GobbleMock: An Adaptive Antipode Robot for Adolescent Orthorexia Nervosa

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Abstract

Orthorexia nervosa is a clinically significant obsession with healthy eating. It involves acute anxiety, emotional distress, and rigid dietary restrictions that impair daily functioning. Adolescents are particularly at risk due to social media pressure, identity formation struggles, and high rates of anxiety disorders. To give additional support for people with orthorexia (beyond therapies) chatbots and apps are being developed, but physical robots remain largely unstudied.

The psychological profile of orthorexia includes perfectionism and emotional instability. Rumination and rejection of emotions keep eating disorders going, yet not everyone can access or afford therapy.

Socially assistive robotics shows promise: the Purrble device, a soft robotic toy, has helped reduce sensory overload and loneliness in people with eating disorders [1].

This study proposes GobbleMock, a robot that mirrors anxious behaviour in an absurdist, playful way. By combining humour, tactile grounding, and adaptive algorithms, it offers a personalised approach to reducing orthorexia symptoms in adolescents. The method includes haptic feedback, trigger learning, CBT techniques (see Appendix F), and a four-week procedure using validated scales (TOS, DASS-21, DERS-SF – see Appendices A, B, C).

Introduction

Orthorexia nervosa is a severe and clinically significant form of obsession with healthy food. It is marked by acute anxiety, emotional distress, and impaired daily functioning- all provoked by excessively rigid dietary rules. Not surprisingly, eating disorders frequently co-occur with depression, anxiety disorders, and body dysmorphic disorder [3].

Adolescents are especially vulnerable. According to Kapn and Makaricheva (2024), the global prevalence of orthorexia ranges from one to seven percent, and roughly one third of students experience some symptoms[5]. Three factors help explain this. First, social media algorithms frame rigid dietary restrictions as both aesthetic and socially desirable. Second, during the identity crisis of adolescence, controlling food "purity" can feel like a manageable tool when everything else feels chaotic. Third, high rates of anxiety mean that ritualised eating sometimes becomes a maladaptive way of reducing emotional tension.

Researchers have responded by designing chatbots and mobile applications, but the role of a physical robot remains largely unexplored. This study therefore asks: Can the GobbleMock antipode robot influence orthorexic habits and psychological states by mirroring anxious behaviour back to the user?

Literature review

Existing works suggest that the psychological profile of individuals with orthorexia is characterized by perfectionism, obsessive-compulsive tendencies, and emotional instability. The desire to structure a chaotic reality often turns into a pathological preoccupation with food purity, especially when self-esteem is low. Adhering to strict dietary rules provides an illusion of achievement and social validation [6].

Meta-analyses indicate that rumination and rejection of emotional experience are central to maintaining eating disorders, which points toward the need for interventions that promote emotional acceptance and cognitive reappraisal [1]. Although cognitive and behavioral therapies help some patients, not everyone can afford or access them. To fill this gap, recent reviews have emphasised the potential of technological tools. The Purrble device, a soft robotic toy that simulates a heartbeat, deserves special attention. Its vibration speeds up and then slows down as the user strokes it, creating an experience of co-regulation. A pilot study found that Purrble helped individ-

uals with eating disorders manage sensory overload and emotional dysregulation, reducing distress and loneliness [2].

Jung and colleagues (2025) argue that socially assistive robots are most effective in mental healthcare when they are personalised and capable of adapting to individual needs[4]. Building on that idea, the current study proposes that an adaptive robot can bridge digital cognitive tools and sensory support - something chatbots alone cannot do well.

Methodology

Participants. Adolescents aged 14-18 with TOS $\geq$ 35 and BMI (Appendix E) $\geq$ 17.5. Exclusion: psychosis, severe suicidality, allergies. Target n = 34 (power analysis: α=0.05, power=0.80, d=0.5, 20% attrition).

GobbleMock is a soft, plush-covered mobile robot (20 cm, rabbit-shaped). It mirrors anxiety through chaotic spinning, funny sounds, and gentle "nibbling". It provides haptic feedback for breathing (4s/6s) and pacing. It learns triggers via questionnaire, in-app tagging, and optional heart rate monitor.

Measures. Primary (pre/post): TOS, DASS-21, DERS-SF. Secondary: interaction logs and daily EMA (anxiety 0-10 - see Appendix D).

Procedure. Week 1: consent, baseline, orientation. Weeks 2-3: robot at home, daily EMA, weekly therapist review. Week 4: post-assessment. Safety alert if anxiety ¿ 8/10 for three days.

Analysis. Paired t-tests. Cohen's d for effect sizes. Multilevel modelling for EMA. Thematic analysis for interviews.

Ethics. Two-week weaning protocol. Data anonymised and stored locally. Robot does not replace medical care. Absurdist mode user-disableable.

Expected outcomes. We expect TOS scores to decrease by at least 20%, which is roughly comparable to the psychoeducation effects reported by Leccese et al. (2025) [7].DASS-21 anxiety subscale is expected to drop by at least 15%. A feasibility criterion is set at four or more daily interactions with the robot. In qualitative reports, we hope to find themes like "being seen but not judged."

Conclusion

This proposal addresses an under-researched area in adolescent orthorexia treatment: the potential of a physically present, interactive robot. What makes GobbleMock different from a smartphone app is that it meets the user during moments of acute distress, when cognitive strategies are hard to access, and offers tactile grounding and real-time feedback. The absurdist mirroring is intended to disrupt rigid eating-related compulsions gently, without confrontation. Adaptive algorithms are there so the robot learns what each user finds most triggering and most calming. We predict roughly a 20% reduction in orthorexic symptoms and a 15% reduction in anxiety, but these are estimates that need testing.

Limitations are clear. There is almost no direct evidence yet for robotics specifically in orthorexia, and attachment to the device will require careful ethical monitoring. Still, if even modest effects are found, adaptive robotics could add something genuinely new to how we support adolescents who struggle with rigid healthy eating. Further feasibility studies and controlled trials are the logical next step.

References

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Appendix A: Teruel Orthorexia Scale (TOS)

TOS (Teruel Orthorexia Scale) – A 17-item scale distinguishing healthy orthorexia (interest in healthy eating) from pathological orthorexia (obsessive fixation with negative consequences). Scores ≥ 35 indicate clinically significant orthorexic symptomatology.

Appendix B: DASS-21

DASS-21 – A 21-item self-report questionnaire measuring depression, anxiety, and stress (7 items per subscale). Items are scored 0-3, with subscale scores doubled to range 0-42. Higher scores indicate greater severity of negative emotional states.

Appendix C: DERS-SF

Difficulties in Emotion Regulation Scale – Short Form. An 18-item measure assessing six domains of emotion regulation difficulties: non-acceptance of emotional responses, difficulty engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity.

Appendix D: EMA Daily Prompt

EMA (Ecological Momentary Assessment) – A method of collecting real-time data on participants' current states in their natural environment. Participants receive daily prompts to rate anxiety (0-10) and identify triggers. This captures fluctuations missed by retrospective questionnaires.

Appendix E: BMI

BMI ≥ 17.5 – Body Mass Index calculated as weight (kg) divided by height (m) squared. The cutoff of 17.5 represents the lower threshold of underweight. In eating disorder research, this ensures participants are medically stable without acute malnutrition or electrolyte disturbances, making it safe to participate in a non-clinical robotics study.

Appendix F: Cognitive Behavioral Therapy (CBT)

CBT is a psychotherapeutic approach targeting maladaptive thoughts and behaviors. For orthorexia, it addresses overvalued beliefs about food purity. GobbleMock integrates CBT by prompting cognitive restructuring, guiding exposure with haptic feedback, and detecting relapse patterns.