popular, it is suggested that their emphasis on visual or tactile stimuli proves to be ineffective at sensory-grounding in autistic individuals. This paper proposes the design of a cost-effective, low-tech therapeutic stimulation tool specifically for adolescents (17-18 years old) with ASD and SPD. The design aims to channel sensory craving behaviours through controlled, targeted proprioceptive and tactile stimuli – offering a safe and more accessible mimic to sensory integration therapy. The tool is designed as a bistable hand-gripper; it requires an optimised grip force of approximately 7.5 kg, encouraging repetitive muscle contraction that alleviates sensory underload. In order to ensure safety and durability for low-functioning autistic individuals – specifically against blunt force or mouthing – the tool includes a fatigue-resistant, polyether-based thermoplastic polyurethane core surrounded by high-density memory foam for deep pressure stimulation. The exterior uses a food-grade, textured silicone cladding and impact-resistant polypropylene blocks, deliberately avoiding fragile mechanisms, electronic components, or toxic materials. The next steps of the research would focus on prototyping and testing to evaluate the device's feasibility in minimising sensory understimulation within the target population in daily life.

Introduction

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental condition, and up to 90% of autistic individuals experience sensory processing differences (SPD). An aspect of SPD is hyposensitivity to sensory cues – it can leave an autistic individual under-stimulated and lead to sensory seeking behaviors such as biting hands, hitting oneself, or mouthing inedible objects. These behaviors can cause physical injury, choking, or ingestion of toxic material, especially for low-functioning autistic individuals who cannot communicate their needs.

Current options fall short – evidence shows that commercial fidget devices like pop-its and sensory putty do not yield effective results and can even act as distractions, while sensory integration therapy places a high financial burden on families.

Moreover, ASD is growing in prevalence worldwide, and so is the number of autistic individuals who self-harm because of unmet sensory needs. A safe, non-toxic, intuitive tool that provides proprioceptive input without relying on communication would be an accessible way to reduce injury and stress in daily life.

Research question: How can a fidget tool be designed to satisfy the sensory seeking needs of autistic individuals with SPD, so that stimming takes place under controlled and safe conditions?

Design process

Constraints (low-functioning users): No small parts (springs, gears) that can break or be swallowed; food-grade materials and no sharp edges; operable without instructions or communication.

Sensory modality: Smell, sound and vision were ruled out, as scent preferences vary too much and electronics add cost, battery upkeep and fragile parts. The design uses tactile and proprioceptive input instead.

Dimensions: Grip dimensions come from hand data

(Kong & Lowe, 2005; Daruis et al., 2021). The 95th percentile gives a 4 cm grip diameter and 10 cm height. Target grip force is 20% of the 95th percentile 18-year-old male maximum (7.5 kg, or 73.5 N) so repeated squeezing does not fatigue the user.

Mechanism: Fitness hand grippers were rejected because their torsion spring prevents the handles from compressing flat. A slap bracelet's bistable core was rejected because the grip cylinders are too narrow and it raises safety concerns. The final design uses a TPU core rod cut slightly longer than the distance between the top and bottom blocks. It bows outward when installed and snaps to a second stable position when squeezed straight.

Materials: Polyether TPU 50D core (fatigue and hydrolysis resistance, low toxicity), a high-density memory foam layer, and Shore 30A silicone cladding. Polypropylene end blocks (low toxicity, low cost, durable).

Stiffness: Applying Euler-Bernoulli fixed-fixed beam theory gives $E \approx 118$ MPa. The closest grade is 50D.

Conclusion

A low-tech, mechanical sensory tool was designed to give proprioceptive and tactile input to adolescents with ASD and sensory processing differences. Its bistable TPU core provides resistance and a clear snap, and its layered handles and rounded blocks are built to withstand mouthing, biting and impact. The design avoids electronics and small parts to keep cost and failure risk low.

Next steps:

1. Measure squeeze force and snap behaviour on printed prototypes, and refine the core using a large-deflection model
2. Run fatigue, bite and sound-level tests
3. Pilot usability with neurotypical peers, then trial with ASD participants aged 16-18, with ethics approval, guardian consent and assent, and

- occupational therapist involvement
4. Compare behavioural outcomes against stress balls and commercial grippers
5. Evaluate the quiet variant and multiple sizes

Discussion

The tool targets understimulation and sensory-seeking behaviour. Squeezing the handles straightens the core, which pushes back and requires sustained muscle effort. This gives proprioceptive input, and the ridged silicone adds tactile input. The snap on release gives a predictable sound that may act as a focus point and help with habituation, though this has not been tested.

The design differs from common fidget tools in two ways. Pop-its and putty give mostly visual and tactile input, which showed little benefit for students with ASD in classroom studies (Schoenen et al.). This tool gives resistance-based input instead. Compared with a stress ball or hand gripper, it adds a bistable action that signals when the squeeze is complete, and a layered surface built to survive chewing and throwing.

