The Experience and Effect of Adolescent to Robot Stress Disclosure: A Mixed-Methods Exploration

Elin A. Björling[1 [0000−0002−0385−2562]], Honson Ling[1 [0000−0003−0334−6130]], Simran Bhatia[1 [0000−0002−9171−242X]], and Kimberly Dziubinski[1]

University of Washington,Seattle, WA 98105
{bjorling,honsoneo,simran18,kimdz}@uw.edu

Abstract. Social robots hold the potential to be an effective and appropriate technology in reducing stress and improving the mental health of adolescents. In order to understand the effect of adolescent-to-robot disclosure on momentary stress, we conducted an exploratory, mixed-methods study with sixty-nine US adolescents (ages 14-21) in school settings. We compared a generic, minimalist robot interaction among three different robot embodiments: physical, digital computer screen, and immersive, virtual reality. We found participants' momentary stress levels significantly decreased across multiple interactions over time. The physical and virtual-reality embodiments were most effective for stress reduction. In addition, our qualitative findings provide unique insights into the types of stressors adolescents shared with the social robots as well as their experiences with the different interaction embodiments.

Keywords: social robots · adolescents · perceived stress· self-disclosure· virtual reality.

1 Introduction

School is a common source of stress for many US adolescents [2]. Chronic stress has been correlated with increased rates of depression [29] and decreased learning [37]. With many schools lacking the resources to implement sufficient mental health programs [16], there is an urgent need for an appropriate and innovative solution to mitigate adolescent stress in school.

US adolescents' lives are typically mediated through a variety of digital technologies [14]. Therefore, the use of a digital device to reduce adolescent stress may be an accessible, desirable, and contextually appropriate tool in the school setting. To address the challenge of school stress in adolescents, our overall project aims to develop a school-based, social robot designed to engage adolescents in an anonymous, stress-reducing interactions. Disclosing stress through human-robot interactions has shown promising therapeutic benefits and likability for adults [4] [28] and undergraduates [27]. In today's COVID-19 climate, social robots also offer the benefit of a social agent unable to contract or express viruses [40]. Adolescents have shown a desire to share emotions and stressors anonymously with

a social robot [8], however, the effect of a disclosure interaction on momentary stress for adolescents has not been well explored.

Therefore, our current mixed-methods study explored the following research questions: (1) Do repeated disclosure interactions with a social robot reduce momentary, perceived stress in adolescents? (2) How does social robot embodiment affect momentary stress?

2 Background

2.1 Stress and Adolescents

Eighty-three percent of teens report that school is a significant source of stress [2]. Chronic, daily stress has negative physiological [31] and psychological [9] outcomes for adolescents, including depression [30]. Chronic stress negatively impacts cognitive function and learning [37] and yet many schools lack the resources maintain accessible school-based mental health programs [16]. Finally, school stress as a result of COVID-19 is likely to worsen adolescent mental health [17] as was found in Chinese adolescents [11].

2.2 Robots to Reduce Stress and Anxiety

A recent review of social robots illustrated five robotic devices (mostly animoids) that effectively reduced anxiety or increased social interactions in mostly elderly adults [34]. A few animoid robots have been designed explicitly for these purposes. For example, the social robot Therabot [15] an animated dog was designed to support those who have survived trauma by reducing feelings of overwhelm. Another example, Paro [38] a plush seal, has shown reduction of anxiety and increased social interactions in seniors in assisted living [22] and has been shown to reduce physiologic stress in adults [1]. Long-term robot interactions have shown stress reduction in the elderly [38], promoted physical and emotional verbal expressions in children [20], reduced workplace [41] and mental stress in adults [24], as well as reduced physiological stress in infants [39]. However, little is known about the effect of social robot interactions on stress in adolescents.

2.3 Robot Embodiment

A body of research has investigated how different robot platforms affect the quality of social interaction between a human and a robot. In summary, when compared to robots on a computer screen, adult participants were more likely to follow directions given by a physically present robot [3], gain more cognitive learning offered by a physical robot tutor [26], and empathize more with a physical robot's vulnerability [35]. Children in a hospital setting showed stronger verbal and physical engagement with a physical robot compared to digital versions [21]. However, how well these studies of embodiment transfer to adolescent participants remains unknown.

2.4 Human-to-Robot Disclosure

Self-disclosure, the act of disclosing intimate and emotional information about oneself, is an intervention that has been successful in reducing stress in both in-person and online human-human interactions [19][42]. In terms of human-to-robot disclosure, Birnbaum, et al. [5] found that adults find a responsive robot comforting during stress-related disclosures. Ling and Björling [27] conducted a small experimental study (n=36) to explore the impact of robot disclosure on human disclosure. They found that college students interpreted a robot's technical disclosure as emotional. Martelaro, et al. [28] found that high school students disclosed more vulnerability when interacting with a social robot that expresses high vulnerability. Although disclosure has been studied in HRI, the relationship effect of disclosure with a robot on perceived stress has not been explored. As we hope to improve adolescent mental health, it is critical to understand whether interacting with a social robot can help reduce adolescent stress as well as which robot embodiments may be most effective.

3 Methods

3.1 Study Design

The current research study utilized a mixed-methods, within-subjects design to understand the effect of three different robot embodiments (physical, computer screen, and virtual reality) on momentary stress during a simple, stress-disclosure activity. See Figure 1. Given academic stress is prolific in both high school [2] and college samples [23], we recruited a diverse group of adolescents (ages 14-21) through convenience sampling. The study was implemented and conducted in common areas at three local high schools and one university to maintain contextual validity. Participants interacted with each of the three platforms through an assigned order to ensure counterbalance.

Fig. 1. Examples of each robot embodiment. A: Physical, B: Digital, C: Virtual Reality

3.2 Technology Design

For this particular study, we designed a generic robot interaction in order to maintain focus on the interaction effect on momentary stress. EMAR is a social robot previously designed through co-design and interaction studies with adolescents [7]. The physical robot prototype (EMAR V4) consisted of two stacked, felt-covered boxes, each with a slot for an Android-powered, Nexus 7 tablets to create a digital face and belly. One tablet renders the robot's face which has blinking eyes and a small immobile mouth. The other tablet is located at the robot's belly and was disabled for this study. EMAR V4 along with a replication of a local high school classroom environment was modeled at exact scale in a Unity game engine [36]. The Unity engine was displayed using an HTC Vive headset for the virtual reality embodiment and on a flat screen monitor for the digital embodiment. In all interactions, participants were seated with EMAR on a table facing them at eye level and wearing headphones to ensure communication.

Teleoperation Design To maintain consistency across all three embodiments, we designed an interface to ensure consistent teleoperation across the research team. The robot's face was animated with natural-like blinking and a static mouth. The robot's speech was controlled through a customized "Wizard of Oz" interface including a series of questions designed to elicit stress stories from the participants. See Table 1. Operators followed a clear path the interaction using a small number of impromptu buttons for pre-specified utterances (*e.g.* "I see," "I'm sorry I didn't hear that"). Additionally, there were a set of empathetic responses such as "Thanks for sharing that with me," and "That sounds stressful," to ensure that the participant felt heard. In a reliability test, no significant differences were found in participant stress or interaction length across operators.

Table 1. Social robot prompts that elicit momentary stress and mood as well as stress stories.

Momentary	1. Can you tell me how stressed do you feel right now?
	2. I would also like to know, what is your mood right now?
Stress Story	1. I also really like to hear stories.
	2. Would you like to share a stress story with me?
	3. Do you want to tell me more about that?
	4. How did that make you feel?

3.3 Study Procedure

Intake Survey and Stress Stories In order to acknowledge individual differences affecting the participants' responses and preferences, we measured the

participants' overall perceived stress scores and their overall attitudes toward robots. The Perceived Stress Scale (PSS-10) [12] is a 10-item questionnaire that measures the degree to which situations in one's life are appraised as stressful. The Negative Attitude Towards Robots Scale (NARS) is a 14-item attitude survey [32]. After completing their intake forms, participants were asked to notate three different, personal stress stories, one to share with each robot embodiment.

Platform Interactions and Measuring Momentary Stress Participant robot interactions were ordered to ensure counterbalance. For all three conditions, the participants were aware that a researcher was known to be operating the robot. We developed a simple computer-based visual analogue scale (VAS) (0 = no stress at all, 100 = most stress experienced) to measure momentary stress before and after each robot interaction. VASs are commonly used to reliably measure momentary, perceived stress even over very brief time intervals [25, 10].

Exit Interview After completing all three interactions, participants were invited into a quieter area (usually a school hallway) along with 1-2 other participants who had completed the interactions. Participants were interviewed and asked questions such as, "How did it feel interacting with each of these robots?" and "In which environment did you feel most comfortable?"

3.4 Analyses

One-way ANOVAs were used to explore group differences for age, gender, and school site for the NARS and PSS. To explore the effect of embodiment on momentary stress level, we conducted Wilcoxon signed-rank tests on stress levels before and after each type of platform interaction. This method is non-parametric, does not assume normality, and is used for repeated measurements on a single sample to assess whether their population mean ranks differ. Post-hoc comparisons were conducted to detect differences in stress level changes across embodiments. In order to examine the effect of time on momentary stress, a within-subject ANOVA was conducted on participant's baseline stress level, and three other time-points where participants had their stress level measured after each robot interaction. Finally, following procedures for an explanatory sequential mixed-methods design [13] we contextualized the quantitative findings by exploring the interaction and exit interview data for context related to the quantitative findings using applied thematic analysis [18].

4 Findings

4.1 Demographics

Overall, 69 adolescents (39 females, 30 male) ranging in age from 14 to 21 years ($M = 17.4, SD = 1.59$) participated in the study. See detailed grade and age demographic information is in Table 2.

Table 2. Descriptive demographics by school site.

School	n	Female	Age (m)	Grade (m)
High School 1	8	100%	16.3	10.5
High School 2	28	32%	16.25	10.39
High School 3	10	70%	18.2	12
University	23	65%	18.78	13.26
Total	69	67%	17.39%	11.59

The participants self-reported their ethnicity in an open-ended item on the intake survey. From these data, ten broad ethnic categories emerged across all participants. Forty-four percent of our participants identified as white or Caucasian. Fifty-six percent of our participants identified themselves as a non-white ethnicities including Chinese (14.5%), Asian (13%), East Indian (5.8%), Korean (4.3%), Hispanic/Filipino (4.3%), Middle Eastern (2.9%), African American (1.7%), Ghanian (1.4%) and Mixed Race (7.2%).

4.2 Perceived Stress and Attitudes Toward Robots

When comparing PSS and NARS scores by gender, age, grade or school/study site, no significant differences were found. Our participants had an average PSS score of 19.78 ($SD = 6.69$) which is higher than published norms for the PSS, but similar to other studies we have published for these age groups [6]. When exploring the NARS scores by age, no significant differences were found. However, the lowest average scores ($M = 26.5$, $SD = 7.77$) were observed in the youngest participants (age 14). Female participants, however, scored significantly higher ($M = 39.90$, $SD = 8.32$) in negative attitudes towards robots than male participants ($M = 35.83$, $SD = 7.69$) ($t(68) = 2.078, p = 0.042$). See Figure 2 for more detail for the PSS and NARS by age.

4.3 Adolescent-Robot Interactions

Upon introduction, many participants were polite when interacting with the robot and even asked how the robot was doing or said, "It's nice to meet you." When the robot asked about their current stress level, participants responses ranged widely from statements such as, *"I only feel slightly stressed,"* [Female, 16, School 1] to *"I feel like I have a lot of stress in my life right now"* [Female, 16, School 2]. Many adolescents seemed comfortable disclosing their stressors to a social robot. A few adolescents shared stressors outside of their school experience, such as difficulties with a job or being away from family, but most stories were school-related , which was appropriate as their interactions with the robot occured at school. For example,

> I just like got really stressed out from studying and taking all those AP tests. So yeah, it's cause AP tests are really stressful and sometimes they

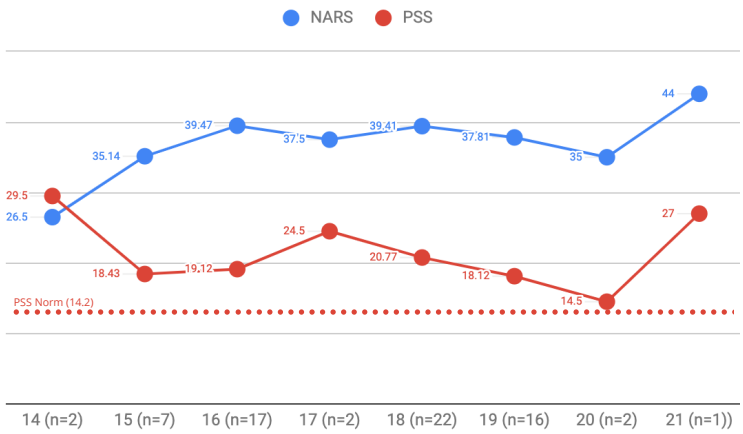

Fig. 2. Average NARS and Average PSS scores by age

> are really hard right? And it was my junior year, I wanted to keep my grades good. [Male, 18, School 3]

In their exit interviews, a few participants recalled feeling anticipatory anxiety prior to interacting with a robot for the first time. For example, one participant stated, *"At first I did't know how it will work and it felt weird, but after [the] first try it got more comfortable"* [Female, 18, School 3].

4.4 Changes in Momentary Stress

Momentary stress was decreased for 69% of participants after the first robot interaction regardless of robot embodiment. When comparing average momentary stress before each robot interaction ($M = 45.26, SD = 23.66$), participants reported a significantly lower momentary stress after the 3rd robot interaction regardless of embodiment ($M = 33.98, SD = 21.99$), $z(57) = -4.55, p = 0.001$. See Figure 3 for more details.

In exit interviews, participants articulated their experience of the robot interactions as stress-reducing over time. As one participant stated, *"So, as each level started going, progressing, I felt less stressed"* [Female, 19, School 4]. One participant clearly articulated that repeatedly sharing her stressors with the robot allowed her to become increasingly comfortable talking about her feelings.

> As I went on, I think part of the reason why I liked EMAR is because I was getting used to talking, so I wasn't as stressed. I was used to it. I was used to the process of talking about my feelings and stuff. [Female, Unknown Age, School 4]

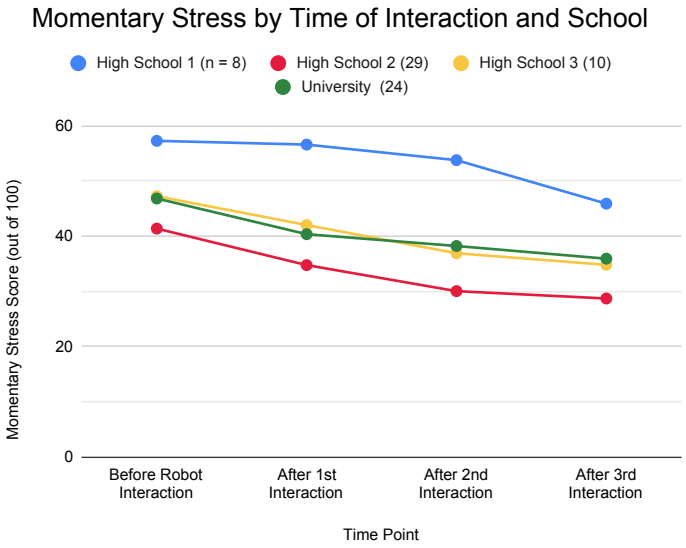

Fig. 3. Average momentary stress by time of interaction and school

4.5 Physical and Virtual Embodiments Were Most Stress-Reducing

In our analysis of the effects of robot embodiment on momentary stress, 58 participants had a complete set of momentary stress data, and were included in this analysis. The physical robot, followed by the virtual embodiment had the most significant stress reduction effects. See Figure 4 for more detail. The participants' described the physical robot as a *"caring."* They gave the physical robot descriptions such as *"it feels present"*, *"it's in the real world"*, and *"it's with me."* One participant stated, *"...the physical one feels like a real person, and that you can confide in"* [Female, School 1]. Another participant suggested, *"I also felt, like the reactions also almost felt more authentic given that it was right there"* [Female, School 4].

In the virtual embodiment, participants expressed a range of experiences and included descriptions such as *"safe"*, *"private"*, and *"peaceful."* One teen even mentioned, *"I was able to feel in tune with my emotions"* when in the virtual environment [Female, 18, School 3]. Teens described their interactions with the virtual embodiment as an escape. For example one teen said, *"VR is kind of a place where you can just shut out the real world and go into the robot world where you can carry your experiences"* [Male, 15, School 2]. Another teen suggested the VR interaction helped her to avoid human stressors. *"In the outer environments [real world] there might be stressors around—for example one of my stressors is humans."* [Female, 19, School 4]

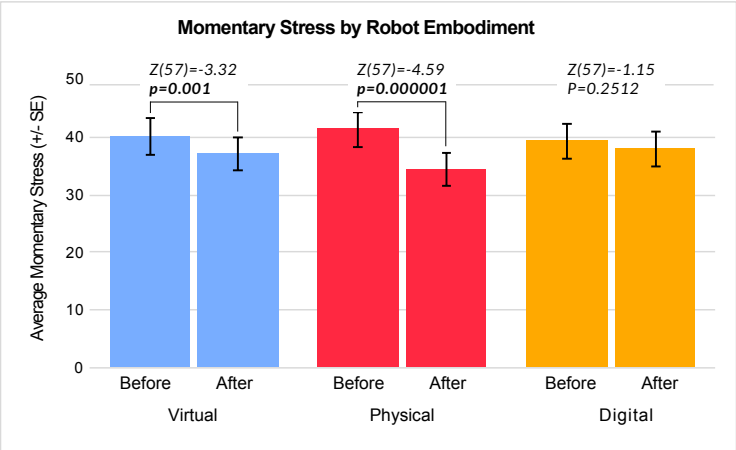

Fig. 4. Mean of momentary stress before and after each embodiment interaction (n=58)

One participant had the insight that her stress felt less real in the virtual interaction.

> In the VR, my stress just seemed like less real. I was like, "oh okay, now I can talk about it and figure it out" —in the real world the physical (robot), the stress seemed like it was like piling on a bit." [Female, 19, School 4]

4.6 Limitations

Certainly one limitation of this study is the novelty effect associated with the technology design. Teens were engaged and highly interested in talking to the robot in all three embodiments. In addition, the anticipatory anxiety of talking to a robot seemed to reduce over time which may confound the momentary stress effect. Therefore, these interactions needs to be studied in-situ in the wild. Additionally, the study was set up with full transparency such that participants were aware that humans were operating the robots. This may have impacted their responsiveness as well and therefore it's imperative to study an autonomous robot interaction in the wild to better understand the true impact of disclosure to a robot on momentary, perceived stress.

4.7 Discussion

This study design intentionally created a generic and very simple adolescent-to-robot stress disclosure interaction. Participants shared unique stress stories with each robot embodiment and found the robot embodiments engaging and the

activity stress reliving. Adolescent participants showed significant reductions in momentary stress across all embodiments and over the three robot interactions. However, how much of this had to do with a reduction in anticipatory stress remains unknown.

Although all robot interactions were stress reducing, the physical robot reduced stress most significantly for the group regardless of interaction order. This finding is not surprising given the wealth of literature on the powerful effect of a physically present robot [3]. What was surprising was the significantly stress reducing effect of the virtual embodiment and environment and this deserves more attention. Potential explanations may be that the virtual environment felt more intimate and private, allowing for more effective disclosure. Birnbaum, et al. [5] found their robot's responsiveness to the human's stressor created a sense of intimacy. Adolescents commonly use "escape" as a coping mechanism for managing stress [33]. Therefore, the stress reduction of the virtual environment may have been complemented by simultaneously providing a form of escape.

This preliminary study shows potential for adolescent-robot disclosure interactions as a stress-reducing interaction. In addition, it illustrates the possibility of a social robot embodiment as a potential moderator of stress-reducing disclosure. However, a more rigorous study in the wild is needed to determine the true effect of a disclosure interaction on momentary stress as well as what the most appropriate and effective robot embodiment may be for a robot intended to support mental health in adolescents.

References

1. Aminuddin, R., Sharkey, A.: A paro robot reduces the stressful effects of environmental noise. In: Proceedings of the European Conference on Cognitive Ergonomics 2017. pp. 63–64 (2017)
2. Association, A.P., et al.: Stress in america 2013 highlights: Are teens adopting adults' stress habits (2014)
3. Bainbridge, W.A., Hart, J.W., Kim, E.S., Scassellati, B.: The benefits of interactions with physically present robots over video-displayed agents. International Journal of Social Robotics **3**(1), 41–52 (2011)
4. Birnbaum, G.E., Mizrahi, M., Hoffman, G., Reis, H.T., Finkel, E.J., Sass, O.: What robots can teach us about intimacy: The reassuring effects of robot responsiveness to human disclosure. Computers in Human Behavior **63**, 416–423 (2016)
5. Birnbaum, G.E., Mizrahi, M., Hoffman, G., Reis, H.T., Finkel, E.J., Sass, O.: What robots can teach us about intimacy: The reassuring effects of robot responsiveness to human disclosure. Computers in Human Behavior **63**, 416–423 (2016)
6. Björling, E.A., Cakmak, M., Thomas, K., Rose, E.J.: Exploring teens as robot operators, users and witnesses in the wild. Frontiers in Robotics and AI **7**, 5 (2020)
7. Björling, E.A., Rose, E.: Participatory research principles in human-centered design: engaging teens in the co-design of a social robot. Multimodal Technologies and Interaction **3**(1), 8 (2019)
8. Björling, E.A., Rose, E., Davidson, A., Ren, R., Wong, D.: Can we keep him forever? teens' engagement and desire for emotional connection with a social robot. International Journal of Social Robotics pp. 1–13 (2019)

9. Bolton, J.L., Molet, J., Ivy, A., Baram, T.Z.: New insights into early-life stress and behavioral outcomes. Current opinion in behavioral sciences **14**, 133–139 (2017)
10. Cella, D.F., Perry, S.W.: Reliability and concurrent validity of three visual-analogue mood scales. Psychological reports **59**(2), 827–833 (1986)
11. Chen, F., Zheng, D., Liu, J., Gong, Y., Guan, Z., Lou, D.: Depression and anxiety among adolescents during covid-19: A cross-sectional study. Brain, Behavior, and Immunity (2020)
12. Cohen, S., Kamarck, T., Mermelstein, R., et al.: Perceived stress scale. Measuring stress: A guide for health and social scientists pp. 235–283 (1994). https://doi.org/10.1037/t02889-000
13. Creswell, J.W., Clark, V.L.P.: Designing and conducting mixed methods research. Sage publications (2017)
14. Davies, C., Eynon, R.: Teenagers and technology. Routledge (2013)
15. Duckworth, D., Henkel, Z., Wuisan, S., Cogley, B., Collins, C., Bethel, C.L.: Therabot: The initial design of a robotic therapy support system. In: HRI (Extended Abstracts). pp. 13–14 (2015)
16. Eiraldi, R., Wolk, C.B., Locke, J., Beidas, R.: Clearing hurdles: The challenges of implementation of mental health evidence-based practices in under-resourced schools. Advances in school mental health promotion **8**(3), 124–140 (2015)
17. Golberstein, E., Wen, H., Miller, B.F.: Coronavirus disease 2019 (covid-19) and mental health for children and adolescents. JAMA pediatrics (2020)
18. Guest, G., MacQueen, K.M., Namey, E.E.: Applied thematic analysis. Sage Publications (2011)
19. Hofmann, S.G., Asnaani, A., Vonk, I.J., Sawyer, A.T., Fang, A.: The efficacy of cognitive behavioral therapy: A review of meta-analyses. Cognitive therapy and research **36**(5), 427–440 (2012). https://doi.org/10.1007/s10608-012-9476-1
20. Jeong, S.: The impact of social robots on young patients' socio-emotional wellbeing in a pediatric inpatient care context. Ph.D. thesis, Massachusetts Institute of Technology (2017)
21. Jeong, S., Breazeal, C., Logan, D., Weinstock, P.: Huggable: Impact of embodiment on promoting verbal and physical engagement for young pediatric inpatients. In: 2017 26th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN). pp. 121–126. IEEE (2017)
22. Kang, H.S., Makimoto, K., Konno, R., Koh, I.S.: Review of outcome measures in paro robot intervention studies for dementia care. Geriatric Nursing (2019)
23. Karaman, M.A., Lerma, E., Vela, J.C., Watson, J.C.: Predictors of academic stress among college students. Journal of College Counseling **22**(1), 41–55 (2019)
24. Kühnlenz, B., Erhart, M., Kainert, M., Wang, Z.Q., Wilm, J., Kühnlenz, K.: Impact of trajectory profiles on user stress in close human-robot interaction. at-Automatisierungstechnik **66**(6), 483–491 (2018)
25. Lesage, F.X., Berjot, S., Deschamps, F.: Clinical stress assessment using a visual analogue scale. Occupational medicine **62**(8), 600–605 (2012)
26. Leyzberg, D., Spaulding, S., Toneva, M., Scassellati, B.: The physical presence of a robot tutor increases cognitive learning gains. In: Proceedings of the annual meeting of the cognitive science society. vol. 34 (2012)
27. Ling, H.Y., Björling, E.A.: Sharing stress with a robot: What would a robot say? Human-Machine Communication **1**(1), 8 (2020). https://doi.org/10.30658/hmc.1.8
28. Martelaro, N., Nneji, V.C., Ju, W., Hinds, P.: Tell me more: Designing hri to encourage more trust, disclosure, and companionship. In: The Eleventh ACM/IEEE

International Conference on Human Robot Interaction. pp. 181–188. IEEE Press (2016)
29. Martinez, G., Bámaca-Colbert, M.Y.: A reciprocal and longitudinal investigation of peer and school stressors and depressive symptoms among mexican-origin adolescent females. Journal of youth and adolescence **48**(11), 2125–2140 (2019)
30. Maughan, B., Collishaw, S., Stringaris, A.: Depression in childhood and adolescence. Journal of the Canadian Academy of Child and Adolescent Psychiatry **22**(1), 35 (2013)
31. McEwen, B.S.: Neurobiological and systemic effects of chronic stress. Chronic stress **1**, 2470547017692328 (2017)
32. Nomura, T., Suzuki, T., Kanda, T., Kato, K.: Measurement of negative attitudes toward robots. Interaction Studies **7**(3), 437–454 (2006). https://doi.org/10.1075/is.7.3.14nom
33. Oláh, A.: Coping strategies among adolescents: A cross-cultural study. Journal of Adolescence **18**(4), 491 (1995)
34. Scoglio, A.A., Reilly, E.D., Gorman, J.A., Drebing, C.E.: Use of social robots in mental health and well-being research: systematic review. Journal of medical Internet research **21**(7), e13322 (2019)
35. Seo, S.H., Geiskkovitch, D., Nakane, M., King, C., Young, J.E.: Poor thing! would you feel sorry for a simulated robot? a comparison of empathy toward a physical and a simulated robot. In: 2015 10th ACM/IEEE International Conference on Human-Robot Interaction (HRI). pp. 125–132. IEEE (2015)
36. Unity Technologies: Unity, https://unity.com
37. Vogel, S., Schwabe, L.: Learning and memory under stress: implications for the classroom. npj Science of Learning **1**, 16011 (2016)
38. Wada, K., Shibata, T., Saito, T., Sakamoto, K., Tanie, K.: Psychological and social effects of one year robot assisted activity on elderly people at a health service facility for the aged. In: Robotics and Automation, 2005. ICRA 2005. Proceedings of the 2005 IEEE International Conference on. pp. 2785–2790. IEEE (2005)
39. Williams, N., MacLean, K., Guan, L., Collet, J.P., Holsti, L.: Pilot testing a robot for reducing pain in hospitalized preterm infants. OTJR: occupation, participation and health **39**(2), 108–115 (2019)
40. Yang, G.Z., Nelson, B.J., Murphy, R.R., Choset, H., Christensen, H., Collins, S.H., Dario, P., Goldberg, K., Ikuta, K., Jacobstein, N., et al.: Combating covid-19—the role of robotics in managing public health and infectious diseases (2020)
41. Yorita, A., Egerton, S., Oakman, J., Chan, C., Kubota, N.: A robot assisted stress management framework: Using conversation to measure occupational stress. In: 2018 IEEE International Conference on Systems, Man, and Cybernetics (SMC). pp. 3761–3767. IEEE (2018)
42. Zhang, R.: The stress-buffering effect of self-disclosure on facebook: An examination of stressful life events, social support, and mental health among college students. Computers in Human Behavior **75**, 527–537 (2017)