Acute or a Cute Robot? The Effect of Angularity on Medical Service Robot Perception

Problem

- One in three Americans report that they avoid medical visits (Cleveland Clinic Medical Professional, 2021).
- Considering our modernizing world, applying robotics to healthcare, particularly with Medical Service Robots (MSRs), yields the potential to improve patient engagement and overall care ("Medical robots," n.d.).
- Manipulating the design of MSRs can potentially be used to project positive emotions, considering that curved shapes are typically associated with warmth, while angular tend to evoke fear (Naghdi, 2021).
- The purpose of this study was to manipulate the angularity of MSR designs to decrease perceived threat and increase perceived warmth and trust among patients.

Literature Review

- Across studies that utilized various types of stimuli (ex. geometric shapes, logos, smartphones, etc.), the rounded versions are consistently more preferred to the angular ones (Lu & Ho, 2013; Meiting & Hua, 2021; Oros et al. 2014; Silvia & Barona, 2008).
- Research shows that designs that incorporate round shapes are perceived as warmer than their angular counterparts (Bar & Neta, 2006; Larson et al., 2012; Meiting & Hua, 2021).
- Among numerous stimuli (ex. geometric angles, emotionally neutral objects, etc.) the angular version conveyed a sense of threat and triggered a negative bias (Bar & Neta, 2006, 2007; Friedenberg et al., 2023; Larson et al., 2012).
- In a study that observed the effect of shoulder and waist-to-hip ratio of robot designs, the female (more curved) robot was attributed more affective trust (Bernotat et al., 2019). Apart from this study, limited research exists regarding the effects of angularity on trust.

Hypotheses

• Compared to both the angular MSR and no image shown conditions, a curved MSR...

- will be preferred
- will be perceived as more warm
- will be perceived as less threatening
- will be perceived as more trustworthy

Dros, M., Nikolić, M., Borovac, B., & Jerković, I. (2014). Children's preference of appearance and pare



re 1: Image of a Commercial MSR mage Credit: IEEE Spectrum

Selected References

Unless otherwise indicated, all figures were made by the researcher rum.ieee.org/how-diligents-robots-are-making-a-difference-in-texas-hospitals Bar, M., & Neta, M. (2007). Visual elements of subjective preference modulate amygdala activation. *Neuropsychologia*, 45(10), 2191–2200. https://doi.org/10.1016/j.neuropsychologia.2007.03.008 veland Clinic Medical Professional. (2021). *Iatrophobia (Fear of the doctor)*. Cleveland clin https://mv.clevelandclinic.org/health/diseases/22191-jatrophobia-fear-of-doctor riedenberg, J., Lauria, G., Hennig, K., & Gardner, I. (2023). Beauty and the sharp fangs of the beast: Degree of angularity predicts perceived preference and threat. *Psychological Research*, 87(8), 2594–2602. https://doi.org/10.1007/s00426-023-01822-v son, C. L., Aronoff, J., & Steuer, E. L. (2012). Simple geometric shapes are implicitly associated with affective value. *Motivation and Emotion*, 36(3), 404–413. .u, Y., & Ho, C. (2013). Difference curvature of product shape evoked emotional variation in preferences. <u>http://design-cu.jp/iasdr2013/papers/1540-1b.pdf</u> ua, W. (2021). Angular or rounded? The effect of the shape of green brand logos on consumer perception. *Journal of Cleaner Production*, 279, 123801. be language impact a character design? (With illustrated examples). Dream farm studios. dios.com/blog/shape-language-in-character-design/#What_is_shape_psychology_Infographic

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Result & Discussions



$F(2,230)=3.80 \quad p=.02$

- An ANOVA revealed a statistically significant difference (p=.02) where the curved robot was most
- The Post Hoc test portrays the curved MSR was more preferred to the angular (p=.04). Previous research demonstrates that curvature is preferred to angularity (Lu & Ho, 2013; Meiting & Hua, 2021; Oros et al. 2014).







- An ANOVA did not reveal a significant relationship between angularity and perceived
- A potential explanation includes that perhaps some items on the adapted scale may have been ambiguous given they were altered to fit the context of MSRs

Limitations & Further Study

Limitations

• Participants could not experience the prototypes in person

Further Study • Manipulating the gender of the robot

- Does the gender of the robot elicit particular perceptions? • Asking medical staff their opinions of MSRs
- Do doctors like the robots or do they feel threatened by them?
- Measuring the perceptions of different demographic groups • Are older individuals as receptive to MSRs?





Dependent Variables Figure 8: Analysis with Gender

Threat: F(1,230) = .73 p = .39Preference: F(1,230)=7.10 *p*<.01 Warmth: F(1,230)=4.10 *p*=.05 Trust: $F(1,230) = 4.50 \, p = .04$

• Two-way ANOVAs did not portray significant interactions between gender and perception, however, main effects for preference, perceived warmth, and trust were observed. Males rated the robots generally higher than women

Conclusions & Implications

Conclusions

• The appearance and contour of MSRs influence their perceptions as the curved design elicited more a positive response.

Implications

- Implementing curvature into MSR design can be valuable for creating designs that are most positively perceived.
- Males preferred the MSRs more than women. This reveals the importance of addressing gender specific attitudes in the implementation of healthcare technology.



Methodology

Variables

• Independent Variables:

- This study had three conditions
 - A curved MSR
 - An angular MSR
 - A no image condition
- Dependent Variables:

Variable	Number of Items	Cronbach's Alpha	Example
Preference	1 item measure	N/A	"I like the visual appearance of this MSR"
Warmth (Cuddy et al., 2009)	4	.892	"As depicted, how warm does the MSR seem?"
Threat Friedenberg et al., 2023)	1 item measure	N/A	"how threatening does this MSR seem?"
Trust (Bernotat et al., 2019)	6	.882	"This MSR would be reliable"

Stimuli/Materials:

• Participants were randomly assigned to their condition along with a description of the MSR

The description was identical across all conditions





Figure 2: Curved and Angular Version of the MSR Design

Participants

• Participants were recruited on Prolific

- A screener was applied to select a population of American young adults There were 230 participants in total
- The power analysis indicated a minimum sample size of 165



Figure 3: Gender Demographics Pie Chart

• After viewing the stimuli, participants were asked to answer the scales for each variable, demographic questions, and a manipulation check.