# Sealy: Playful Robotic Companions for Everyday Productivity

ANONYMOUS AUTHORS

**ACM Reference Format:**
ANONYMOUS AUTHORS. 2018. Sealy: Playful Robotic Companions for Everyday Productivity. In *Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX).* ACM, New York, NY, USA, 7 pages. https://doi.org/XXXXXXX.XXXXXXX

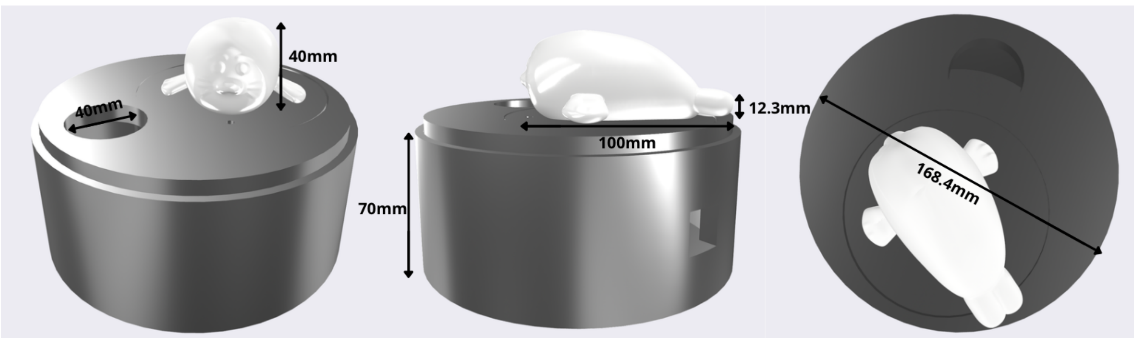



figure 1: Dimensions of Sealy and its base (front, side, top views).

## ABSTRACT

Desk work is punctuated by small self-regulation lapses, posture drift, fatigue, and brief off-task moments. We present Sealy, a seal-like desktop companion that explores nonverbal co-regulation through contingent mirroring. Sealy mirrors posture by subtly slumping when the user slouches, and mirrors fatigue via gradual eyelid closure. Off-task phone engagement is signaled through a focus metaphor: Sealy sits on a rotating ice floe oriented toward a "fishing hole" during on-task work; during phone use, the floe rotates and Sealy turns away.

We contribute a design rationale for low-demand, socially legible cues, a minimal state-to-behavior mapping, and a feasibility evaluation plan centered on interpretability, role framing (pet vs. monitor), autonomy, and perceived surveillance.

Author's Contact Information: ANONYMOUS AUTHORS.


Manuscript submitted to ACM

## INTRODUCTION AND RELATED WORK

Productivity tools often rely on alerts, timers, and tracking to externalize self-regulation, but these approaches can disrupt attention and introduce evaluative pressure. We propose an alternative: Sealy, a small desk companion that uses peripheral, nonverbal cues to reflect user behavior without explicit instruction. Sealy employs behavioral contingency as a compact cue language: slumping in response to poor posture, closing its eyelids gradually to signal fatigue, and rotating away from its fishing hole when phone use is detected. These cues are designed not to enforce compliance, but to provide low-salience, interpretable feedback without interrupting workflow or imposing corrective actions.

This work introduces Sealy's interaction mechanism and presents a feasibility study investigating how users interpret these cues. We ask: Does a desk-side pet robot that mirrors fatigue, slouching, and phone distraction affect workers' focus? Specifically, we explore how Sealy's cues are perceived, and how they influence short-term disengagement behaviors without increasing perceived surveillance.

Desktop companions are often framed as pets, peers, or supervisors, with this framing shaping perceived support and pressure [4]. Digital companions must balance efficacy with privacy, a well-documented tension in the literature [5]. For example, interruption-detection systems (e.g., phone-use monitoring) can improve productivity but risk inducing a sense of surveillance in users [7]. Sealy addresses these challenges by prioritizing role framing, autonomy, and perceived surveillance as key outcomes.

Mirroring and nonverbal synchrony can shape robot perception, though effects depend on context and timing [1]. Upper-body pose mirroring enhances perceived humanness and rapport [2], while expressive desk artifacts influence posture and task persistence [3]. Sealy builds on this by using mirroring as a peripheral, optional cue for micro-corrections, avoiding direct instruction.

Animal-like companions (e.g., PARO [12], Keepon [13]) show that minimal, readable motions sustain engagement, while embodiment alters interaction quality compared to virtual or plush alternatives [14–16, 21]. Sealy's seal-like, baby-schema form leverages evidence that cuteness increases caretaking motivation [9], evokes affiliative emotion [10], and focuses attention [11], framing contingent cues as care rather than evaluation.

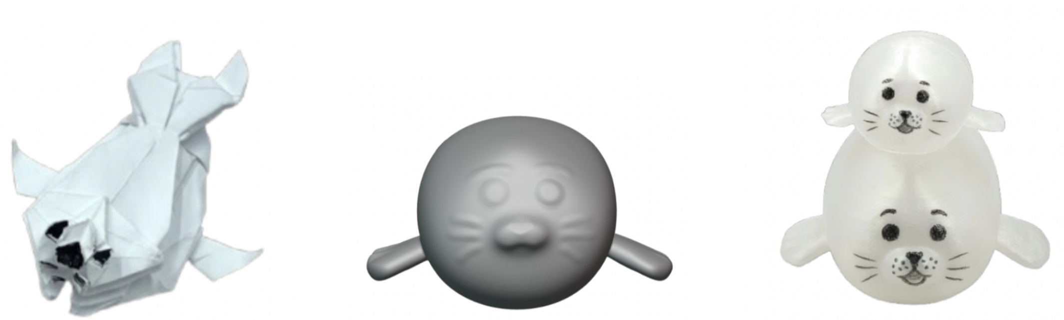
Posture feedback systems face trade-offs in privacy, robustness, and long-term effects [8]. Sealy avoids explicit corrective feedback, instead triggering low-intensity, contingent behaviors to mitigate intrusiveness.

Prior work isolates mirroring/synchrony, affective companionship, or productivity feedback. Sealy fills this gap by introducing a minimal, interpretable state-to-behavior cue language for a pet-like desktop robot, integrating posture, fatigue, and off-task engagement. Our study tests whether contingency is experienced as support rather than supervision [1–5, 7, 8, 12–16, 21].

## 3. DESIGN RATIONALE

Sealy is an ambient desk companion: cues should be perceivable in peripheral vision without competing with the primary task. Behaviors are constrained to low amplitude, multi-second transitions, and no speech/notifications, and are intended to avoid evaluative feedback (e.g., scores, warnings) that can trigger supervisory framing. Sealy's seal-like, baby-schema form supports quick legibility from brief glances. A rotating ice floe facing a "fishing hole" provides a single glanceable channel: aligned = on-task; turned away = off-task.

Sealy uses a minimal set of contingent cues. Posture drift triggers a gradual slump that mirrors direction and "weight," returning to baseline as posture recovers. Fatigue-related cues (e.g., sustained stillness or head/eye droop) trigger slow



(a) (b) (c)

Figure 2: Some prototypes of Sealy the Seal
(a) Origami Sealy
(b) 3D model of Sealy
(c) Two 3D printed Sealy in PLA

eyelid closure and reduced motion tempo. Off-task phone engagement rotates the floe, turning Sealy away from the hole without scolding.

To preserve flow and reduce "being watched" impressions, Sealy applies hysteresis (brief confirmation before switching states) and persistence (states remain long enough to be noticed, then decay to baseline).

In addition, we minimize surveillance risk through on-device inference, no raw video retention, and transparent sensing controls (detailed in §3.1.2).

Figure 3.a: Initial position of Sealy

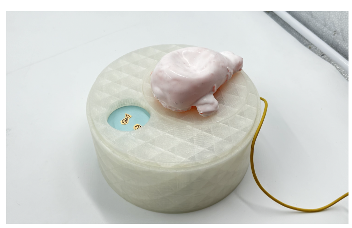


Figure 3.b: Sealy slouching when the posture isn't correct

Figure 3.c: Sealy turns away from the fishing hole during phone distraction

### 3.1 Technical implementation

*3.1.1 Hardware implementation.* Sealy was designed as a 3D-modelled character in Blender, emphasizing a rounded, organic shape and expressive facial features to foster approachability. The model was 3D-printed at scale and used as a mold to cast a silicone replica (Rebound 25), chosen for its elastic properties to enable realistic deformation during slouching interactions.

To support dynamic movement, Sealy was mounted on a motorized platform driven by a stepper motor and gear assembly, enabling rotation away from the user to signal disengagement (e.g., during phone use). A servomotor controls a transparent fishing line anchored to the top of Sealy's back, producing both postural slumping and subtle breathing motions. A second servomotor, connected to Sealy's eyelids via thin wires, facilitates gradual eyelid closure, reinforcing visual cues of fatigue or drowsiness.

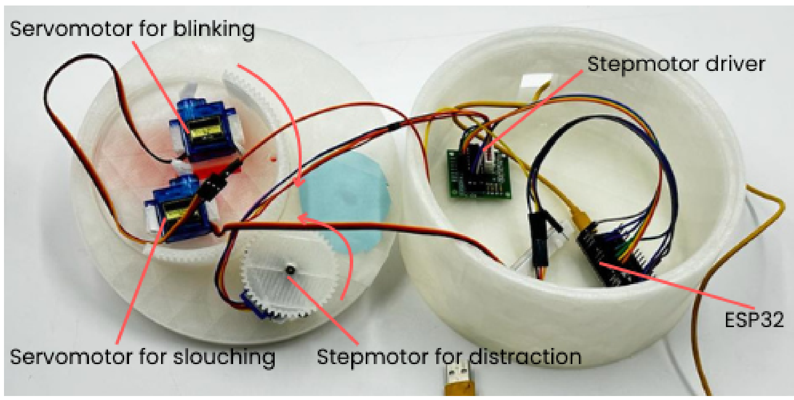



figure 4: Electronic components showing the inside of the platform

*3.1.2 Software implementation.* To detect user behaviors indicative of disengagement or fatigue, Sealy integrates three computer vision models, each tailored to a specific behavioral cue. For posture detection, the system employs MediaPipe Pose, which tracks landmarks of the shoulders and spine. Following an initial calibration phase to establish a baseline posture, the model continuously compares the user's current position to this baseline, identifying excessive slouching in real time. Phone detection combines MediaPipe with a custom object detection class based on YOLOv8n, enabling robust identification of phone use during tasks. Fatigue detection relies on MediaPipe Face Mesh, leveraging three established metrics: Eye Aspect Ratio (EAR = $\frac{\|p_2-p_6\|+\|p_3-p_5\|}{2\times\|p_1-p_4\|}$), where $p_1$ to $p_6$ represent facial landmark coordinates around the eye; Mouth Aspect Ratio (MAR = $\frac{\|p_2-p_8\|}{\|p_4-p_6\|}$), with $p_1$ to $p_8$ corresponding to landmarks around the mouth; and Percentage of Eye Closure (PERCLOS = $\left(\frac{\text{Time Eyes Closed}}{\text{Total Time}}\right) \times 100\%$).

These models operate within a unified processing loop on the user's computer, with real-time outputs transmitted to the hardware system via a WebSocket server. This architecture ensures seamless synchronization between behavioral detection and Sealy's physical responses.

## 4. Study Protocol: Lab Feasibility Study

### 4.1 Goal

This lab feasibility study examines whether a desk-side pet robot (Sealy) that uses contingent nonverbal cues influences workers' focus and disengagement behaviors. We focus on whether Sealy reduces off-task phone engagement and whether its cues are perceived as supportive rather than supervisory.

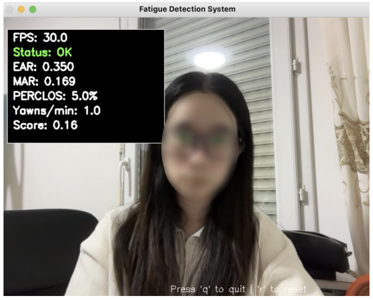



Figure 5.a: The user shows no signs of fatigue

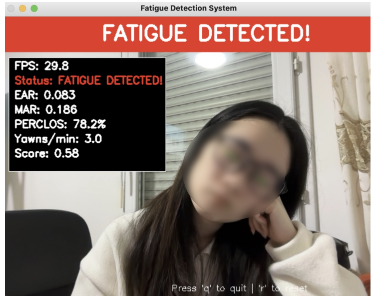



Figure 5.b: The user is detected closing their eyes

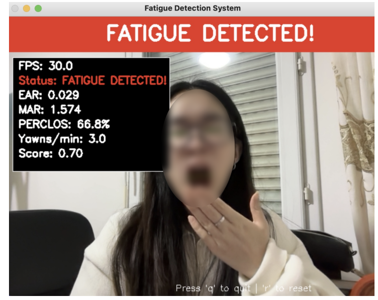



Figure 5.c: The user has their mouth open

### 4.2 Research Question

We address one overarching research question: "How does a desk-side pet robot that mirrors detected fatigue, slouching, and phone distraction affect workers' focus, disengagement behaviors, and perceptions of autonomy?" We evaluate this question by measuring off-task phone engagement, participants' role framing of Sealy and perceptions of autonomy/surveillance, and exploratory task performance outcomes.

### 4.3 Design

We employ a within-subjects design with four counterbalanced conditions using a Latin square. In C0 (Control), no robot is present. In C1 (Non-Contingent), Sealy exhibits idle motions (e.g., breathing-like micro-movements) without linking behavior to participant state, controlling for robot presence and motion. In C2 (Mirroring-Only), Sealy contingently mirrors posture slump and fatigue cues (via eyelid closure) but does not rotate in response to phone engagement. In C3 (Full Contingency), Sealy mirrors posture/fatigue and additionally rotates its platform contingent on phone engagement. This design isolates the contribution of mirroring (C2) and phone-linked cues (C3), while C1 controls for motion alone. The planned sample is $N = 4$, adjustable based on resources.

### 4.4 Task

Participants complete a proofreading and error-detection task using four parallel passages counterbalanced across conditions. Each condition lasts 15–20 minutes. Outcomes include detection accuracy and completion time, and we treat pause durations as exploratory.

### 4.5 Apparatus

Participants work on a laptop with Sealy placed in peripheral vision, and their phone remains on the desk with free use. Phone engagement is logged as pickup count and time to first pickup; if consented, an overhead video may be collected for audit coding.

### 4.6 Procedure

Participants first receive a brief orientation (2–3 minutes) with a neutral cover story describing the study as an evaluation of desktop companion behaviors. They then provide a short baseline focus/affect rating (about 1 minute). For each condition, participants complete a 15–20 minute work block with the condition-specific Sealy behavior, followed by a short post-block survey (2–3 minutes) assessing focus, workload (NASA-TLX), role framing, and autonomy/surveillance perceptions. A 3–5 minute break separates blocks. At the end of the study, participants complete manipulation checks and a short interview.

### 4.7 Measures

Our study employs a multi-method approach to evaluate Sealy's impact. Behavioral measures track phone pickups (count and time to first pickup) and task performance (accuracy and completion time). Self-report measures include a focus scale, NASA-TLX for workload, role framing assessments (pet/peer/supervisor), and perceptions of autonomy/surveillance. Qualitative data explores participants' perceptions of Sealy's behavior, awareness, and supportive vs. supervisory nature. Manipulation checks verify contingency awareness and cue recognition.

### 4.8 Operational Definitions

Phone engagement is operationalized as phone pickup events (phone lifted) and time to first pickup within each block. Posture drift is defined as shoulder deviation of at least 15° sustained for at least 5 seconds (MediaPipe Pose). Fatigue cues are defined using PERCLOS exceeding 70% for at least 3 seconds (MediaPipe Face Mesh). Sealy's contingent response latency is specified as 1–2 seconds after detection, and movement parameters are set to remain noticeable but not disruptive, with posture mirroring implemented as a 10–15° torso slump over 2–3 seconds, eyelid closure to approximately 50% over 1–2 seconds, and phone-linked platform rotation of approximately 30° over 3 seconds.

### 4.9 Analysis Plan

We prioritize estimation and feasibility signals and compare C3 (Full Contingency) to C0/C1 for phone engagement and interpretation outcomes, using mixed-effects models with condition as a fixed effect and participant as a random intercept. We report effect sizes (Cohen's *d*) and 95% confidence intervals, and we treat task performance outcomes as exploratory.

### 4.10 Validity Controls

We counterbalance condition order using a Latin square and counterbalance passages as parallel materials to reduce learning effects. We apply smoothing and hysteresis in Sealy's state transitions to avoid abrupt reactivity and reduce carryover across conditions.

### Conclusion

This work presents Sealy, a minimal desk companion that uses subtle, contingent nonverbal cues to support focus by mirroring user posture, fatigue, and phone engagement. As a proposed feasibility study, this protocol aims to explore whether such cues can reduce distractions without introducing evaluative pressure.

Expected contributions include:

- Reduction in off-task phone use through peripheral awareness cues (e.g., Sealy turning away);
- Promotion of a supportive (rather than supervisory) perception, leveraging pet-like embodiment;
- Exploratory insights into task performance impacts.

By prioritizing user autonomy and calm interaction, Sealy offers a potential alternative to intrusive productivity tools. Future work will validate these effects in naturalistic settings and compare them to explicit feedback systems.

## REFERENCES

## References


[1] D. Stoeva, A. Kriegler, and M. Gelautz. Body Movement Mirroring and Synchrony in Human–Robot Interaction. *ACM Transactions on Human-Robot Interaction*, 13(4):1–26, 2024.

[2] L. A. Fuente, H. Ierardi, M. Pilling, and N. T. Crook. Influence of upper body pose mirroring in human-robot interaction. In *International Conference on Social Robotics*, pages 214–223. Springer International Publishing, 2015.

[3] C. Breazeal, A. Wang, and R. Picard. Experiments with a robotic computer: body, affect and cognition interactions. In *Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction*, pages 153–160, 2007.

[4] S. Yoon, S. Kim, G. Park, and H. Lim. Evaluating How Desktop Companion Robot Behaviors Influence Work Experience and Robot Perception. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*, pages 1–7, 2024.

[5] H. Kim and B. Lee. Investigating work companion robot interactions to enhance work-from-home productivity and experience. *Archives of Design Research*, 37(4):43–63, 2024.

[6] R. C. Preston and N. T. Fitter. Increasing Personalization in Long-Term Interactions with a Workplace Companion Robot.

[7] R. Wang, M. Chen, and H. Hu. Labo is Watching You: A Robot that Persuades You from Smartphone Interruption. In *Companion of the 2023 ACM/IEEE International Conference on Human-Robot Interaction*, pages 810–812, 2023.

[8] C. Krauter, K. Angerbauer, A. Sousa Calepso, A. Achberger, S. Mayer, and M. Sedlmair. Sitting posture recognition and feedback: a literature review. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems*, pages 1–20, 2024.

[9] M. L. Glocker, D. D. Langleben, K. Ruparel, J. W. Loughead, R. C. Gur, and N. Sachser. Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults. *Ethology*, 115(3):257–263, 2009.

[10] K. K. Steinnes, J. K. Blomster, B. Seibt, J. H. Zickfeld, and A. P. Fiske. Too cute for words: Cuteness evokes the heartwarming emotion of kama muta. *Frontiers in Psychology*, 10:387, 2019.

[11] H. Nittono, M. Fukushima, A. Yano, and H. Moriya. The power of kawaii: Viewing cute images promotes a careful behavior and narrows attentional focus. *PloS One*, 7(9):e46362, 2012.

[12] W. Moyle, C. J. Jones, J. E. Murfield, L. Thalib, E. R. Beattie, D. K. Shum, et al. Use of a robotic seal as a therapeutic tool to improve dementia symptoms: a cluster-randomized controlled trial. *Journal of the American Medical Directors Association*, 18(9):766–773, 2017.

[13] H. Kozima, M. P. Michalowski, and C. Nakagawa. Keepon: A playful robot for research, therapy, and entertainment. *International Journal of Social Robotics*, 1(1):3–18, 2009.

[14] W. D. Stiehl, J. Lieberman, C. Breazeal, L. Basel, L. Lalla, and M. Wolf. The Design of the Huggable: A Therapeutic Robotic Companion for Relational, Affective Touch. In *AAAI Fall Symposium: Caring Machines*, pages 91–98, 2005.

[15] W. D. Stiehl, J. K. Lee, C. Breazeal, M. Nalin, A. Morandi, and A. Sanna. The huggable: a platform for research in robotic companions for pediatric care. In *Proceedings of the 8th International Conference on Interaction Design and Children*, pages 317–320, 2009.

[16] S. Jeong, D. E. Logan, M. S. Goodwin, S. Graca, B. O'Connell, H. Goodenough, et al. A social robot to mitigate stress, anxiety, and pain in hospital pediatric care. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction Extended Abstracts*, pages 103–104, 2015.

[17] W. Q. Koh, F. X. H. Ang, and D. Casey. Impacts of low-cost robotic pets for older adults and people with dementia: scoping review. *JMIR Rehabilitation and Assistive Technologies*, 8(1):e25340, 2021.

[18] D. Chubinidze, Z. Li, P. Slovak, J. Baudinet, E. Dufour, and K. Tchanturia. Introducing a smart toy in eating disorder treatment: a pilot study. *Nutrients*, 16(4):467, 2024.

[19] Y. Tahara, A. Amemiya, Y. Kitagawa, N. Arimatsu, C. Kawasumi, T. Nagasawa, et al. Stress reduction effects of two types of robots on adults living alone. *Journal of Nursing Science and Engineering*, 11:100–105, 2024.

[20] C. K. Tan, V. W. Lou, C. Y. M. Cheng, P. C. He, and V. E. J. Khoo. Improving the social well-being of single older adults using the LOVOT social robot: qualitative phenomenological study. *JMIR Human Factors*, 11(1):e56669, 2024.

[21] S. Jeong, C. Breazeal, D. Logan, and P. Weinstock. Huggable: the impact of embodiment on promoting socio-emotional interactions for young pediatric inpatients. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pages 1–13, 2018.