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Designing Socially Assistive Robots Exploring Israeli and German Designers' Perceptions

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Socially assistive robots (SARs) are becoming more prevalent in everyday life, emphasizing the need to make them socially acceptable and aligned with users' expectations. Robots' appearance impacts users' behaviors and attitudes toward them. Therefore, product designers choose visual qualities to give the robot a character and to imply its functionality and personality. In this work, we sought to investigate the effect of cultural differences on Israeli and German designers' perceptions of SARs' roles and appearance in four different contexts: a service robot for an assisted living/retirement residence facility, a medical assistant robot for a hospital environment, a COVID-19 officer robot, and a personal assistant robot for domestic use. The key insight is that although Israeli and German designers share similar perceptions of visual qualities for most of the robotics roles, we found differences in the perception of the COVID-19 officer robot's role and, by that, its most suitable visual design. This work indicates that context and culture play a role in users' perceptions and expectations; therefore, they should be taken into account when designing new SARs for diverse contexts.

CCS Concepts: • **Human-centered computing** → **Interaction design**; **HCI design and evaluation methods**; **Empirical studies in HCI**;

Additional Key Words and Phrases: Context-driven design, visual qualities, socially assistive robot, professional designers.

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1 Introduction

1.1 Design of Socially Assistive Robots (SARs)

SARs are becoming more prevalent in everyday life [1–3], fulfilling different roles and tasks and establishing varied relationships [4]. The context of the use of SARs can be parsed into four contextual layers: the domain in which the SAR exists, the physical environment, its intended users, and the robot's role; these layers define the human–robot relationship [5]. Even though researchers are working to ensure that SARs follow social norms and expectations [6–8], knowledge is still limited regarding the visual design research of SARs [9, 10]. Indeed, the design space for SARs is vast, and narrowing it down to specific use cases is an extremely demanding task, as a recent interdisciplinary overview of advances in social robotics clearly illustrates [11]. Instead of designing new systems bottom-up and based on user requirements, much research in the field focuses on evaluating users' perceptions of existing off-the-shelf SARs [12–15].

SARs' morphology varies between anthropomorphic (human-like and androids), zoomorphic (animal-like), and technical (machine-like) [16–19]; different robots' tasks and use cases deserve using different morphology [7, 20, 21]. For example, using a human-like appearance is more suitable in cases where the robot should be perceived as sociable [20]. Still, there is more to design than morphology: designers use different **Visual Qualities (VQs)** such as shapes, colors, outlines, textures, and dimensions as tools to lead the user to desired behavioral and cognitive responses [22–25], even minor design manipulations were found to affect users' perception and behaviors [26]. This work focuses on basic VQs as understanding the effect of those may also implicate the design of anthropomorphic and zoomorphic robots.

Matching the physical embodiment of the SAR to its task can help reflect the robots' functions and capabilities and improve users' acceptance [16, 21, 27, 28]. In addition, studies conducted among potential users found that the robots' role and context of use affect users' expectations and selections of their robotic appearance [5, 29]. Hence, it's evident that the context of use must be incorporated into the design process. Still, manufacturers often utilize the same embodiment for different contexts [5].

In [30], a deconstruction of existing commercial robots' visual and physical components was used to create a design taxonomy. Following this, the authors reconstructed and created 30 new self-designed robots that differ by their three basic VQs: body structure, outline, and color to study the impact and value of the visual design of SARs. Building upon the reconstruction of these robots, it was found that the SARs' VQs impact people's perception of the robot's character as being friendly, childish, innovative, threatening, and so forth. For example, an A-shape or hourglass structure would be a better choice for the design of a friendly SAR than a V-shape [30]. While the respondents could ascribe characteristics to different SARs' VQs, going the other way around and ascribing VQs to express desired characteristics was more of a challenge; participants stated different expectations regarding the robot's characteristics suitable for each context. However, when asked to select VQs that best express these expectations, respondents' personal preferences and demographic data were more significant factors affecting their selections [5].

1.2 Cultural Differences in SARs' Perception

Hofstede [31] developed the cultural dimensions theory to explain national cultural differences in perceptions and behaviors. This five-dimension model considers power distance, collectivism and individualism, gender roles, uncertainty avoidance, and long and short-term orientation.

Users' cultural values, beliefs, and habits affect their expectations of robots [32, 33]. Previous studies found cultural differences regarding the likability and familiarity of robots [34] as well as the levels of trust, compliance, and comfort in interacting with robots [35–39]. These may affect the design of interaction patterns and cognitive models [19, 40–42]. In addition, [43] found cultural differences in robots' role perception; while Japanese participants considered humanoid robots as an extension of humans, UK participants preferred humanoid robots would not perform tasks that require "human-like" qualities, such as empathy, caring, or independent decision making.

Research related to cultural design preference in terms of visual appearance focused mainly on robot morphology [44–46], although researchers have no clear agreement regarding the appropriate design for each culture. For example, [44, 46, 47] found that participants of Asian cultures (Korean and Japanese) preferred more human-like robots, while Western cultures (US and European) preferred machine-like robots. On the other hand, [45] found an opposite trend comparing US American and Japanese preferences and perceptions. Other studies evaluated the cultural effect on specific visual aspects of robots, such as the choice of materials [47] and dimensions [48]. Although understanding cultural aesthetic preferences is important when designing products for global distribution [49, 50], we found no studies that link robotic aesthetics and role perceptions in different cultures.

1.3 The Role of Designers

In the design domain, visual features are used to communicate and represent concepts and ideas [51]; their selection can directly affect the user's actions [52]. Designers rely on their experience, habits, intuitive feelings, and inspiration from artistic works to develop the VQs for a new product [53]. Therefore, it is reasonable that cultural background [50] and the level of experience [51] affect their design thinking, processes, and outcomes. Although the current ideal is a "user-centered" or "human-centered" process, also referred to as "co-design," where potential users are actively involved in the design process, this ideal is rarely achieved. Financial and temporal constraints often result in designers' drafts and prototypes entering the final solution. A commendable exception is the design of a range of sketches for virtual assistants for users with impairments [52] performed by two of the co-authors.

In this study, we explore the perceptions and preferences of design students and professional designers of Israeli and German cultures in four use cases for SARs. Choosing these two cultures was a convenience decision, as the authors of this article had access to designers in both countries. We argue that it is not the specific two cultures that matter but rather the exploration of the need to recognize and be aware of cultural differences among designers, users, and use cases.

2 Study Design

2.1 Aim and Scope

Previous studies [5, 30] evaluated potential users' perceptions and preferences. In this study, we aim to understand the effect of cultural background on professional designers' perceptions: perceptions of a robot's desired characteristics in a context of use and perceptions of the most suitable VQs to express it. The following guiding questions were addressed:

(1) *What affects designers' selections when designing SARs in different contexts?* Professional designers consider the context of use (and branding) in their design; it is part of their professionalism. Therefore, we expect to find common links in their approach to the context of use, the desired characteristics, and the selected VQs.

(2) *How does the cultural background impact the perception of SARs' roles and desired characteristics?* Studies have shown that cultural differences affect users' perceptions of robots' roles and functions [19, 32–43]; we assume that professional designers are also influenced by their cultural background.

Table 1. Four SAR Use Cases by their Contextual Layers

	Domain	Environment		Users		Role
ALR	Business	An assisted living residence facility	Semi-public Indoor	Older adults	Non-professional	Information exchange human-led interaction
MAR	Healthcare	Hospital	Public Indoor	Medical crews Hospitalized and caregivers	Professional Non-professional	Information exchange/ Transport Human-led interaction/equal
COR	Authority	Public places	Public Indoor/outdoor	Passersby	Non-professional	Regulation Robot-led interaction
PAR	Home assistance	Home	Personal Indoor	Diverse	Non-professional	Physical load reduction/ Cognitive stimulation/emotional stimulation Human-led interaction/equal

(3) *Are there shared perceptions regarding the meaning of VQs among designers of different cultures?* Designers from different cultures have different perceptions regarding the meaning of VQs and attributes. As [49] stated: "Understanding the culture of others may be an essential element in creating products that people in other parts of the world appreciate." We assume the cultural background of the designers participating in our study will affect their design language.

2.2 Four Use Cases for SARs

The context of the use of SARs can be deconstructed into four contextual layers: the domain in which the SAR exists (e.g., healthcare, educational, entertainment), the physical environment (i.e., indoor or outdoor, personal or public), its intended users (i.e., professional or nonprofessional, demographics, needs and abilities), and the robot's role (by abstract roles and by a human–robot hierarchy) [5]. Therefore, we defined four SAR use cases that differ by contextual layers. All four use cases share some comparable prerequisites, such as the robot's mobility and a screen to enable concentrating on role and VQs rather than on the physical components:

A service robot for an **Assisted Living/Retirement Residence (ALR)** facility aims to roam the lobby and be used by the facility residents to register for various classes and activities. In addition, it provides information and helps communicate (via video calls and chats) with staff members.

A **Medical Assistant Robot (MAR)** for a hospital environment aims to assist the medical team, especially when social distancing is required. Through it, the medical team can communicate in video calls with isolated patients and bring equipment, food, and medicine into patients' rooms.

A **COVID-19 Officer Robot (COR)** aims to ensure passersby comply with COVID-19 restrictions like social distancing or wearing a face mask.

A **Personal Assistant Robot (PAR)** for home/domestic use seeks to assist users with daily tasks, recommend activities at home and outside, and remind them of their duties and appointments. In addition, the robot allows users to watch videos, listen to music, play, and have video chats with family and friends.

Table 1 presents the four cases by their contextual layers.

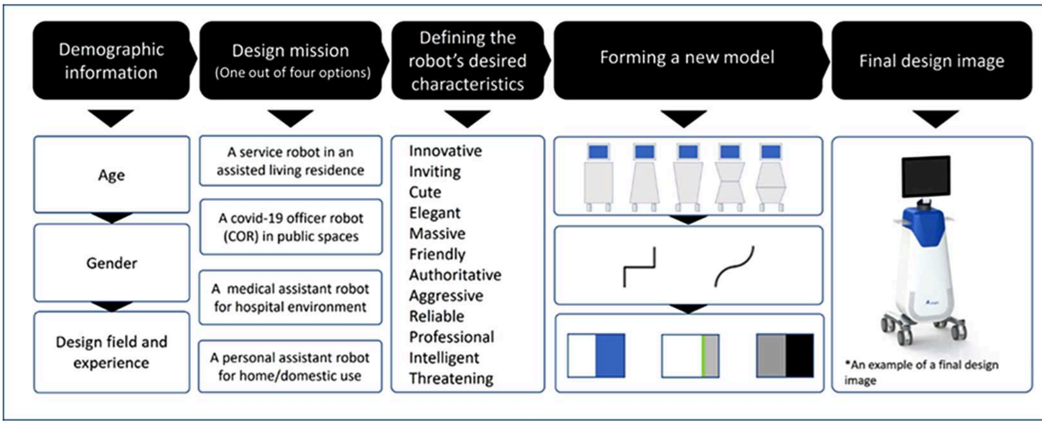

Fig. 1. The online questionnaire structure. The robot was formed by selecting one option for body structure, outline, and color combination. The final design rendered image showcases an A-shape structure, a rounded outline, and a combination of white and blue colors.

2.3 Study Design

2.3.1 Online Questionnaire Design. Using Qualtrics, we designed an online questionnaire to be distributed to professional designers and design students from Israel and Germany. At first, participants were requested to indicate their professional background and experience level in the design field. They could choose an option from a list or write in their own words (see Appendix A for details). Following, in a between-subjects design, they were randomly presented with one of the four use cases detailed in Section 2.2. Each respondent received only one design mission for one use case.

Following a brief explanation of the use context of the use case, they were asked to select relevant words out of a word bank to define the robot's desired characteristics. The word bank contained 12 words based on previous studies related to SARs' perception [55–57] that were found relevant: innovative, inviting, cute, elegant, massive, friendly, authoritative, aggressive, reliable, professional, intelligent, and threatening. In addition, respondents had the option of adding their own adjectives. Then, they were asked to design the robot by selecting three types of VQs, one step at a time, that, in their opinion, best expresses the desired characteristics that they have chosen. Three VQ types, in the following order, were chosen based on [30]: body structure (A-shape, diamond, hourglass, rectangle, or V-shape), outline (chamfered or rounded), and color combination (dark colors, white and blue combination, or white).

The questionnaire was developed in English and then translated into Hebrew and German using a two-way translation procedure (translated to Hebrew/German and then back to English by at least three English speakers independently). Translating the questionnaires to the native language of the respondents helps ensure that they can understand the questions well and provide accurate responses. In addition, it helps guarantee that the participants are permanent residents or native speakers of these languages and not just living there for a short time. Figure 1 illustrates the questionnaire design.

2.3.2 Questionnaire Distribution. We contacted design faculties in universities, industrial design firms, and professional associations of designers in Israel and Germany. We asked them to distribute the online questionnaire to their members, coworkers, teaching staff, and students via their mailing lists and social media platforms like Facebook and LinkedIn.

Table 2. Respondents' Data by Use Case

	Israelis			Germans			
Use case	Gender Males	Females	Age M (SD)	Gender Males	Females	Not disclosed	Age M (SD)
ALR facility	8	20	32 (10.3)	8	11	2	28.2 (10.6)
MAR	9	24	32.2 (8.9)	9	14	0	28.7 (10.4)
COR	16	15	35.5 (12.5)	8	14	1	30.8 (11.3)
PAR	8	12	31.7 (7.6)	11	10	0	28.4 (9.3)
Total	41	71	33 (10.1)	36	49	3	29.0 (10.3)

M, mean.

Table 3. Respondents' Professional Backgrounds

Use case	Design field		Professional experience	
	3D designers	2D designers	Design students	Professional designers
ALR	24	25	31	18
MAR	31	25	27	29
COR	32	22	23	31
PAR	17	24	23	18
Total	104	96	104	96

3D, three dimensional; 2D, two dimensional.

3 Results

We collected data from 200 professional designers and design students aged 18–72 (mean (M) = 31.3, SD = 10.4) from Israel and Germany. Table 2 summarizes the respondents' gender and work experience by use case. Respondents' professional backgrounds as designers varied between **three-dimensional (3D)** designers (including product design, fashion, and art; 52%) and **two-dimensional (2D)** designers (including graphic design, illustration, and game design; 48%), and two levels of professional experience: students (52%) and professional designers (48%) as detailed in Table 3. Professional experience and age were highly correlated (0.7); therefore, in our following analyses, where relevant, we used the factor of professional experience rather than age.

We analyzed the results to identify the factors affecting respondents' selections of desired characteristics for the SARs (Section 3.1) and their selection of VQs (Section 3.2). We analyzed the connections between the selections to see if the designers share the same language to express different characteristics (Section 3.3). In addition, 91 respondents (59 Israelis and 32 Germans) contributed additional comments (one or more); we excluded greetings and vague comments. The remaining 121 comments were analyzed using thematic analysis (Section 3.4). The following paragraphs present the designers' selections and relevant statements as they provide insights to understand the results better.

3.1 Selection of Desired Characteristics for the SARs

We used a Chi-square test of independence to evaluate the effect of the context and participants' characteristics, cultural background (Israeli/German), design field (3D or 2D), professional experience (professional/student), and gender on their selections of desired characteristics across

Table 4. Factors Affecting the Designers' Selection of Words

	Innovative	Inviting	Elegant	Friendly	Authoritative	Professional	Intelligent
Context	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$		
Culture		$p < 0.05$		$p < 0.05$	$p < 0.01$		$p < 0.01$
Gender	$p < 0.05$					$p < 0.05$	
Design field		$p < 0.01$		$p < 0.01$	$p < 0.05$	$p < 0.05$	$p < 0.01$
Experience						$p < 0.01$	

Light gray boxes represent a significance level of $p < 0.05$, and dark gray boxes represent a significance level of $p < 0.01$. Detailed Chi-square values are in the following sections.

all use cases. Regardless of the use context and the participants' origin, the most selected word was *Reliable*; 78.5% of the designers marked this word as a required characteristic. It appeared as one of the top selected words in all four use contexts.

The context of use affected the designers' selection of describing words. In addition, we found that participants' cultural background, professional experience, and gender affected their expectations and perceptions of the robots' desired characteristics. Using the Chi-square test of independence, we found statistically significant effects for seven words: innovative, inviting, elegant, friendly, authoritative, professional, and intelligent. Table 4 summarizes the results, and the following sections detail the findings. We excluded the word *Aggressive*, which was selected only in 1% of the cases, and the words *Massive* and *Threatening*, which were selected only in 2%. A table containing all word selections by the different factors can be found in Appendix B.

3.1.1 Desired Characteristics by Context. We compared the number of participants who selected a certain character with those who did not for each of the four use cases and performed a Chi-square test to determine whether these variables had a significant association. The use context presented to the designers was found to significantly affect their selection of five describing words: *Innovative* (X^2 $(3, N = 200) = 15.76, p < 0.01$), *Inviting* ($X^2(3, N = 200) = 15.06, p < 0.01$), *Elegant* ($X^2(3, N = 200) = 17.37, p < 0.01$), *Friendly* ($X^2(3, N = 200) = 13.52, p < 0.01$), and *Authoritative* ($X^2(3, N = 200) = 38.82, p < 0.01$). The word *Innovative* was mainly ascribed to the MAR use case; 53.6% of the designers thought a medical robot should look innovative, compared to 16.3% in the ALR use case. *Inviting* was selected mainly for the ALR use case; 76% of the designers selected it for this context, compared to only 39% for COR. The designers found the word *Elegant* relevant mainly to the context of PAR (43% compared to 23% in the overall data). The context of COR was perceived as the most *Authoritative* (48% compared to 19.5% in the overall data) and the least Friendly (61% compared to 77.5% in the overall data).

Still, the top selected words did not differ greatly between the four use cases. The word *Reliable* was selected as a relevant characteristic for all four use cases, *Friendly* was selected for all except for the COR use case, *Professional* was selected for MAR and COR, and *Inviting* was chosen as a required characteristic for ALR. Table 5 presents the most selected words for each context and their rate. The complete table is in Appendix B. Results were mostly similar among the Israeli and German designers, except for the COR use case; a detailed analysis of the different use cases by cultural background is presented in Section 3.1.3.

3.1.2 Cultural Background Differences. Excluding the context, respondents' culture significantly affected their selection of four describing words; German designers were likelier than Israelis to select three words: *Inviting, Friendly*, and *Intelligent,* while Israeli designers showed a higher

Table 5. Most Selected Words (over 65%) for Each Context and Their Rate

Case study	Most selected words
ALR	Reliable (88%) Friendly (88%) Inviting (76%)
MAR	Friendly (86%) Reliable (84%) Professional (70%)
COR	Reliable (70%) Professional (68%)
PAR	Friendly (76%) Reliable (71%)

Table 6. Culture-Related Four Describing Words

	Israelis	Germans	
Inviting	45% ($N = 50$)	63% ($N = 55$)	X^2 (1, $N = 200$) = 6.3, $p < 0.05$
Friendly	71% ($N = 80$)	85% ($N = 75$)	X^2 (1, $N = 200$) = 5.38, $p < 0.05$
Authoritative	30% ($N = 34$)	6% ($N = 5$)	X^2 (1, $N = 200$) = 19.15, $p < 0.01$
Intelligent	38% ($N = 42$)	63% ($N = 55$)	X^2 (1, $N = 200$) = 12.33, $p < 0.01$

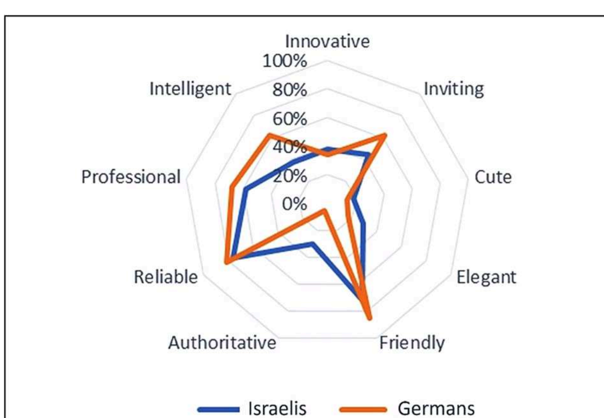

Fig. 2. A comparison of Israeli and German designers' selection of describing words presented in a radar chart.

tendency to select the word *Authoritative*. These relations were found significant using the Chi-square test of independence. Table 6 summarizes these results; Figure 2 illustrates the selection of words by culture in a radar chart.

Table 7. Most Selected Words by Israeli and German Designers (over 65%) for the Context of MAR and Their Rate

Most selected words	Most selected words by Israeli designers	Most selected words by German designers
Friendly (86%)	Friendly (81%)	Friendly (96%)
Reliable (84%)	Reliable (81%)	Reliable (87%)
Professional (70%)	Professional (72%)	Professional (65%)
		Intelligent (65%)

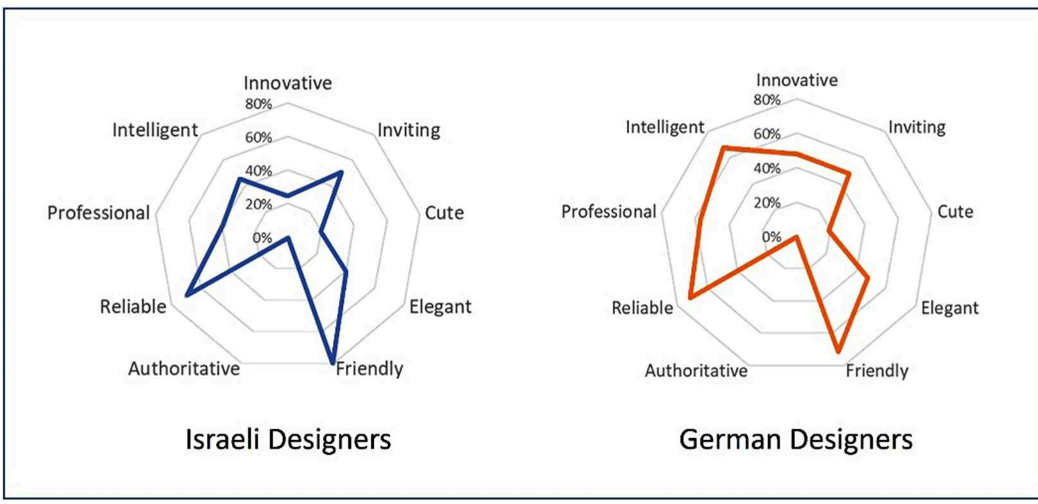

Fig. 3. Respondents' assigned characteristics for the context of MAR by culture.

3.1.3 Cultural Differences by Use Context. Here, we look at each one of the four use cases separately.

An MAR for a Hospital Environment. The top selected words for the context of MAR were *Friendly*, *Reliable*, and *Professional*. German respondents also tend to select the word *Intelligent* (65%), while only 30% of the Israeli designers chose it. In addition, both Israeli and German designers suggested additional words for this context (the suggested words were written in the participants' native language and were translated to English using a two-way translation procedure). Among the Israeli designers, we identified two groups of words related to two different medical roles: *Nursing roles* (*Calming, Comforting*, and *Compassionate*) and *Expert roles* (*Practical, Clean*, and *Purposeful*). German designers contributed three additional words that are related to *Pleasing roles* (*Gentle, Familiar*, and *Funny*). Table 7 presents the most selected words by Israeli and German designers for the context of MAR and their rate.

We found statistically significant relations among the Israeli respondents for the context of MAR and two describing words: *Innovative* (X^2 $(1, N = 112) = 8.34$, $p < 0.01$) and *Professional* (X^2 $(1, N = 112) = 5.27$, $p < 0.05$); 59% of the Israelis designers selected the word *Innovative* for the design of a medical robot compared to 38% in the overall data, and 72% of them selected the word *Professional* compared to 58% in the overall data. Figure 3 illustrates the two cultural groups' chosen words for the context of MAR in a radar chart.

Table 8. Most Selected Words by Israeli and German Designers (over 65%) for the Context of ALR and Their Rate

Most selected words	Most selected words by Israeli designers	Most selected words by German designers
Reliable (88%)	Reliable (83%)	Reliable (95%)
Friendly (88%)	Friendly (83%)	Friendly (90%)
Inviting (76%)	Inviting (66%)	Inviting (86%)
		Professional (81%)

A Service Robot for an ALR Facility. Table 8 presents the most selected words by Israeli and German designers (over 65%) for the context of ALR and their rate. The top selected words for the context of a service robot for an ALR facility were *Reliable, Friendly*, and *Inviting*. German designers also indicated *Professional* as a desired characteristic; 81% of them selected it, while only 42% of the Israeli designers did. In addition, four Israeli designers suggested additional words for this context: *Familiar, Protecting*, *Gentle*, and *Easy to use*; one designer explained in detail:

> In my opinion, older people may feel intimidated by technology; their fears must be considered. We should think about how to make them feel more comfortable by designing robots more similar to the things that are familiar to them.

None of the German designers contributed additional words for this context, but one did add a detailed remark regarding the design process for older adults:

> Seniors have a different approach to technology; computers often overwhelm them. Young generations are digital natives, are automatically attracted to something like robots, or are more likely to deal with and operate them. This is different with older people. I would definitely go to retirement homes and talk to the seniors. They know best how this robot has to be designed.

We found statistically significant relations between the context of ALR and two describing words: *innovative* (X^2 (1, $N = 200$) = 10.9, $p < 0.01$) and *inviting* (X^2 (1, $N = 200$) = 13.78, $p < 0.01$). About 76% of the designers (Israelis and German) selected the word *Inviting* for the design of an ALR compared to 45% in the overall data. In addition, designers were less likely to ascribe the word *innovative* to the design of an ALR; only 16% of them did, compared to 42% in the overall data. Figure 4 illustrates the two cultural groups' chosen words for the context of ALR in a radar chart.

A PAR for Home/Domestic Use. The top selected words for a PAR context were identical for both cultures: *Friendly* and *Reliable*. German designers were also more likely to select the word *Intelligent*; 67% of them did, compared to only 50% of the Israeli designers. In addition, six designers suggested additional words for this context; Israeli designers contributed *Soft* and *Minimalistic*, and German designers contributed *Reserved* and *Discreet*. In addition, some asked for it to be "not too big" and "Likeable, with a certain character." Table 9 presents the most selected words by Israeli and German designers (over 65%) for the context of PAR and their rate.

We found statistically significant relations between the context of PAR and the selection of the describing words: *Elegant* (X^2 (1, $N = 200$) = 11.9, $p < 0.01$) and *Professional* (X^2 (1, $N = 200$) = 4.1417, $p < 0.05$). The designers (Israeli and Germans) were less likely to select the word *Professional* for this context (49% compared to 66% in the overall data) and more likely to choose the word *Elegant* (44% compared to 18% in the overall data). In addition, no designer selected the word *Authoritative* for this context (compared to 32.5% in the overall data). Figure 5 illustrates the two cultural groups' chosen words for the context of PAR in a radar chart.

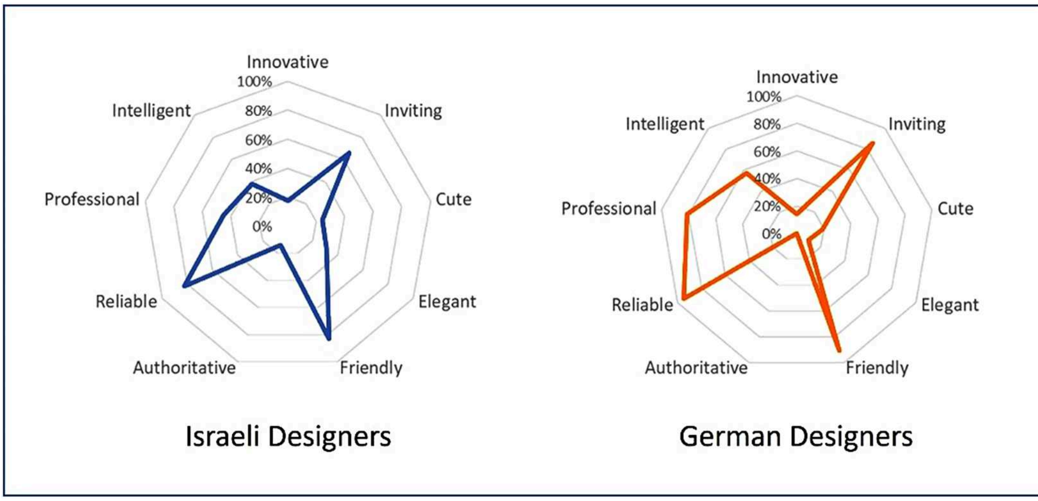

Fig. 4. Respondents' assigned characteristics for the context of ALR by culture.

Table 9. Most Selected Words by Israeli and German Designers (over 65%) for the Context of PAR and Their Rate

Most selected words	Most selected words by Israeli designers	Most selected words by German designers
Friendly (76%) Reliable (71%)	Friendly (80%) Reliable (70%)	Friendly (71%) Reliable (71%) Intelligent (67%)

A COR. The top selected words for the context of COR in the overall data were *Reliable* (70%) and *Professional* (69%). However, looking at each culture separately reveals the different perceptions of this context's role. About 68% of the Israeli designers selected the word Authoritative as one of the most suitable characteristics, while only 22% of the German designers did. On the other hand, the German designers aimed for a friendlier robot; Friendly was the most selected word for the context of COR by the German designers (83% compared to 45% among the Israeli designers). One German designer suggested the additional word Sovereign. None of the Israeli designers suggested additional words for this context. Table 10 presents the most selected words by Israeli and German designers (over 65%) for the context of COR and their rate.

Since the results showed these two cultures do not share the same perception of this robot's role and character, we conducted the Chi-square test of independence separately. Among the Israeli designers, we found statistically significant relations between the context of COR and four describing words: *Authoritative, Inviting, Friendly, and Elegant.* The designers were aiming for a COR to look more *Authoritative* (X^2 (1, N = 112) = 28.34, $p < 0.01$) and less *Inviting* (X^2 (1, N = 112) = 9.11, $p < 0.01$), *Friendly* (X^2 (1, N = 112) = 14.49, $p < 0.01$), *and Elegant* (X^2 (1, N = 112) = 6.94, $p < 0.01$) than the three other contexts. Still, some Israeli designers thought differently; one of them explained his selection of the words: *Friendly*, *Inviting*, *Reliable*, and *Professional*:

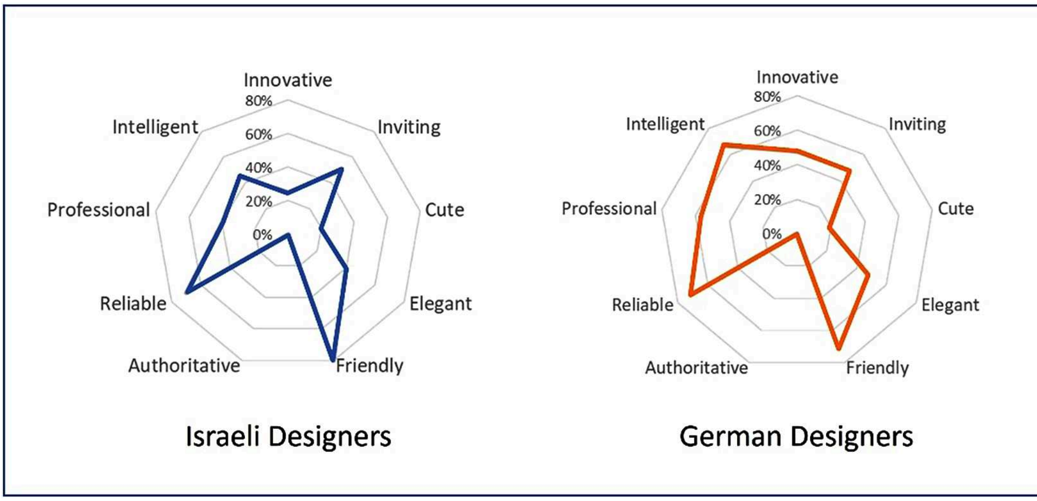

Fig. 5. Respondents' assigned characteristics for the context of PAR by culture.

Table 10. Most Selected Words by Israeli and German Designers (over 65%) for the Context of COR and Their Rate

Most selected words	Most selected words by Israeli designers	Most selected words by German designers
Reliable (70%)	Authoritative (68%)	Friendly (83%)
Professional (69%)	Reliable (68%)	Reliable (74%)
	Professional (68%)	Professional (70%)

> In my opinion, we should design a robot, not human-like, but as close as possible to a human figure, so it will not create a certain reluctance or fear when facing an adult or a 5-year-old child……It should be as friendly as possible. Not threatening or aggressive, it should give even the most suspicious person a sense of confidence and friendliness.

Among the German designers, we found statistically significant relations between the context of COR and the word *Authoritative* (X^2 (1, N = 88) = 13.12, $p < 0.01$). The German designers used this word only for this context. Figure 6 illustrates the two cultural groups' chosen words for the context of COR in a radar chart.

3.1.4 Gender Differences. We analyzed the effect of the respondents' demographic information on their word selections using a Chi-square of independence. Since age was highly correlated with professional experience, we report the impact of the second in the next section. Female designers expressed their desire for innovative and professional robots. About 42.5% selected the word *Innovative* compared to only 27% of the male designers. The relation between these variables was significant (X^2 (1, N = 197) = 4.69, $p < 0.05$). About 69% of the female designers selected the word *Professional* compared to only 53% of the male designers (X^2 (1, N = 197) = 5.09, $p < 0.05$).

3.1.5 Differences Related to the Professional Design Field and Experience. We analyzed the effect of the respondents' design field and professional experience on their word selections using a

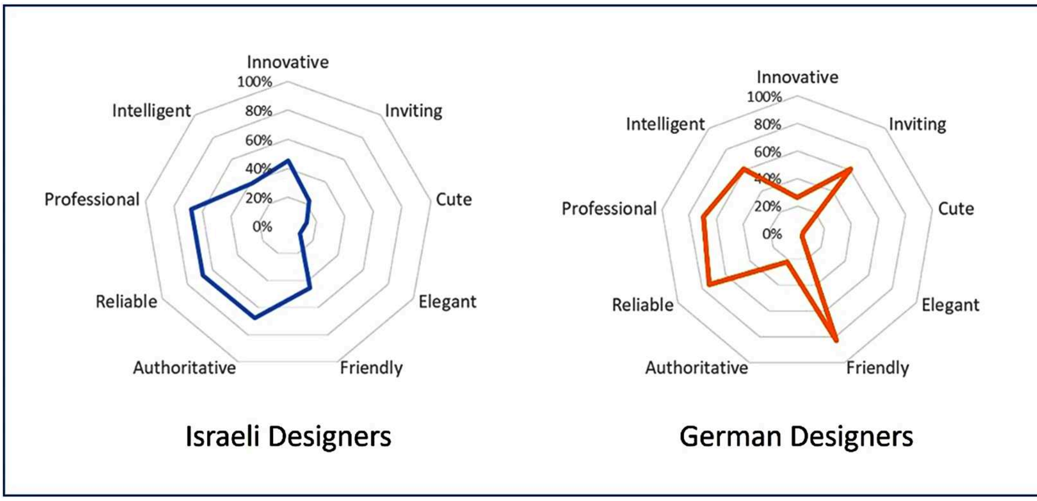

Fig. 6. Respondents' assigned characteristics for the context of COR by culture.

Chi-square test of independence. Results showed that respondents' design field and professional experience affected their selections of six describing words: *Innovative, Inviting, Friendly, Authoritative, Professional*, and *Intelligent*.

Respondents' design field was found to affect their perceptions. 3D designers (product, fashion, and art) were more likely to select an authoritative character for their robot than 2D designers (graphic, illustration, and game design), 26% compared to 12.5% (X^2 (1, N = 200) = 5.76, $p < 0.05$). In addition, they were less likely to select *Inviting*, 42% compared to 64% (X^2 (1, N = 200) = 9.03, $p < 0.01$), *Friendly*, 69% compared to 86% (X^2 (1, N = 200) = 8.5, $p < 0.01$), *Professional*, 56% compared to 70% (X^2 (1, N = 200) = 4.19, $p < 0.05$), and *Intelligent*, 38% compared to 59% (X^2 (1, N = 200) = 8.74, $p < 0.01$).

Design students were more likely to desire a professional-looking robot (71%) than professional designers (53%). The relation between these variables was significant (X^2 (1, N = 200) = 6.78, $p < 0.01$).

3.2 Selection of VQs

After selecting the characteristics of the SAR, designers were asked to choose the most suitable VQs for the context of use they had. Some VQs were selected more frequently than others, regardless of the context, culture, or other factors. For example, most designers (87.5%, Israelis: 86%, Germans: 90%) preferred rounded edges over chamfered ones. Only 11% of them (Israelis: 8%, Germans: 14%) chose the dark color scheme, and most (55.5%, Israelis: 56%, Germans: 54.5%) preferred the white color scheme. The two most selected structures were the A-shape (31%) and the diamond shape (30.5%). We found significant effects of the context on the respondent's selections of structure (X^2 (12, N = 200) = 24.98, $p < 0.05$) and color (X^2 (6, N = 200) = 24.64, $p < 0.01$). Cultural design differences were only found in the case study of COR.

The following paragraphs present the VQ selections of all respondents together by context; the context of COR is discussed in detail in Section 3.2.4. The respondents' gender and professional experience did not affect any of the VQs' selections. A table containing all VQs' selections by the different factors can be found in Appendix C.

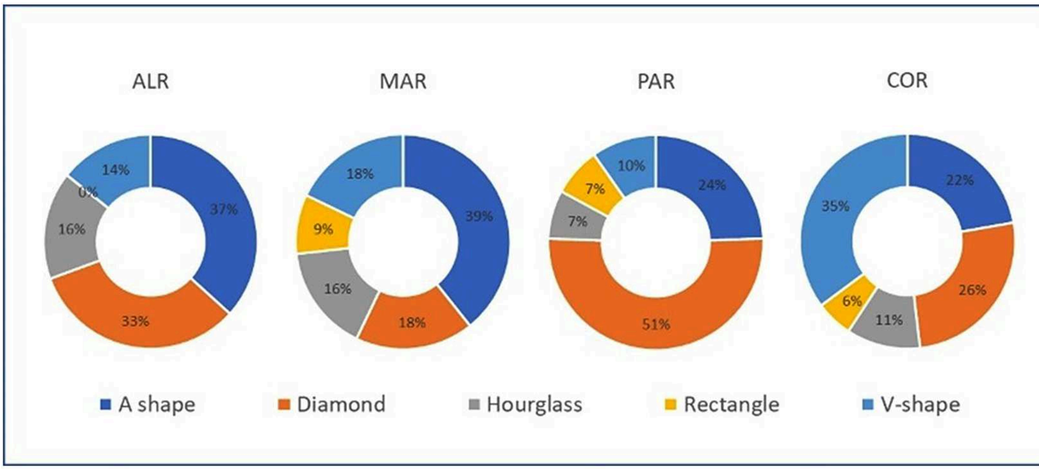

Fig. 7. Designers' structure selections by context.

3.2.1 Body Structure. Out of the five options for the body structure (A-shape, diamond, hourglass, rectangle, and V-shape), three were selected as the final design (most selected) for the four contexts. For the design of PAR, most designers (51%) selected the diamond shape (compared to 30.5% in the overall data). Even though the diamond was the preferred structure for this context among both cultures, Israeli designers showed an even higher tendency toward it; 65% selected it compared to 38% of the German designers. For the design of MAR, most of the designers (39%) selected the A-shape (compared to 31% in the overall data). The two cultures' selections were highly similar. For the design of ALR, most designers (37%) selected the A-shape (compared to 31% in the overall data). Again, the two cultures' selections were highly similar. For the design of COR, most designers (35%) selected the V-shape structure (compared to 20% in the overall data). However, as detailed in the following section, we have found significant differences between the Israeli and German selections. Figure 7 illustrates the designers' structure selections by context.

3.2.2 Outline. Most designers selected a rounded outline for all four contexts. No significant relations were found between the context and the outline selection. Figure 8 illustrates the designers' outline selections by context.

3.2.3 Color. The context of use affected the designers' tendency to select a color combination for their robot, and the relationship between these two variables was significant (X^2 (6, N = 200) = 24.64, $p < 0.01$). White was the most selected color out of the three options; 55.5% of the respondents chose it. Furthermore, it was the preferred color for the design of COR (67%), ALR (63%), and MAR (55%). For the use context of PAR, there was no explicit agreement among the designers; the most selected color was the white and blue combination (39% compared to 33.5% in the overall data), followed by the white color (32% compared to 55.5% in the general data) and the dark combination (29% compared to 11% in the general data). Figure 9 illustrates the designers' color selections by context. The comments also supported these results; three of the designers in this context (two German and one Israeli) mentioned they would like to have more color options:

> As a customer, I would probably like to be able to choose the color selection myself because when buying a new item in the household, you always pay attention to the environment (many of our furniture are black; hence I would tend towards black objects for new purchases).

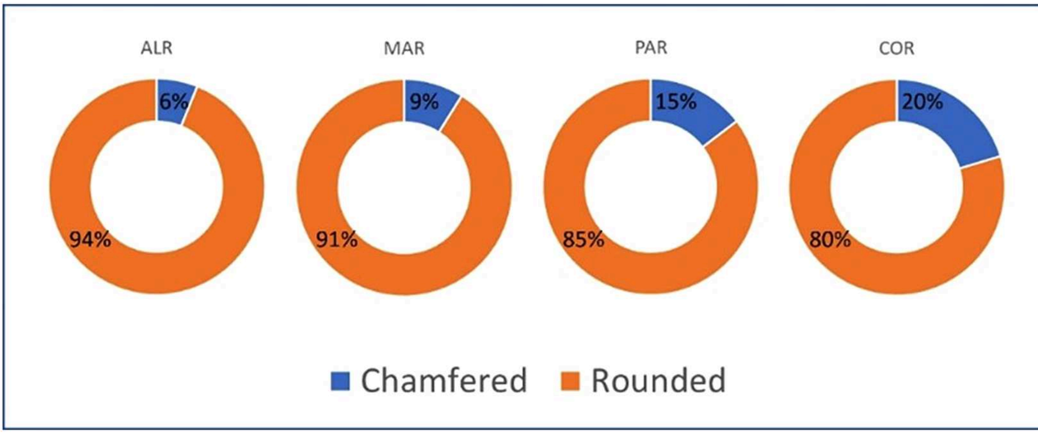

Fig. 8. The designers' outline selections by context.

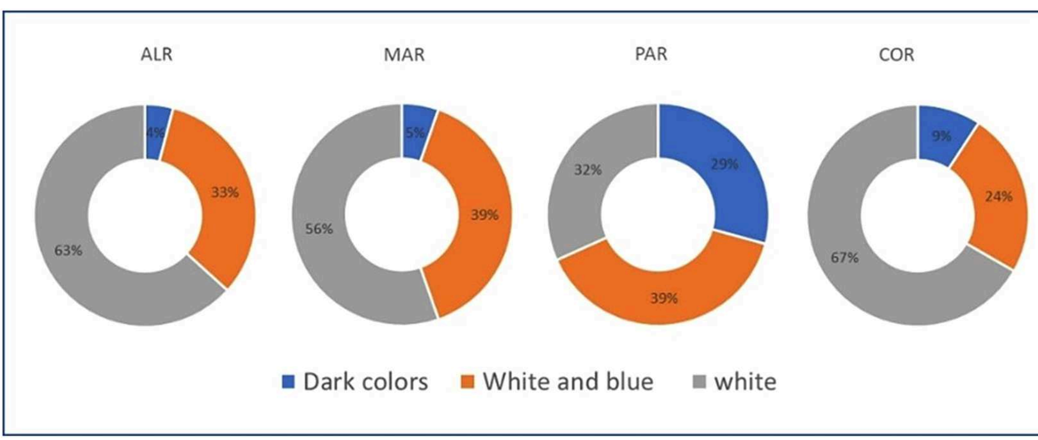

Fig. 9. The designers' color selections by context.

3.2.4 Cultural Differences in the Context of COR. Israeli and German designers' selections resembled the PAR, MAR, and ALR designs. However, we found cultural differences in the design of COR; the Israeli designers preferred the V-shape structure for this context (42%), while the German designers selected a diamond structure (38%). Figure 10 compares Israeli and German designers' body structure selection in the COR context. One of the Israeli designers explained her selection of the V-shape structure:

> Inspectors are antagonists because their job is to enforce the law. Therefore, they must be designed in a masculine form to avoid encouraging vandalism in places where society is patriarchal.

Although rounded edges were the preferred outline across all four contexts and the two cultures, a Chi-square test of independence found a significant relationship between the presented use context and the selection of edge type (X^2 (3, $N = 112$) = 8.67, $p < 0.05$) among Israeli designers. The Israeli designers showed a higher tendency to select chamfered edges in the case of COR (29% compared to 14% in their overall data). On the other hand, German designers' selections were similar to their overall data (9% compared to 10%). Figure 11 compares Israeli and German designers' outline selection in the COR context.

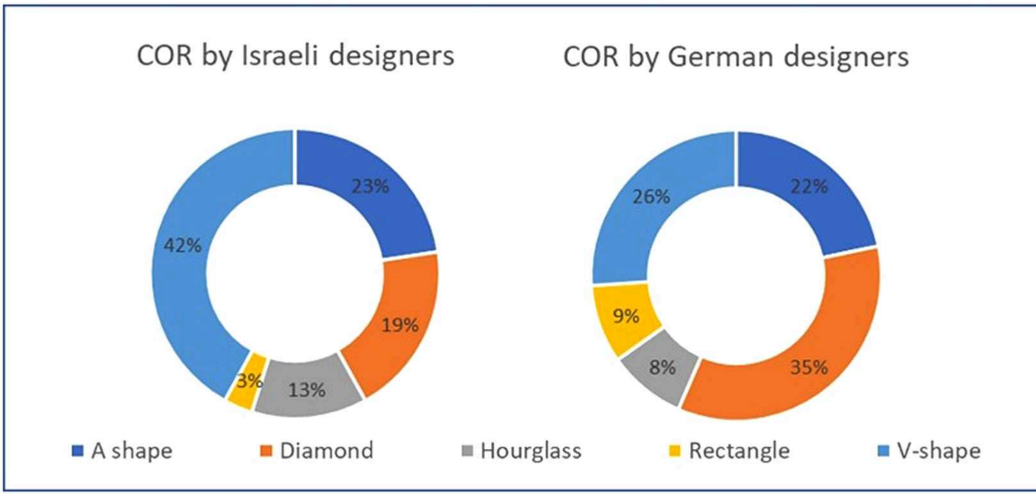

Fig. 10. Israeli and German designers' body structure selection in the COR context.

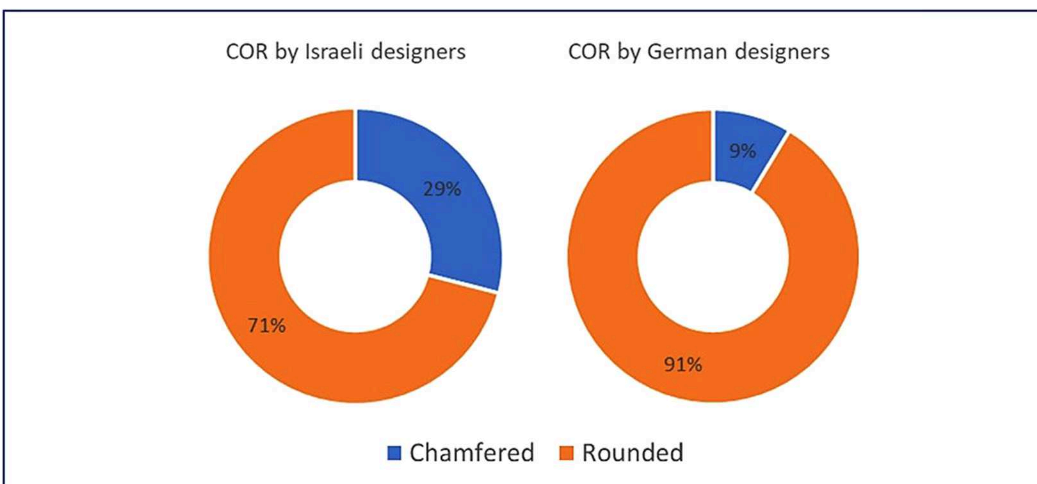

Fig. 11. Israeli and German designers' outline selection in the COR context.

Israeli and German designers mainly selected the white color for the context of COR. However, the German designers' selections were more varied; 57% selected white, 30% preferred a combination of white and blue, and 13% chose a dark color scheme. On the other hand, the Israeli designers were more similar; 75% selected white. Figure 12 compares Israeli and German designers' color selection in the COR context.

3.2.5 The "Preferred" Design by Context and Culture. We summarized the designers' selections to create the "preferred" design for each context by culture. The designs were created by combining each VQ type's most frequently selected options. For instance, the majority of Israeli designers opted for a V-shaped structure (42%), a rounded outline (71%), and a white color (74%) for the design of COR. We found that Israeli and German designers' selections were highly correlated when designing MAR, PAR, and ALR. MAR's and ALR's final designs were similar. However, the

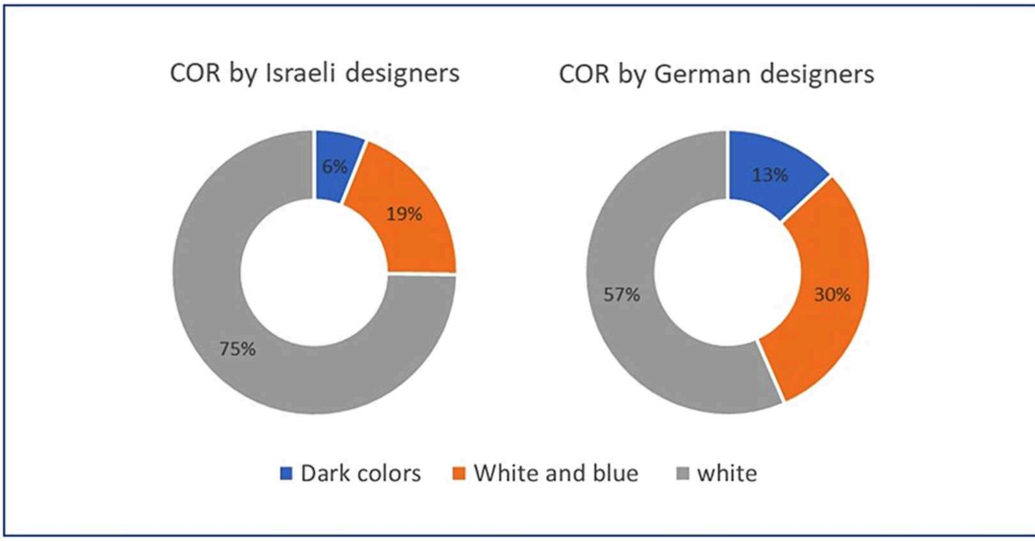

Fig. 12. Israeli and German designers' color selection in the COR context.

design of COR differed between the two cultures. Table 11 summarizes the designers' selections of VQs and presents illustrations of the final designs by cultures and contexts.

3.3 Characteristics and VQ Selections

We found significant relationships between some of the characteristics the designers chose and the VQs they selected. For example, to express an authoritative robot (regardless of the use context and culture), the most used structure was the V-shape (46%); the relationship between the two variables is significant (X^2 (4, N = 200) = 22.26, $p < 0.01$). In addition, the designers showed a significant (X^2 (1, N = 200) = 7.65, $p < 0.01$) higher tendency to select chamfered edges (26% compared to 12.5% in the overall data). To achieve an inviting appearance, the designers avoided using dark colors (6% compared to 11% in the overall data) and showed a slightly higher tendency to select a white and blue combination. The relation between these variables was significant (X^2 (2, N = 200) = 6.36, $p < 0.05$). Furthermore, designers were significantly (X^2 (1, N = 200) = 9.3, $p < 0.01$) more likely to select rounded edges outline (94% compared to 87.5% in the overall data). Figures 13–15 illustrate the relations between the selected characteristics and VQs' selections.

3.4 Thematic Analysis

Ninety-one respondents contributed additional comments (one or more). We excluded greetings and vague statements and remained with 121 constructive comments. A thematic analysis of participants' comments revealed five themes, based on [30]: general appearance, the use of main components, dimensions, use context, and supportive interaction. Each is divided into subcategories, as detailed in Table 12.

The most common theme was using the main components; 55 designers commented regarding the screen and wheels design (regardless of use context). Most of the comments regarding the wheels suggested hiding them, as two explained:

> I would start with hiding the wheels inside the robot's body, creating an enigmatic element in the robot's mobility.
>
> I would hide the wheels ("floating" effect) to make it look more futuristic and intelligent.

Table 11. Designers' Selection of VQs

		COR	MAR	PAR	ALR
Israelis	Structure	V shape (42%)	A shape (38%)	Diamond (65%)	A-shape (38%)
	Outline	Rounded (71%)	Rounded (88%)	Rounded (90%)	Rounded (97%)
	Color	White (74%)	White (56%)	[a]White and blue (40%)	White (52%)
	Illustration				
Germans	Structure	Diamond (35%)	A-shape (39%)	Diamond (38%)	A-shape (38%)
	Outline	Rounded (91%)	Rounded (96%)	Rounded (81%)	Rounded (90%)
	Color	White (57%)	White (57%)	White and blue (38%)[a]	White (76%)
	Illustration				

[a]Not significant.

The most frequent comment regarding the screen was a suggestion to make it part of the body; some suggested designing it differently, and one preferred to have a more human-like head instead of a screen. Fourteen designers asked for more color options (nine Israelis and five Germans), and some of them added color suggestions: green, light gray, orange, and mustard. Four were asking for different structures; two of them suggested more amorphic shapes, as one explained:

> I would use shapes and structures of nature; these are rooted in our mind and memories, expressing empathy and calmness, making us feel in a familiar, safe place even unconsciously.

Eleven designers commented on the robots' dimensions, suggesting different heights and body-screen proportions. In addition, three designers asked for more human-like shapes for the cases of COR and ALR. One designer asked for a pet-like figure for the case of PAR.

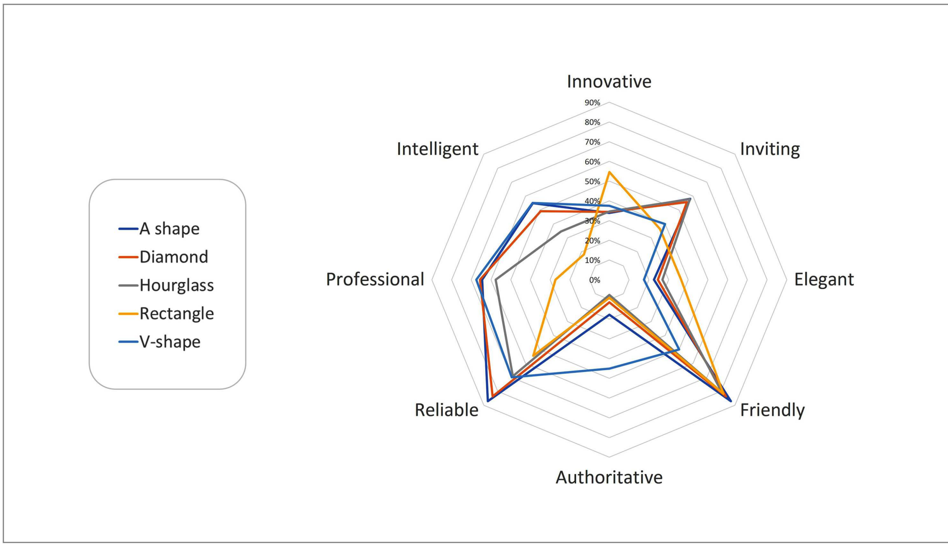

Fig. 13. Relations between selected characteristics and structure selection.

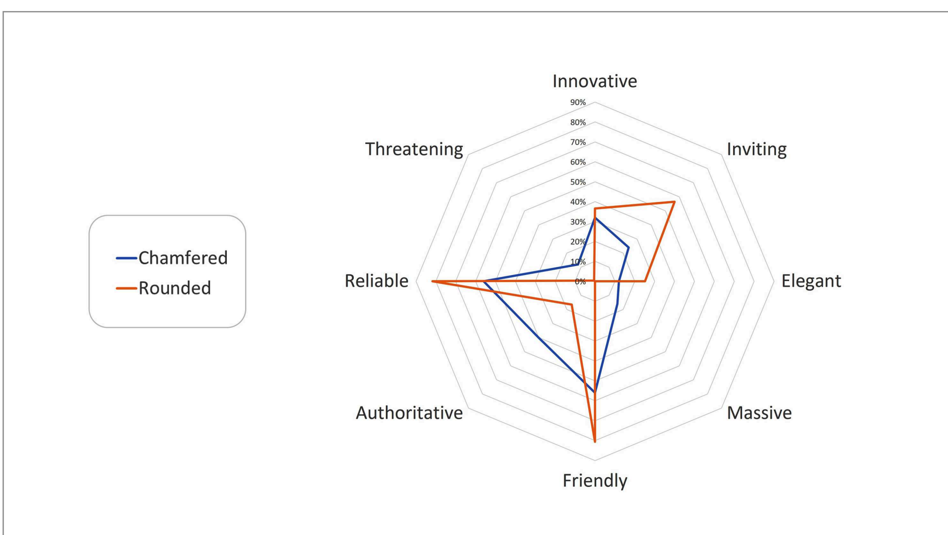

Fig. 14. Relations between selected characteristics and outline selection.

4 Discussion

This study aimed to explore the cultural differences between Israeli and German designers in their perception of SARs' design in various use contexts. We assumed that professional designers are more likely to consider the context of use than their personal preferences in their design, as it is part of their professionalism. Our findings indicate that the context of use influenced the designers' desired characteristics for the robot and their selection of its VQs. The desired characteristics were

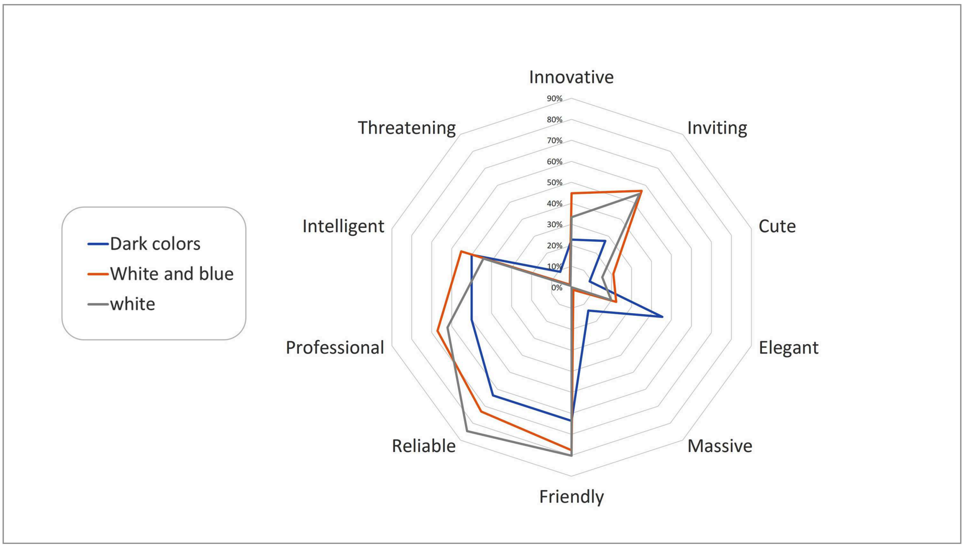

Fig. 15. Relations between selected characteristics and color selection.

Table 12. A Thematic Analysis of Participants' Comments

Theme	Sub-themes	Israelis	Germans
General appearance	Structure	($N = 4$)	($N = 2$)
	Color	($N = 9$)	($N = 10$)
	Morphology	($N = 4$)	
The use of main components	Screen	($N = 19$)	($N = 10$)
	Wheels	($N = 19$)	($N = 7$)
Dimensions	Heights	($N = 5$)	
	proportions	($N = 4$)	($N = 2$)
Use context	Environment conditions	($N = 3$)	($N = 2$)
	Robot role	($N = 3$)	($N = 2$)
Supportive interaction	Robots' characteristics	($N = 11$)	($N = 1$)
	Interaction and usability	($N = 2$)	($N = 1$)
	Graphics and add-ons	($N = 1$)	

consistent with a previous study conducted among potential users (who were not professional designers) [5]. This means that users and designers share the same expectations of SARs in different contexts. However, in [5] the respondents' selection of VQs tended to be based more on personal preferences, and they couldn't link characteristics with VQs. Yet here, in the current study, designer-respondents used the selected characteristics to guide them into the design process by using the three VQs options to evoke feelings and create a certain character in the robot.

In addition, we found that while Israeli and German designers share similar perceptions of most robotics roles, there were differences in their perception of the COR's role. This influenced their choice of the most appropriate visual design for COR. This finding is consistent with previous studies that suggest cultural differences affect the perceptions of robots' roles and functions [19, 32–43]. To design an authoritative-looking COR, Israeli designers tend to select the V-shape structure, and the German designers who desired a friendly and reliable-looking COR selected the diamond structure. These design selections correlate with previous findings that link these particular shapes (VQs) with users' perceptions [30]. The COVID-19 Officer use case confirms our assumption that professional designers are biased by their cultural background. It illustrates the importance of considering cultural nuances in the design process, as these can lead to misunderstandings, rejection, or negative attitudes of users when the robot's appearance doesn't match cultural-based expectations. However, the study did not confirm our assumption that the cultural background of designers affects their design language; our results indicate that Israeli and German designers share similar perceptions of the meaning of VQs. These findings correlate with [49] arguing that Israel and Germany belong to the same cultural group of "Meritocrats" and share similar esthetic preferences.

The use case of PAR has demonstrated once again the importance of allowing customization in the design of personal robots [58, 59]. Designers' color selections for this particular use case varied across all three options. Furthermore, three designers added comments regarding the need for more color options to match the robot's design to the customer's home. Most designers chose the diamond-shaped structure for this use case.

We found no cultural differences regarding the words and VQs selections for the MAR use case. The top selected words for this use case were Friendly, reliable, and Professional. However, we did find an interesting observation regarding the perception of MAR's role. We note that there are three different interpretations of medical roles: Nursing roles (Calming, Comforting, and Compassionate), Expert roles (Practical, Clean, and Purposeful), and Nursing roles (Gentle, Familiar, and Funny). Further investigation is needed to understand whether these interpretations are culture-related. These would also affect the robot's behaviors, as [60] stated: "A robot nurse might enter patients' social spaces, whereas a robot surgeon or a robot janitor in the same hospital won't."

When asked to design an ALR, the designers were concerned with the idea of older adults using technology; they selected the words *Reliable*, *Friendly*, and *Inviting* and avoided the word *Innovative*, which was selected significantly less for this use case. Four designers suggested additional words: *Familiar*, *Protecting*, *Gentle*, and *Easy to use*; all four are related to protecting the elderly. It would be interesting to investigate the perceptions and preferences of potential users—residents in assistive living facilities.

5 Conclusion

One of the key insights from our study is the cross-cultural difference in the perception of the COR's role and its optimal visual design. The use case of a COR is a robot that can monitor and enforce regulations in a public building, such as verifying the green pass and ensuring face mask compliance. Our results show that even in the case of two Western cultures that are considered to have similar perceptions, we may find different expectations of specific robot roles. Israeli designers favored a more authoritative robot for this role, whereas German designers opted for a more friendly and reliable robot. This suggests that different cultures vary in their expectations and preferences regarding the degree of sociality and authority that a robot should exhibit when performing a delicate and potentially invasive task. This also has implications for the design of the robot's VQs, such as structure, outline, and color, as these VQs can elicit different impressions and emotions among users.

Therefore, our study emphasizes the importance of taking into account the cultural context and the specific use case when designing the role of a robot and its VQs. It is essential to conduct cultural research to understand how people from different cultures perceive robots and their roles.

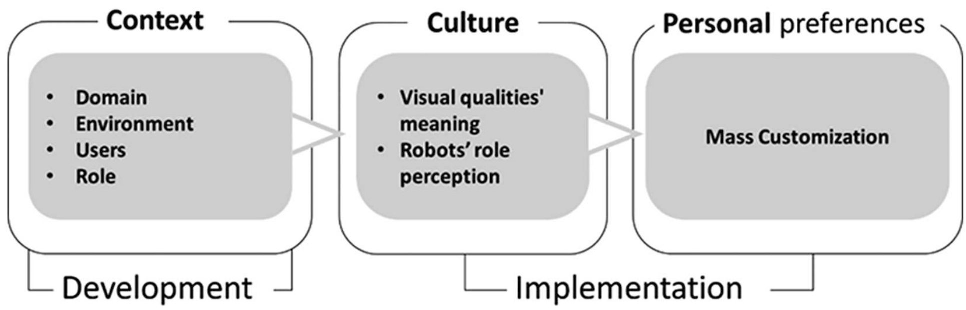

Fig. 16. Design factors that must be considered when designing new SARs. The context of use is being examined during the development phase of the robot, but cultural and personal preferences tend to emerge later in the implementation phase.

Understanding cultural differences in the perception of robot roles and appearance is necessary for human–robot interaction research. It has implications for the industry as it can help designers create more effective and inclusive robots. Cultural awareness is a crucial aspect of design that should not be overlooked. Robot designers must recognize that cultural differences can significantly impact how people perceive and interact with the robot. By considering cultural differences and being aware of cultural backgrounds, designers can create robots that are more accessible to people from different backgrounds. Cultural awareness can also help designers avoid creating products that may be offensive or insensitive to certain cultures. In today's globalized world, it is more important than ever for designers to be culturally aware and sensitive to the needs of diverse populations. By doing so, they can create products that are aesthetically pleasing, functional, and meaningful to people from different cultures.

To conclude this study's findings, when designing a new SAR, designers must consider the four layers of the context in the development stage; the selected VQs of a new robot should align with a robotic character suitable to the intended domain, environment, users, and the robot's role. It's recommended to allow a certain level of customization in the implementation stage to provide an easy way to adjust the design to different cultures' perceptions of VQs and robotic roles. This is even more crucial for the case of personal SARs, where personal preferences are more dominant. Figure 16 summarizes these recommendations in a model.

6 Limitations

Our study has several limitations that are related to the participants and the questionnaire structure. These are as follows:

Limited Background Information on Participants. We translated the questionnaires to the native language of the respondents, but this does not capture their countries of origin, duration of residence, and cultural affiliation. These factors are important for understanding their attitudes and behaviors, and their omission may limit our ability to contextualize our findings fully. In addition, we did not account for participants' prior experience with robots or technology, which could affect their interactions and perceptions. This factor would provide valuable context for interpreting our findings.

Gender Distribution and Cultural Backgrounds. The uneven gender distribution across the four cases may influence our findings. Moreover, our study mainly examined Western cultures, which are part of the same aesthetic preference cultural group. To gain a more comprehensive understanding, evaluating VQs and robotic roles across a wider range of cultural backgrounds is essential.

Use Case Variation and VQ Selection Alternatives. Our study focused on four use cases, all of which had similar requirements (e.g., mobility and a screen for performing roles). To enhance generalizability, future studies should address diverse use cases with different requirements. In addition, participants were limited in their selection of VQs when designing their SARs. They could only choose from three VQs: structure, outline, and color, with a fixed set of options. As a result, all final designs had the same screen, wheels, proportions, and dimensions. Future studies should assess the perception and preferences regarding other VQs.

Despite these limitations, our research contributes valuable insights to the field, and we encourage future studies to address these aspects for a more holistic perspective.

7 Future Work

Our study has opened up several avenues for future research that can address the limitations and extend the findings of our work. Our subsequent studies will evaluate VQs and robotic roles across a wider range of cultural backgrounds. These may include cultures that differ in their aesthetic preferences, values, norms, and beliefs regarding robots and technology. This would allow us to identify the commonalities and differences among various cultural groups and how they shape the perception and expectation of robot roles. In addition, to overcome the limitations of our VQ selection, we will assess the perception and preferences regarding other VQs that can affect the design of SARs, such as height preferences that were found to be culturally related [48] or the design of the screen and the wheels that appear important to the designers. This would allow us to explore how these VQs interact with each other and with the use case and culture to create different impressions and expectations of robot roles.

Finally, to enhance the generalizability of our findings, our future studies address diverse use cases with different requirements for SARs. These may include use cases that require different interaction and motion modalities. This would allow us to investigate how these requirements affect the perception and expectation of robot roles and how they vary across cultures. By addressing these aspects, our future research can contribute to advancing the field of HRI and provide valuable insights for designing and deploying culturally appropriate SARs in different contexts, considering users' perceptions and preferences of both the robotic role and its VQs.

Appendices

Appendix A

Text Options Participants Were Given to Indicate Their Design Background (in Section 2.3.1)

Question	
Design field	Product designer Graphic designer Illustrator CG artists (computer game designers) Other—Please tell us more:_________
Experience level	Design student Professional designer Design lecturer Other—Please tell us more:_________

Appendix B

Word Selections by the Different Factors

		Case study				Culture		Gender		Design field		Experience	
N (%)	General	COR	ALR	PAR	MAR	Israeli	German	Male	Female	3D	2D	Students	Prof.
Innovative	72 (36%)	**19 (35.2%)**	**8 (16.3%)**	**15 (36.6%)**	**30 (53.6%)**	42 (37.5%)	30 (34.1%)	**21 (27.3%)**	**51 (42.5%)**	35 (33.7%)	37 (38.5%)	42 (40.4%)	30 (31.3%)
Inviting	105 (52.5%)	**21 (38.9%)**	**37 (75.5%)**	**20 (48.8%)**	**27 (48.2%)**	**50 (44.6%)**	**55 (62.5%)**	40 (51.9%)	63 (52.5%)	**44 (42.3%)**	**61 (63.5%)**	56 (53.8%)	49 (51%)
Cute	33 (16.5%)	5 (9.3%)	11 (22.4%)	8 (19.5%)	9 (16.1%)	21 (18.8%)	12 (13.6%)	14 (18.2%)	19 (15.8%)	15 (14.4%)	18 (18.8%)	16 (15.4%)	17 (17.7%)
Elegant	47 (23.5%)	**4 (7.4%)**	**11 (22.4%)**	**18 (43.9%)**	**14 (25%)**	32 (28.6%)	15 (17%)	18 (23.4%)	29 (24.2%)	28 (26.9%)	19 (19.8%)	24 (23.1%)	23 (24%)
Massive	4 (2%)	3 (5.6%)	1 (2%)	0 (0%)	0 (0%)	2 (1.8%)	2 (2.3%)	2 (2.6%)	2 (1.7%)	4 (3.8%)	0 (0%)	2 (1.9%)	2 (2.1%)
Friendly	**155 (77.5%)**	**33 (61.1%)**	**43 (87.8%)**	**31 (75.6%)**	**48 (85.7%)**	**80 (71.4%)**	**75 (85.2%)**	56 (72.7%)	96 (80%)	**72 (69.2%)**	**83 (86.5%)**	78 (75%)	77 (80.2%)
Authoritative	39 (19.5%)	**26 (48.1%)**	**4 (8.2%)**	**0 (0%)**	**9 (16.1%)**	**34 (30.4%)**	**5 (5.7%)**	13 (16.9%)	26 (21.7%)	**27 (26%)**	**12 (12.5%)**	22 (21.2%)	17 (17.7%)
Aggressive	1 (0.5%)	1 (1.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.1%)	1 (1.3%)	0 (0%)	1 (1%)	0 (0%)	1 (1%)	0 (0%)
Reliable	**157 (78.5%)**	38 (70.4%)	43 (87.8%)	29 (70.7%)	47 (83.9%)	85 (75.9%)	72 (81.8%)	60 (77.9%)	96 (80 %)	76 (73.1%)	81 (84.4%)	87 (83.7%)	70 (72.9%)
Professional	125 (62.5%)	37 (68.5%)	29 (59.2%)	20 (48.8%)	39 (69.6%)	65 (58%)	60 (68.2%)	**41 (53.2%)**	**83 (69.2%)**	**58 (55.8%)**	**67 (69.8%)**	**74 (71.2%)**	**51 (53.1%)**
Intelligent	97 (48.5%)	26 (48.1%)	22 (44.9%)	24 (58.5%)	25 (44.6%)	**42 (37.5%)**	**55 (62.5%)**	32 (41.6%)	64 (53.3%)	**40 (38.5%)**	**57 (59.4%)**	57 (54.8%)	40 (41.7%)
Threatening	4 (2%)	3 (5.6%)	0 (0%)	0 (0%)	1 (1.8%)	3 (2.7%)	1 (1.1%)	1 (1.3%)	3 (2.5%)	4 (3.8%)	0 (0%)	1 (1%)	3 (3.1%)

Light gray boxes represent a significant level of $p < .05$.

Appendix C

VQs Selections by the Different Factors

		Case study				Culture		Gender		Design field		Experience	
N (%)	General	COR	ALR	PAR	MAR	Israeli	German	Male	Female	3D	2D	Students	Prof.
A shape	62 (31%)	12 (22 %)	18 (37%)	10 (24%)	22 (39%)	34 (30.5%)	28 (32%)	23 (30%)	39 (32.5%)	30 (29%)	32 (33%)	36 (34.5%)	26 (27%)
Diamond	61 (31.5%)	14 (26%)	16 (33%)	21 (51%)	10 (18%)	32 (28.5%)	29 (33%)	20 (26%)	39 (32.5%)	30 (29%)	31 (32%)	36 (34.5%)	25 (26%)
Hourglass	26 (13%)	6 (11%)	8 (16%)	3 (7%)	9 (16%)	13 (11.5%)	13 (15%)	11 (14%)	15 (12.5%)	12 (11.5%)	14 (14.5%)	9 (9%)	17 (18%)
Rectangle	11 (5.5%)	3 (5.5%)	0 (0%)	3 (7%)	5 (9%)	5 (4.5%)	6 (7%)	6 (8%)	4 (3.5%)	7 (6.5%)	4 (4%)	3 (3%)	8 (8%)
V-shape	40 (20%)	19 (35%)	7 (14%)	4 (10%)	10 (18%)	28 (25%)	12 (14%)	17 (22%)	23 (19%)	25 (24%)	15 (15.5%)	20 (19%)	20 (21%)
Chamfered	25 (12.5%)	11 (20%)	3 (6%)	6 (15%)	5 (9%)	16 (14%)	9 (10%)	10 (13%)	14 (12%)	17 (16%)	8 (8%)	16 (15.5%)	9 (9%)
Rounded	175 (87.5%)	43 (80%)	46 (94%)	35 (85%)	51 (91%)	96 (86%)	79 (90%)	67 (87%)	106 (88%)	87 (84%)	88 (92%)	88 (84.5%)	87 (91%)
Dark colors	22 (11%)	5 (9%)	2 (4%)	12 (29%)	3 (5.5%)	9 (8%)	13 (15%)	10 (13%)	12 (10%)	10 (9.5%)	12 (12.5%)	11 (11%)	11 (11.5%)
White and blue	67 (33.5%)	13 (24%)	16 (33%)	16 (39%)	22 (39%)	40 (36%)	27 (30.5%)	28 (36.5%)	39 (32.5%)	35 (33.5%)	32 (33.5%)	34 (32.5%)	33 (34.5%)
White	111 (55.5%)	36 (67%)	31 (63%)	13 (32%)	31 (55.5%)	63 (56%)	48 (54%)	39 (50.5%)	69 (57.5%)	59 (57%)	52 (54%)	59 (56.5%)	52 (54%)

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