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Turtles, Locks, and Bathrooms: Understanding Mental Models of Privacy Through Illustration

Abstract: Are the many formal definitions and frameworks of privacy consistent with a layperson's understanding of privacy? We explored this question and identified mental models and metaphors of privacy, conceptual tools that can be used to improve privacy tools, communication, and design for everyday users. Our investigation focused on a qualitative analysis of 366 drawings of privacy from laypeople, privacy experts, children, and adults. Illustrators all responded to the prompt "What does privacy mean to you?" We coded each image for content, identifying themes from established privacy frameworks and defining the visual and conceptual metaphors illustrators used to model privacy. We found that many non-expert drawings illustrated a strong divide between public and private physical spaces, while experts were more likely to draw nuanced data privacy spaces. Young children's drawings focused on bedrooms, bathrooms, or cheating on schoolwork, and seldom addressed data privacy. The metaphors, themes, and symbols identified by these findings can be used for improving privacy communication, education, and design by inspiring and informing visual and conceptual strategies for reaching laypeople.

Keywords: privacy, mental models, metphor, illustration, drawing, user, qualitative

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1 Introduction

Though many philosophical theories of privacy have been proposed, there has been little focus on laypeople's conceptions of privacy. A formal lay theory of privacy could help privacy researchers better understand and model behaviors of everyday people. We performed an exploratory analysis of a set of 366 open-data drawings solicited from both children and adults responding to the prompt, "What does privacy mean to you?" We explored how both privacy experts (i.e., privacy scholars, students, and professionals) and non-experts conceptualize and visualize privacy with the hope of informing risk communication, privacy tools design, and iconography. Our process of qualitative coding is discussed at length, and constitutes a productive contribution to privacy fields in and of itself by defining a framework to codify the visual language of privacy.

Privacy scholars have wrestled with the challenge of defining and conceptualizing privacy. Dozens of theories and models of privacy have been formed, from the seminal "right to be let alone" [57] to the common notion of privacy as control over information [39]. To allow nuance and flexibility, Solove's "A Taxonomy of Privacy" [53] rejects the need for a single definition and compellingly defines a taxonomy of privacy concepts that encompass key elements of previous definitions.

Despite so many philosophical and legal perspectives, there has never been a comprehensive study of laypeople's conceptions or mental models of privacy in general. A mental models approach has been used in several fields where it is vital to understand how laypeople conceptualize a term, process, or technology. While these models are not "ground truth" and often implicitly or explicitly include misunderstandings or misplaced focus, they still may influence individual behavior. These models have been used across disciplines, including medicine, education, and environmental studies, for developing more effective risk communication strategies, improving usability, shaping policy to protect against likely harms, and to allow a better grasp on everyday understandings of abstract phenomena [27, 40].

Relevant mental models research on everyday privacy perspectives has focused on very specific domains [27, 34] or has centered on security [9, 14, 58]. While the security-based perspective is a helpful starting point, as Camp [9, p. 43] notes, "the interaction between privacy and security on the network is subtle," and a security focus tends to emphasize questions of access while de-emphasizing questions of usage.

One interview study comparing privacy concern and knowledge in the U.S. and India concluded that Americans associated privacy with information more often than Indian participants, who associated it more often with the home or physical space [30].

There are also scores of surveys investigating consumer privacy, which tend to explore attitudes [19] rather than conceptual models, or are again limited to specific consumer domains [17, 24]. While an aggregation and analysis of consumer survey data could help begin to build mental models (e.g. around recurring themes like surveillance and contextuality [48]), such a structured approach may miss themes that appear more organically. Therefore, we opt for a more exploratory approach.

We provide a preliminary exploration of lay and expert mental models of privacy. In order to provide generalizability in a world with rapidly-changing technology, we focus on privacy in general ("What does privacy mean to you?") rather than particular aspects of privacy (e.g. "What is online privacy?"). In addition, we map parallels and gaps in philosophical privacy frameworks, with the goal of giving some intuition to how useful those theories are for improving the usability of privacy tools. While our opportunistic dataset does not provide the consistency of a more controlled study, it does provide data collected in a variety of situations, with populations (i.e., children) that would be otherwise difficult to reach.

The Privacy Illustrated dataset is a collection of over 366 pictures from child and adult volunteers drawing their response to the prompt, "What does privacy mean to you?" [47]. We executed a systematic, qualitative analysis of these drawings by coding them for privacy themes, recurring symbols, and other image attributes. With this data, we hope to explore the overlaps and disconnects between expert and lay conceptions of privacy. In addition, visual data allows for an exploration of the visual culture of privacy. We hope to inform privacy-related visual design, for example in iconography, by understanding which aspects of privacy frameworks lend themselves to visual representation, and what novel or well-known metaphors of privacy the illustrators volunteered in drawings.

In this paper, we present an overview of past research on analysis of illustrations. This provides precedent for building visual mental models in order to improve our understanding of privacy. Our discussion of our research methods explains our process of systematic visual analysis, highlights some of its pitfalls, and elaborates on the overall framework we define to organize privacy's visual language. Our results and conclusion focus on the following research questions:

- What models and metaphors of privacy lend themselves to effective visual expression?
- What differences between experts (scholars and professionals) and laypeople appear?
- What visual symbols are associated with privacy?

We conclude by identifying the potential strengths and weaknesses of different mental models, metaphors, and visual symbols of privacy. Finally, we suggest ideas that could be used to improve privacy education and notices for everyday people.

2 Related Work

Below we overview some of the concepts in privacy, psychology, cognitive science, and visual methods that our work relies on. We describe relevant privacy theories, situate our work among a rich body of literature on technology and mental models, define what we mean by "metaphor," give an overview of visual methods, and describe the current state of privacy iconography.

2.1 Privacy Theory

Many researchers have attempted to define privacy in order to create a framework for its study, though none to our knowledge have included detailed discussions of privacy's visual representation. We focus on two well-established frameworks of privacy, Westin's states [59] and Solove's taxonomy [53], to frame our analysis of the images discussed in this paper. We looked for visual representations of concepts from the frameworks in the drawings we analyzed.

Solove's taxonomy, which focuses on information privacy, categorizes harmful activities, including information collection, processing, dissemination, and invasion [53]. Solove notably includes contextual harms,

such as information collection, which may not be considered a privacy violation in some circumstances. We provide an overview of the taxons in Appendix B.

In contrast to Solove's privacy harms, Westin's privacy states focus on people and their physical, identity, and psychological privacy. *Solitude* and *intimacy* are physical states that allow for privacy alone or in groups, respectively. *Anonymity* describes a state of privacy even when in public. Lastly, *reserve* is a state that describes the presence of a psychological barrier against distraction or intrusion [59].

These frameworks can be used by privacy engineers, lawyers, and other experts to identify privacy threats and states, but it is not clear whether the themes and definitions in these theories translate well into lay conceptions of privacy, much less their visual conceptions. A recent study [29] on children's understanding of online privacy made a similar investigation by mapping children's conceptions to that of Nissenbaum's framework [42]. Nissenbaum models privacy as "contextual integrity," a flow with constraints [42].

In addition to these frameworks, we scoured privacy literature for usage of metaphor, analogies, and models. For example, while Nissenbaum uses the metaphor of "constrained flow", Lederer et al. suggest a model of privacy for ubiquitous computing environments: privacy "faces." They propose that designers model privacy as users choosing and swapping a variety of faces in different contexts [33]. We reference a variety of these metaphors from prior work throughout the paper, comparing them to the metaphors our illustrators used.

2.2 Mental Models

Mental models were described by psychologist Johnson-Laird as "structural analogues of the world as perceived and conceptualized, which enable people to make inferences and predictions, to understand phenomena, to decide and control actions, and to experience events by proxy" [25, p. 145]. Mental model-based methodologies have been used in privacy and security research to categorize the types of security threats that a home computer user thinks they might face [58], to categorize users' understanding of online behavioral advertising (OBA) and compare that to the reality of OBA [60], to improve password creation by understanding users' models of password hacking [55], to gain insights into what makes users susceptible to phising attacks [15], and to understand how users process and respond to security alerts [6].

Several authors have examined the ways that mental models of digital security enable and prevent users from conceptualizing threats and practices. Camp outlined several models of security, concluding that a medical model, including public health and infection metaphors, shows promise for emphasizing both individual and collective decision-making [9]. Many of our illustrations echoed themes from Camp's physical model, which included locks and physical barriers. Wash interviewed users to formulate his models of security threats and adversaries, finding that people prioritized different protection strategies based on the adversaries they conconceptualized, and that no model was particularly helpful for mitigating botnets [58]. In a preliminary study, Dourish and Delgado note that users expressed futility about their ability to protect themselves, a feeling that cameoed in some of our drawings [14].

In a study focused on economic framings of privacy, Acquisti and Grossklags [1] surveyed 119 participants on their perceptions of privacy. They connected the economics notion of *bounded rationality* to users' need for mental models. Through a series of privacy vignettes, they found that users relied on "simplified" models, and that "security and privacy seem to be synonyms in simplified mental models of certain individuals" [1, p. 31].

Mental models can also be used to illustrate knowledge gaps between different groups of users. Morgan et al. described eliciting the differences between expert and non-expert mental models, with the goal of designing risk communications that address misconceptions and concerns [40]. In a 2015 paper, Kang et al. sought to understand experts' and non-experts' mental models of the internet using surveys, interviews, and a think-aloud drawing exercise. Their analysis classified participants by technical expertise, and they were able to show a substantive difference between how experts drew the internet and how lay participants did so, suggesting a knowledge gap [27], a result that motivated our interest in expertise differences and general privacy conceptions. Kwasny et al. conducted a focus group privacy study where groups were formed by age of the participant. They found that younger adults defined privacy by control over information, consent, disclosure, and similar concepts, whereas older adults often related privacy to personal space [31]. While many of the findings described in the working paper are relevant to our exploration, the paper was a work in progress and used a very small sample size (26 university students, 6 older adults). We similarly investigate differences in age, gen-

der, and expertise, but through a larger sample size and a novel visual medium.

Additionally, previous work has employed mental models to identify new research directions for existing problems. Renaud et al. conducted an interview study with 21 participants to investigate the reasons why users had not adopted end-to-end email encryption. They suggested that widely accepted roadblocks to adoption—usability and availability—were not enough to explain the non-adoption, and examining participants' mental models revealed additional challenges that needed to be addressed [49].

Most recently, Kumar et al. interviewed 18 U.S. families with children ages 5-11 in order to understand children's mental models of online privacy and security. The authors compared their child participants' mental models to Nissenbaum's theory of privacy as contextual integrity, and found that though children in their sample generally demonstrated understanding of the attributes, actors, and contexts defined by Nissenbaum, primarily older children (ages 10+) could describe transmission principles [29]. The authors extrapolate from the knowledge gaps identified in their study to suggest educational opportunities for young children. We apply privacy theory to our larger data set, including illustrations from people of a wider age range, to similar ends: we highlight potential visual, conceptual metaphors of privacy and identify trends in the contexts and symbols people associate with privacy.

2.3 Conceptual Metaphors

Our analysis identifies the metaphors depicted by the illustrators. Theories of *conceptual metaphor* hypothesize that cognition is founded on a map of overlapping metaphors shared collectively by societies. These metaphors serve to map concrete ideas to more abstract target domains. Like mental models, metaphors are not perfect mappings; they are only partial mappings that emphasize and de-emphasize different attributes and capabilities of the target domain [28].

While conceptual metaphors are the brainchild of cognitive linguistics, we extend this notion to visual metaphors, using it to identify metaphors of privacy that appear in the images. As Kovesces explains, "...conceptual metaphors 'work together' with cognitive models in the creation of abstract concepts" [28, p. 107]. Roediger's discussion of metaphors of "memory" and their potential impact on the field of cognitive psychology takes a similar approach [50].

2.4 Visual Analysis

Drawing has been used as a research tool across many fields for understanding perception and mental models, particularly in education [45] and health [21, 26, 35]. Drawings have been used to study abstract phenomena such as celebrity [18], energy [5], and information [23]. While collecting children's perceptions of health, Pridmore and Lansdown [46] were among the first to test the efficacy of different combinations of drawing and writing prompts. They noted that drawing was particularly helpful for circumventing writing, legibility, and language challenges, though drawings without textual annotations were sometimes uninterpretable. However, key questions pertaining to drawings remain unanswered in psychology literature, such as what motivates a person to draw a particular picture when given a prompt; whether they draw the first image that comes to mind; or how the choice of what to draw might vary by demographic factors.

Hartel et al. note that that their analysis of drawings in response to the prompt "What is information?" provides "a fresh visual perspective on the word-based, philosophical analytic statements that dominate scholarship" [23].

2.5 Privacy Iconography

One example of the benefit of a visual analysis of privacy is its application in iconography. Icons are a staple in user interface design, and pictorial icons can have an advantage over text in terms of recognition time and user recollection rate [3, 4].

However, text has always been the conventional medium conveying a company's privacy guidelines to end users, usually in the form of privacy policies and privacy notices. Despite many attempts at designing icons to replace or augment privacy policies [10, 16, 41], no scheme has ever gained popular use. Mozilla, for example, designed a privacy icon scheme [41] that the company Disconnect, in partnership with TRUSTe, used in their browser pluggin product in 2014 [20]. However, this usage was somewhat short-lived, as the product appears to have been retired around 2017.

Our exploration of how laypeople themselves represent privacy visually may not only aid the design of privacy icons from a novel and bottom-up approach, but also help identify specific themes within privacy that may be difficult to represent visually.

3 Methods

This section describes the dataset we used and explains our process of systematic visual analysis. We elaborate on the motivations, definitions and examples for each of the five coding categories that emerged from the analysis. Lastly, we discuss limitations and challenges.

3.1 Image Data

The Privacy Illustrated dataset[1] is a publicly available, growing collection of over 366 images relating to privacy. In 2014, Privacy Illustrated was conceived during a short-term multi-disciplinary art residency at Carnegie Mellon University for cyberfeminist researchers who examined themes of privacy, security, surveillance, anonymity, and large-scale data aggregation [13]. The Privacy Illustrated team collected images from November 2014 through January 2018 through k-12 classroom visits, activities in several college courses, Amazon Mechanical Turk, at community events in the Pittsburgh, PA area, and at privacy-related events in the Washington, DC area. Some drawings were uploaded by visitors to the project website.

Image collection did not follow a formal protocol. Contributors were asked to respond to the prompt, "What does privacy mean to you?" They were encouraged to write a short description of their drawing, and had the opportunity to provide their name or pseudonym and age. Adults asked younger children to describe their drawings and wrote the child's description down verbatim. Online contributors received the same prompt.

Each submission in the collection includes an *image* drawn by hand or with electronic drawing tools by an *illustrator*. Some images include text as a component of the image. In addition, most submissions include a *description* of the image submitted by the illustrator, but not part of the drawing itself. Most of the images we describe in this paper can be found in Appendix A.

All images are secondary data, licensed under Creative Commons 4.0 [12]. Our university institutional review board was consulted and confirmed that this analysis does not constitute human subjects research.

3.2 Coding and Analysis

We analyzed 366 images, 86% of which included a short description of image content. Of all illustrators, 91% opted to include their exact or approximate age. Many submissions also included the illustrator's first name (real or pseudonym), which allowed us to infer the illustrator's gender. We found that 282 (77%) images were suitable for gender prediction at 92% of certainty using Gender-API, a commercial gender prediction API.[2] The remaining images either did not include names or contained only initials. We do not know how many of the names are real and how many pseudonyms are names consistent with the illustrator's gender, but volunteers observed that participants tended to submit a name (or pseudonym) consistent with their gender presentation.

We took methodological inspiration from Miles and Saldana's "Qualitative Data Analysis: A Methods Sourcebook" [38] and Hartel's "Adventures in Visual Analysis" [22, pp. 87–88]; images were coded for themes using a combination of deductive and inductive coding. The codebook was produced iteratively, through discussions, definition, and review by the entire research team. The coding process lent structure to our understanding of lay conceptions of privacy. As Miles and Saldana assert, "[qualitative] coding *is* analysis" [38, pp. 72]. The process yielded five broad categories of codes, which are discussed in depth in Section 3.3.

Once the team was confident in the codebook, two members iteratively coded roughly 20% of the image set ($n = 73$) to review codebook soundness, allow for further inductive coding, and check intercoder reliability. Intercoder reliability is evaluated when more than one coder analyses the same data. It was measured using raw agreement and Cohen's kappa [11]. After coders reached a kappa above 0.8 (with 102 codes in total), one half of the remaining 80% of the drawings was coded by one coder, and the other half was coded by the other coder. Checking for inter-coder reliability was not applicable for this remaining 80% of images as they were coded independently. Note that a kappa above 0.6 is usually considered satisfactory, and that McHugh's scheme considers kappa values above 0.81 to be interpreted as "almost perfect agreement" [36].

Coders also rated each image with a qualitative estimate of (1) how easy the image symbols were to iden-

1 https://cups.cs.cmu.edu/privacyillustrated/

2 https://gender-api.com/

tify (i.e., What symbols do those shapes represent?) and (2) how easy the image content was to interpret (i.e., What do those symbols have to do with privacy?). Fig. 1 is an example of an image for which coders had high *drawing confidence*, but low *interpretation confidence*, as interpreting the significance of the monster was difficult without its description. To estimate how much interpretation relied on text descriptions, our two coders coded the 73 initial images without reviewing their descriptions, and then coded them again after reading the descriptions. In 8% ($n = 6$) of images, either one or both coders rated the images as difficult or impossible to symbolically interpret without descriptions (e.g., Fig. 6); in 26% ($n = 19$) of images, either one or both coders could not interpret their relation to privacy without descriptions (e.g., Fig. 7). These two percentages dropped to 4% ($n = 3$) and 5% ($n = 4$) respectively after coders included descriptions. The interpretation ratings differed very little between coders, indicating agreement between coders on the ease of the task. For the remainder of the images, coders reviewed images and descriptions together when assigning codes.

Fig. 1. This image was not interpretable without its description. Drawing description: "Privacy turns me into a monster. I stress out over the thought of privacy because there is no privacy." By Mike, age 27

Fig. 2. "locked door, password, both texting to strangers, keeping instagram posts private, not meeting strangers face-to-face, restricted area" by Luke, age 11

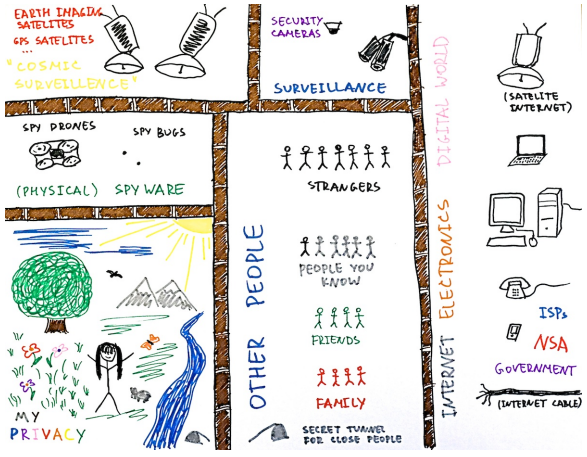

Fig. 3. This image is both composite and demonstrates a rich use of labels. Drawing description: "Privacy is a complex composite. It's hard to achieve absolute privacy. Hopefully it's still possible." By SJ, age 26

3.3 Coding Categories

The five broad categories of the codebook include: metacodes, privacy frameworks, visual symbols, privacy contexts, and privacy metaphors. Metacodes encompass attribute codes, used mainly for metadata and logistics (e.g. whether the image was a composite of smaller images). Privacy framework codes were taken directly from existing privacy frameworks in law and philosophy. Visual symbols (e.g. locks, cameras) were indexed using descriptive coding as a basic inventory of image components, many of which constitute what Hartel calls "pictorial metaphors" [22, pp. 87–88]. Context codes are a broad grouping of recurring social, physical, and communicative contexts (e.g. family, nature, social media). Note that some categories naturally co-occur very frequently; for example, speech bubbles (the symbol) and speech (the context) are likely to co-occur.

These categories are summarized in Table 1 and discussed in this section in depth. The complete codebook is available in Appendix B.

3.3.1 Metacodes

Metacodes tagged meta-attributes of each image such as whether it was composed of multiple independent subdrawings. Inspired by Hartel's discussion of visual syntax [22, pp. 87–88], we identified images with multiple sub-components and coded them as *composites*. Figs. 2 and 3 are examples. Composite images are of interest because they may support the notion of privacy as a set of concepts rather than a discrete definition.

While illustrators were asked to draw a response to the prompt, many drawings (57%) included labels or other written text on the image itself. There were several codes related to whether an image contained text: *includes words*, *only words*, and *description shown* (when the description was written directly on the image area). Labels often added interpretability to an image, but could also add context that would be difficult to represent visually otherwise. Take, for example, the

Table 1. Overview of Coding Categories

	Definition	Subcategories	Examples	# of codes
Metacodes	attribute codes, used for metadata	NA	includes words, composite	5
Frameworks	predetermined hypothesis codes from frameworks in law and philosophy	Solove	surveillance, identification, exclusion	16
		Westin	solitude, intimacy, reserve, anonymity	4
		Agency	displays control, no control, fine-grained access control	3
Visual symbols	an inventory of image components, recurring or notable symbols in drawings	Body	person, group, eyeball	5
		Barrier	wall, door, curtain	6
		Thing	camera, bed, lock, device	18
		Abstract	negation, password input, logo	8
Metaphors	represent privacy as a more concrete process, object, or abstraction	NA	as secure space, as soft barrier, as filter	16
Context	setting, circumstance, or mode of exchange	Social Context	with family, in crowd, under authority	8
		Information Medium	social media, thought, speech	6
		Information Types	financial, demographics, sexual	5
		Physical	in bathroom, in nature	3

image in Fig. 3. In the top-left corner, the "EARTH IMAGING SATELLITES" label was next to two symbols that might not otherwise be recognized as satellites. In contrast, the label "SECRET TUNNEL FOR CLOSE FRIENDS" identified the grey mound as a tunnel, but also added information that might be difficult to express visually (e.g. that the tunnel is secret, that the tunnel is for "close friends"). Others used text not to label, but introduce new themes in entirety (e.g., Fig. 8 shows the word "safe" standing alone), or as symbols in and of themselves (e.g., Fig. 9 includes a hashtag). Like composite images, written text of more than a few characters may be challenging to incorporate into privacy icons.

Most images included a short written description of the drawing. Those that did not were tagged with *no description*. We found that a description can be interpreted ontologically as the following:

1. an elaboration of the drawing's symbolic components,
2. an elaboration of the drawing's metaphorical components, and/or
3. an elaboration on the prompt, not directly related to the drawing.

Without knowledge of the illustrator's intent, it was often impossible to discern which interpretation was most appropriate.

3.3.2 Privacy Frameworks

As one of our research goals was to compare lay conceptions of privacy to expert conceptions, we chose two well-known privacy frameworks to serve as hypothesis codes. One set of codes, derived from Solove's "Taxonomy of Privacy" [53], focuses on privacy violations. We chose this harm-focused framework after noticing that many illustrations depicted privacy harms in action. In contrast, our second framework, Westin's states of privacy from *Privacy and Freedom* [59, pp. 31], describes four ways that people can experience privacy. All of the codes from these two taxonomies and the frequency with which each appeared in our dataset are shown in Appendix B. These two frameworks were chosen in part because they are familiar to both technology and policy audiences and are categorically discrete enough to lend themselves to qualitative coding at scale. However, it should be noted that they both emphasize the perspectives of top-down theory builders rather than grounded or sociological methods. Nevertheless, this sort of deductive coding allows us to ask questions about what aspects of the frameworks appeared and did not appear in images, as well as the symbols and contexts with which they might be associated.

3.3.3 Symbols

As icons are most often concrete visual symbols, we created an index of privacy-related symbols. Symbols represent the source domain of visual metaphors, discrete visual objects. They have well-defined forms (i.e. shape, color, visual components) and sometimes have well-defined metaphorical associations, what Hartel calls "pictorial metaphors" [22, pp. 87–88] For example, "love" is not a symbol, but "heart" is. Some symbols have multiple well-defined forms, such as locks, which could take shape as padlocks or keyholes (Figs. 10, 11).

Symbols were added continuously and inductively to the codebook as they emerged. Some examples include books, windows (Fig. 12, 13), do-not-disturb signs (Fig. 14, 15), and password inputs (Fig. 16). This index of privacy-related symbols can be used to identify common, unusual, or novel symbols for potential applications in iconography or visual risk communication.

3.3.4 Privacy Contexts

We captured recurring and interesting privacy contexts in our illustrations. Contexts are a group of social, physical, and communication themes; they describe relationships between symbols, can be categorized into four groups. Social contexts describe privacy in interpersonal relationships, such as with family, among a crowd, or as a consumer (Figs. 17–20). Communication contexts describe communication mediums, such as social media, speech, or depictions of censorship (Fig. 11, 21). Information contexts describe types of information, such as financial information, demographics, or nudity (Fig. 22). Physical contexts are depictions of spaces, including bathrooms, nature, and notions of personal space (Figs. 23–26).

3.3.5 Privacy Metaphor

Many images depicted high-level representations of privacy instead of privacy in action. These images portrayed privacy as a familiar process, object, or abstraction. That is, while many images depicted privacy associations (e.g., Privacy has something to with writing in my diary, Fig. 27), some suggested very strong associations (e.g., Privacy *is* a diary, Fig. 28). These strong associations are what we consider to be conceptual metaphors.

Heuristically, when the drawing could be summarized by the phrase "privacy as X" where X is a concrete word or occasionally a short phrase, we considered these drawings to contain metaphorical answers to the question prompt. A more theoretical backing to this heuristic is discussed in Section 2.3.

3.4 Illustrator Demographics

The illustrators were from diverse backgrounds, but all drawings were collected from events held in the United States or by Turkers residing in the U.S. More educated people appeared to be overrepresented. Of the images with ages we analyzed, illustrators varied from 4 years to 91 years old. Ages were grouped into 11 categories as shown in Table 2.

Table 2. Age and Estimated Gender of Illustrators
Numbers may sum above 100 due to rounding. Gender is an estimate, predicted from illustrator name or pseudonym.

Age Range	Count	%
6 & under	50	14%
7-10	25	7%
11-13	15	4%
14-18	28	8%
19-29	133	36%
30-39	46	13%
40-49	17	5%
50-59	15	4%
60-69	1	<1%
90-99	1	<1%
Unknown	35	10%
Total	366	101%

Gender	Count	%
Female	149	41%
Male	133	36%
Unknown	84	23%
Total	366	100%

Our gender analysis estimated that the number of male and female illustrators was similar. Gender breakdown of the dataset is shown in Table 2.

The Privacy Illustrated team identified images collected at classes and events for security and privacy professionals or students, and labelled those as created by experts. This division was established because we suspected that those images might depict different trends than those of laypeople who didn't study or work in privacy and security. All other images were labelled as made by non-experts, although it is possible that a few Turkers or attendees at community events might have also been experts. Similar distributions of content categories were found in the images collected online and offline from adult illustrators. Approximately 34% of

the images in this dataset were created by experts and 66% by non-experts. The data suggested a slight skew in gender and expertise; of experts, 27% were women, and 37% were men, though the high number of experts with unknown gender (36%) could affect that gap.

3.5 Limitations and Challenges

Our conclusions are limited by our use of secondary data, the use of drawings, and the inherent difficulties of qualitative visual analysis.

Because we used secondary data that was not collected for research purposes, there are uncontrolled factors in our analysis, including collection method, illustrator effort level, and prompt. For example, some drawings were collected in an elementary school as part of a class, while others were collected during a family event. The amount of reflection and effort that went into drawings may vary by illustrator and collection location. Nonetheless, this dataset included a range of ages and sources not frequently found in privacy research. Additionally, the prompt, "What does privacy mean to you?" was not chosen systematically and may have subtle embedded bias. However, we believe the question was easy for all ages to understand and was presented consistently across all collections.

There are also challenges inherent in using drawing as a research tool. Drawing skill level varied among our illustrators. Images demonstrating high skill may have been more interpretable during analysis. Illustrators may have opted for images they felt were easier to draw, such as eyeballs rather than ears. This challenged our analysis of what privacy aspects could be visually represented. For example, it was often impossible to determine whether an image could not be interpreted because it was thematically subtle versus because the illustration was not skillfully executed.

Backett-Milburn and McKie [2] critique the possible conclusions from draw-and-write studies (i.e., the methodology of drawing and then writing a description of the drawing). They ask the following of a study on children and health:

> Does this method reveal children's own personally meaningful views and feelings about health grounded in their daily experience or are these merely publicly acceptable representations, and what do these say about our culture? [2, pp. 393]

Like health, privacy is abstract and reinforced with public lessons such as "Keep the bathroom door closed!" Many of our drawings demonstrated the use of temporally and culturally relevant symbols and metaphors. For example, Section 4.2.2 notes that the prevelance of the NSA in illustrations could be related to the Snowden leaks that were covered heavily in the news around the time that many images were collected.

Some illustrators may have leaned on cultural rather than personal conceptions of privacy in their drawings. However, as the relationship between the personal, temporal, and cultural is sticky, we did not attempt to disentagle these factors in our analysis. Consider Fig. 29, an adolescent's drawing of the Simpsons (Fig. 29), where Lisa Simpson hides in her room from her annoying brother. How could we pick apart something that combines pop culture references with what is probably a mundane and personal privacy experience for that illustrator? The mix of novel (e.g., see Section 4.3.3), accepted, and even cliche representations in the dataset suggested to us that while some illustrators many have relied on cultural touchpoints, it's likely that the dataset also organically reflected those intertwined concepts. After all, conceptual metaphors are by definition culturally shaped and shared, and mental models are not developed in a mental vacuum. We attempted to stay aware of these complexities and questions when interpreting findings, and encourage readers to do so as well.

4 Findings

Through the coding process, we discovered trends and anomalies in themes, contexts, and symbols. We identified common and innovative visual metaphors that illustrators used to represent privacy, as well as differences in trends for privacy experts and non-experts. This section identifies and gives possible interpretations for these trends and anomalies.

4.1 High-level Trends

The top 5 codes in privacy theory, symbols, contexts, and metaphors are shown in Fig. 4 to give the reader a snapshot of the relative (rather than absolute) frequency of popular codes. The frequencies of codes followed a roughly logarithmic decay curve for all categories. The fifth code represents the inflection point of that curve for most categories. In total, 2,374 codes were applied to 366 images, yielding an average of 6.5 codes per im-

age. Images could be tagged with multiple codes per category, and 7% ($n = 27$) of images were composite.

Of the 366 drawings, nearly 40% ($n = 143$) depicted privacy as controllable by depicting action related to inducing or protecting privacy (e.g., not sharing a key in Fig. 28). The harms of *insecurity*, *intrusion* (Fig. 29), and *surveillance* (Fig. 30) were the most popular depictions from literature, followed by Westin's state of *solitude* (Fig. 26).

Most (65%, $n = 239$) of the drawings had at least one person in them (i.e., drawings coded with *person*, *couple*, or *group*). However, the large prevalence of a single person over *groups* or *couples* combined (combined, 21%, $n = 76$) suggests that privacy was more often depicted as an individual, rather than collective or shared concept. Locks, arguably the most classic symbol of privacy and security, show up in 20% ($n = 75$) of images, as in Fig. 10.

Doors, *personal spaces*, and *bathrooms* are indicators of physical privacy (Figs. 14, 23), while *devices*, *digital* information, and *social media* point to digital and information privacy (Fig. 16). The near-equal frequencies for both suggest that, overall, illustrators focused equally on information and physical privacy.

We also did a non-systematic comparison of symbols in the images with existing privacy icons, focusing especially on common privacy symbols encountered on the Internet. Among all images, we did not observe any symbols that resembled privacy icons such as the adChoices icon [56] in Appendix A.2 or the Mozilla privacy icons. There were two illustrations depicting Chrome's private browsing icon (see Appendix A.2), and two others that referenced Instagram's toggle mechanism for making posts private (e.g., Fig 21).

The following sections explore the privacy contexts, metaphors, and frameworks in depth, intertwining discussions of their associated symbols.

4.2 Privacy Contexts

The contexts refer to the *where*, *who*, and *what* questions of privacy. Who was involved? Where did the scene take place? What was protected or violated? We identified social contexts (the relationships between a person and other entities) like *in family* or *as consumer*; physical contexts (the space or place) such as *nature*; mediums of information such as *digital* or *speech*; and types of information content such as *financial* or *sexual*.

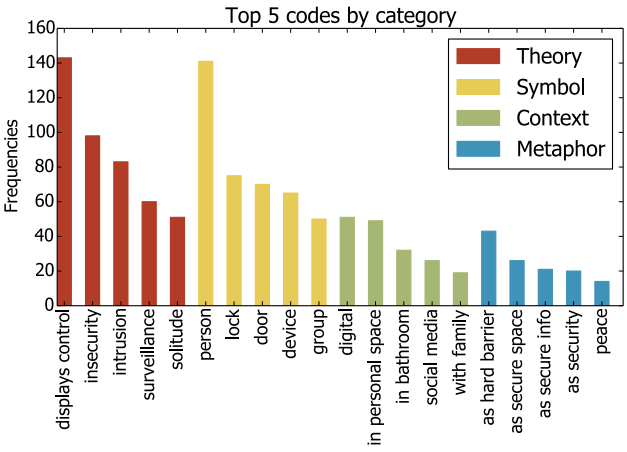

Fig. 4. The Top 5 Themes That Emerged from Each Category.

4.2.1 Contexts, Age, and Expertise

Illustrations by experts more frequently depicted data privacy than illustrations by non-experts. Experts' most frequently-drawn contexts were related to types of information, including *digital*, *financial* and *health* (Fig. 31). In contrast, non-experts focused on spatial and physical contexts such as *in bathroom* or *in personal space* at a higher rate. We were not able to discern any major gender differences across most contexts.

We also analyzed context frequency by age range. Children under 10 frequently drew the contexts *in personal space*, *in a bathroom*, and *with family*. These children were considerably more focused on privacy in the bathroom than other age groups. Additionally, the context of *copying/cheating* was only drawn by children and teenagers (Fig. 32) as well as most images related to *school*. Among children under age 10, there were only two examples of the *digital* and *social media* contexts (3%, $n = 2$ of 75). This could result from young children infrequently using digital and social media. Older kids and teenagers tended to draw *digital* and *social media* more commonly; the frequency of such drawings increased steadily for kids between 11 and 13 and teenagers between age 14 and 18.

4.2.2 Notable Dimensions of Contexts

Here we highlight some notable privacy contexts.

Family: The family is traditionally thought of as a haven of privacy where intimacy abounds. However, 63% ($n = 12$ of 19) of the drawings that involved families actually focused on *intrusion* by family members; for

example, parents hid from their children and kids were annoyed by siblings (Figs. 17, 29).

Copying: The presense of *copying and cheating* (2%, $n = 9$) in the images was surprising to us, as cheating and plagiarism are often associated with theft and intellectual property rather than privacy and sensitive information. Of the drawings that involved being *in school*, nearly all focused on cheating (Fig. 32). It could be that students might have associated plagiarism with privacy because instructors likely warn them to "keep their answers private." This might indicate a trend of emphasizing "hide your answers" over "don't steal answers," putting the burden of privacy and protection on potential victims.

Alternatively, people might view their ideas and answers as part of their identity, making cheating paramount to identity theft (*appropriation*, in Solove's terms) or an attack on autonomy. Fig. 33 doesn't involve cheating, but it does point to a literal security of thoughts. Fig. 34 points instead to the emotional associations of cheating, saying that cheating "makes me feel not very good." Fig. 35 even mentions the theft of a trade secret in the cartoon *SpongeBob*: Plankton stealing the secret recipe for Krabby Patties.[3] This points to an interesting avenue in privacy literature [51]: the association of intellectual property with privacy and/or with identity theft.

Government Agencies: Images were much more likely to depict government organizations or institutions as causing privacy harm rather than protecting privacy. Fig. 36 was one of the two images that involved privacy law and regulation, but nearly all other images involving government depicted government actors as harmful. In fact, 20% ($n = 12$) of drawings depicting surveillance also referenced the National Security Agency (Fig. 37), perhaps related to Edward Snowden's release of NSA documents, which was a current event around the time many of the drawings were collected. Nearly every age group, including children, had at least one depiction of government harm.

Bathrooms: Bathrooms are ostensibly places of physical privacy, designed to prevent exposure of the body. However, some drawings show people hiding in bathrooms for psychological reasons. For example, Fig. 23 shows a person in a bathroom with the description "This is the only time during the day, were I am truly alone and nothing bothers me. No man no children no dogs." These drawings hint that culturally, many groups cope with a lack of privacy by appropriating privacy norms and spaces intended for other contexts. Many bathrooms aren't physically that secure (e.g., bathroom stalls with gaps, Fig. 38), but these images point to the cultural security of that space. Notably, there are other culturally private spaces, such as voting booths, that do not appear in the drawing set at all.

4.3 Privacy Metaphors

Conceptual metaphors are the mappings between concrete and abstract domains that simplify and add richness to everyday understandings about the world. In this section we identify the common and novel metaphors we interpreted in images, as well as discuss their possible strengths and weaknesses in forming mental models of privacy.

4.3.1 Common Metaphors

The images contained many conceptual metaphors of privacy, which are grouped into five high-level categories and described below in order of prevalence.

Barriers: Physical barriers, from doors to clothing, were the most common type of metaphor used. These barriers were associated with ensuring *solitude*, preventing *intrusion*, and keeping unwanted people away. Most barriers were *hard barriers* that were opaque, impenetrable, and solid (mainly *walls*, Fig. 39). In general, these barriers were inflexible and not very portable—people must move behind these barriers to obtain privacy.

A much smaller fraction were *soft barriers*, usually made of cloth. They were split between curtains, blankets, and clothing. These softer barriers were more likely to indicate temporary or flexible states of privacy. As shown in Fig. 5, one illustrator wrote: "Privacy is being able to cover yourself or your things as much as you want," indicating the flexibility of adding or removing clothing and adjusting a curtain.

However, some *hard barriers* also allowed for flexibility of state (Fig. 40). *Doors*, in particular, allow people to switch easily from public to private space, shown by Fig. 41's description "A closed door makes any room a private room!" However, even these more flexible *hard*

3 *SpongeBob SquarePants*, Nikelodeon Animation Studios and United Plankton Pictures. The Krabby Patty is the signature dish of a restaurant in *SpongeBob*.

Fig. 5. No illustrator information or description was provided.

barriers often only allow for a dichotomous change in state (i.e., in/out, private/public).

Overall, this class of metaphor was popular and accessible across expertise and age. The illustrator of Fig. 42 went so far as to say, "Privacy is defined by physical barriers." However, note that this metaphor could be applicable beyond physical privacy, for example in the word "fire*wall*."

Security: A large portion of images not only associated privacy with security, but went on to represent privacy *as security*, *secure space*, or *secure information*. Security is an overlapping, but arguably more concrete domain than privacy, as privacy includes complex sociocultural factors while security focuses more on physical realities. Because of this concreteness, it makes sense that illustrators might fall back on drawing or conceiving privacy as a property of security. This was illustrated particularly well in Fig. 10 by one illustrator who wrote, "To me, privacy is fundamentally about feeling secure."

Among symbols, *locks* unsurprisingly co-occurred frequently with the security metaphor (e.g., Fig. 43). In the metaphors involving *secure information* (e.g., Fig. 44), symbols of *devices* were popular, indicating that people may associate information security with digital security. *Secure spaces* largely included *houses*, *doors*, and unidentified rooms (Fig. 14).

Information Control or Organization: There were a few metaphors that focused on information control and/or organization. These images usually depicted privacy as information flows, networks, categorizations, or some combination of the three. They also often included *arrows* and used colors to indicate data features. Nearly all of these images were also associated with *fine-grained access control*, as they allowed for nuanced information control.

In **flow** metaphors, privacy was depicted as a flow of information, usually passing through a filter or other permeable barrier, like the filter in Fig. 45.

Control **networks**, such as Fig. 46, shared similarities with flows, but suggested two-way transactions, where a filter allows for information flow in only one direction.

Lastly, **categorizations** placed information in different categories by content or relationship. As categorizations require the placement of people and information into neat buckets, these images tended to portray more well-defined social and information types, such as *health* data, *family*, or *financial* data, than other metaphors. These images were often depicted by graphs, such as the radial graph in Fig. 47.

Still other examples were hybridizations of other metaphors. For example, Fig. 48 used a combination of barriers and categorization, representing categories as different shelves in a cabinet, some locked, and some with opaque or glass doors. Fig. 31 illustrated filters, categories, and hard barriers together.

The Home: Some of the images suggested that *homes*, or home-like spaces (such as bedrooms), were not just examples of private spaces, but metaphors for privacy (Fig. 49). The recurrence of homes may connect to the American cultural and legal emphasis on the connection between privacy and property; property is one of the few places explicitly designated as private by law. Homes provide many of the benefits of secure spaces, but are augmented in that their security is less a physical security and more a legal and social guarantee.

Absence: This category of metaphor was a loose grouping of images that showed privacy as an utter absence of some stimulus. For example, images showing privacy as darkness implied an absence of vision (Fig. 50). Some showed an absence of information, by writing or showing literal blankness (Fig. 51).

A few images involved an absence of society, which we called *hermit* images. These images recognized privacy as a socially-defined construct and solved privacy concerns by simply avoiding them altogether; people "went off the grid," moved to islands (Fig. 52), or retreated to nature. One image description (Fig. 53) illustrated this metaphor beautifully: "Privacy means nature, no fences, no boundaries. Man made constraints like houses, businesses, and resorts don't offer privacy in my mind. Privacy needs freedom and elements beyond our control."

4.3.2 Metaphors, Age, and Expertise

Overall, expert images were more likely than non-expert images to contain any metaphor, suggesting that ex-

perts might be more likely to draw privacy as an abstraction. Both experts and non-experts focused most on metaphors of privacy *as a hard barrier* and privacy *as secure space*, but diverged beyond that. Experts more frequently illustrated information exchanges as a *flow* or *filter*, displaying a nuanced awareness of how information can be used and spread.

We found only one difference in metaphor use across age: children under 6 frequently drew privacy *as soft barrier*, focusing on blankets and bed covers (Fig. 19). We saw no differences in metaphor use across genders.

4.3.3 What Can Metaphors Model?

Without the luxury of interviews it is difficult to draw conclusions about the mental models that illustrators have regarding privacy. However, the types of privacy metaphors that illustrators use are potentially related to the types of models they possess.

As alluded to in Section 4.3.1, each metaphor emphasizes and de-emphasizes some aspects of privacy. For example, the metaphor of privacy as a *hard barrier* emphasizes a strong, secure public-private divide, while de-emphasizing the notion of fine-grained access control. On the other hand, the network in Fig. 46 emphasizes access control, trust, and community privacy, while putting aside the notion of security in information transmission.

We found that many of the models described in the privacy literature correspond to the metaphors that illustrators depicted. Examples of metaphors from the literature, emphasis, and corresponding images given in Table 3. Some metaphors found in privacy literature didn't appear in our images. For example, we found no theater metaphors similar to Lang and Barton's description of privacy as a theater, with a backstage, frontstage, and public performance [32]. We also did not observe Spiekermann and Cranor's "privacy spheres" [54], or their emphasis on shared control.

Innovative Metaphors

There were unexpected and nuanced metaphors that appeared and are worth highlighting. One description related to filters was, "Privacy for me is like a place with a one-sided mirror" (Fig. 57), while Fig. 58 sifts a person through a filter. An interesting riff on barriers was an abstract representation of the metaphor of privacy as a rotten egg that had been "pierced by malicious companies and government entities" (Fig. 59). Figs. 40 and 60 are examples of portable barriers for physical safety and secrecy.

One innovative metaphor was from an illustrator who depicted privacy as software: object-oriented software classes for friends, family, and adversaries had different abilities to "get" and pass along information (Fig. 61). This metaphor, while likely not accessible for the general population, is a powerful abstraction and arguably even encompasses all the central components of Nissenbaum's contextual integrity [42].

In contrast, a simple metaphor that encompassed barriers, control, and social norms was an animal's shell. Unlike many hard barriers, an oyster shell or a turtle shell (Figs. 62, 63) is portable, controllable, and serves as both protection and home.

4.4 Privacy Frameworks

To explore what dimensions of privacy threats and states appeared in images and understand the overlap between academic and lay conceptions of privacy, we coded images for themes from privacy frameworks.

4.4.1 Frequent Themes from Privacy Frameworks

The most prevalent codes from Solove's framework were *insecurity* (27%, $n = 98$), *intrusion* (23%, $n = 83$, Fig. 29), *surveillance* (16%, $n = 60$), and *exposure* (10%, $n = 35$, Fig. 24). The most common codes from Westin's states were *solitude* (14%, $n = 51$) and *intimacy* (3%, $n = 11$, Fig. 18).

Two themes from Solove's framework never appeared: *blackmail* and *distortion*. Most of Solove's taxons appeared infrequently, including *identification* (Fig. 64), *interrogation* (Fig. 2's Mr. Stranger), *disclosure* (Fig. 65), *aggregation* (Fig. 66), *breach of confidentiality*, *increased access*, and *appropriation*. It could be that these harms are difficult to draw, that they didn't come to mind for illustrators, or that illustrators' privacy conceptions didn't include them. Images that did show these taxons often relied on words (e.g., by writing the words "identity theft" (Fig. 35), which suggests that these concepts may be difficult to illustrate. One notable exception is an image depicting *increased access*, which shows systemic camera surveillance at a public library. It is captioned: "This is a quick ink pen sketch of the privacy I think should be afforded even in some public places..." (Fig. 67).

Table 3. Metaphors, Emphasis, and Connection to Privacy Literature

Metaphor	Connection to Privacy Lit	Emphasis	De-emphasis	Example Figure
As a mask	Lederer's privacy faces [33]	masks can change across contexts, identification	physical space	Fig. 54
As darkness	Altman's spectrum of openness [43]	public-private spectrum	security	Fig. 55
As a bubble	Supreme Court's "zones of privacy" [52]	public-private boundary	information proccessing violations	Fig. 56
As a venn diagram	boundary management [43]	shifts with context changes	others' boundaries	Fig. 6
As a filter	Byford's privacy "acts as a filtering device" [8]	control, information flows	physical space	Fig. 45

4.4.2 Metaphor and Context Across Themes

There were metaphors, symbols, and contexts that tended to co-occur with different privacy themes. Many trends are unsurprising; most images of *solitude*, for example, involved a single *person* (Figs. 25, 68).

Many drawings related to *social media* or subjects acting as *consumers* also depicted *insecurity* (Fig. 59), but images with other *digital* media also showed *surveillance* (Fig. 69). Of images involving *nature* or *animals*, most alluded to *solitude* (Figs. 25, 70). *Secondary use* was associated with *code/software* and *devices* (Fig. 71).

4.4.3 Frameworks, Age, and Expertise

Experts frequently illustrated nuanced control over information, which was less common for non-experts. We found only a few differences when comparing drawings across age ranges. Illustrators between 40 and 49 focused on having control at a higher rate than other age groups. The privacy framework of *insecurity* was a common theme for ages 14-18 and 40-49. Children between the ages of 7 and 10 were concerned with *exposure* at a higher rate than other age ranges. This correlates with children focusing on the concept of preserving privacy in the bathroom space (Figs. 24, 72).

4.4.4 How is Control Depicted?

Privacy Actions As shown in Fig. 4, many drawings depict people taking action to protect their privacy. Many of these actions overlap with the actions Burgoon et al. [7] identified as messaging strategies people take to restore privacy, such as using barriers as "symbolic markers of occupied territory," use of clothing, and manipulations of distance, noting that people prefer to avoid direct confrontational measures such as telling people to move out of their space. However, direct verbal confrontation (e.g., Fig. 29's "Go away Bart!") was a common privacy action in drawings, possibly because subtler messages such as body language are difficult to draw.

The most common actions, however, were proactive measures related to security, such as locking doors to prevent intruders, picking a long password, or posting "Do not disturb" signs (Figs. 49, 73).

Some themes from frameworks were more likely to be depicted with privacy actions. For example, *identification* usually involved people taking actions such as wearing a mask (Fig. 54). Images depicting *reserve* also showed a high level of privacy control, perhaps because the state involves choosing what and what not to tell others (Figs. 33, 74).

Privacy as Control While many images depicted privacy as controllable, there were fewer that depicted privacy *as control*. One of the more common control mechanisms depicted was privacy as a key under a subject's control. One showed social media-like thumb icons to classify content as yes or no, with the description "Privacy is being able to decide what you want to share with the world" (Fig. 75). Another drawing (Fig. 76), showed control as a set of levers to direct a claw arm to pick up information from buckets.

4.4.5 For Some, Privacy is Hopeless

While some images displayed control over privacy, 6% ($n = 20$) of all images depicted a lack of privacy or a lack of control. Notably, half of these images also depicted *surveillance*, and nearly half depicted *intrusion*, suggesting that people may feel less control over protecting themselves from surveillance-related harms (Figs. 30 and 77). For example, Fig. 78 describes, "In todays society we are constantly being watched. Both in person and [at] the expense of tech it has become almost impossible to be alone."

4.4.6 Meta-commentaries on Privacy

Some images involved themes about privacy that did not fit the frameworks we selected very well. Largely, these images depicted meta-commentaries on or attitudes about privacy. They often discussed the state of privacy in our world, or the relationship between privacy and society at large. Here are a few examples of these commentaries:

- Privacy is ubiquitous (Fig. 79, "Everything has something to do with privacy")
- Privacy is a value or function (Fig. 80, "Privacy is essential to liberty and freedom")
- Privacy as individual or personal (Fig. 81, "It's essential for some people, but may not be for all," like cream in coffee)

Fig. 82 even included the 2014 Kim Kardashian nude magazine cover [44], a possible reference to celebrity's tenuous relationship with privacy, or perhaps as a judgment of someone who didn't follow privacy norms.

Lastly, Fig. 83 rejected privacy altogether, depicting a chaotic tornado and declaring: "Privacy is an illusion."

5 Discussion

In this paper, we presented an analysis of 366 illustrations of privacy, generated by a diverse set of people including children and adults, and privacy experts and non-experts. Taken in aggregate, these results suggest two primary takeaways: (1) these illustrations often focus on a strict dividing line between public and private spheres of life, and (2) illustrations by young children disproportionately depicted physical privacy. We discuss the significance of these takeaways below.

5.1 Public and Private Divide

Many of the illustrations analyzed in this paper showed a strong divide, such as a physical barrier, between a public space and a private space. This was especially frequent in drawings by non-experts. Though many of these drawings included a control mechanism, e.g. a door or a lock, they still presented access to one's self or information as binary: access was either completely "on" for anyone, or completely "off" for everyone. This simple model of information flow centers sharing information as the primary digital privacy risk. Other risks, such as aggregation or context collapse, become secondary because they cannot occur if information is never shared. However, the average person often makes the choice to share information online, so the lack of focus on other information privacy risks is concerning.

Notably, experts more often drew nuanced spaces and metaphors. Their illustrations showed multiple public and private spaces as well as information flows and filters. We suggest that teaching these metaphors to non-experts could help disrupt the binary divide between one private and one public space that they often envision. While the experts' metaphors are not inherently *better*, they may be more useful for thinking about the types of information processing harms prevalent today.

5.2 Children's Depictions of Physical Privacy

Children under 10 frequently drew bedrooms, bathrooms, or cheating on schoolwork when asked to draw privacy. This reflects the domains of privacy we might expect from them; the sanctity of these areas is regularly reinforced by parents and teachers. What is missing from all but two of these children's illustrations is any depiction of digital spaces. Phones, computers, the internet, and online communication did show up in teenagers' illustrations, which suggests that the children under 10 in this population had not yet begun to associate digital spaces with privacy. This omission is significant because it is not clear that children's visions of physical privacy translate to a useful framework for making privacy-conscious decisions online or when interacting with smart toys or digital assistants in their homes [37].

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A Overflow Images

A.1 Selected Illustrations

As of this writing, higher-resolution versions of all images are available on the Privacy Illustrated website [47].

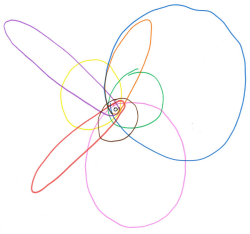

Fig. 6. "Privacy, to me, is control over the compartmentalization and overlap of information for/between distinct audiences." By Josh, age 32

Fig. 7. No description

Fig. 8. "Privacy means having a safe space knowing that no one will be able to see it w/o my permission." By A, age 21

Fig. 9. By Maurice, age 18

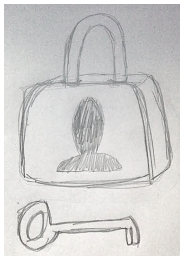

Fig. 10. "To me, privacy is fundamentally about feeling secure. Having the ability to control who has access to me, and to my information, makes me feel like I can control my privacy." By CJ, age 33

Fig. 11. By Daniel, age 16

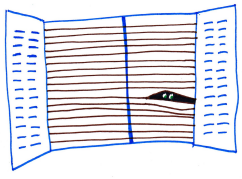

Fig. 12. "Avoiding the neighbors." By Anne, age 26

Fig. 13. "Looking outside, pondering inside. My privacy is accessible and not – inside my window." By Heidi, age 20-35

Fig. 14. "Do not disturb." By Nevins, age $8\frac{3}{4}$

Fig. 15. By Abigail, age 12

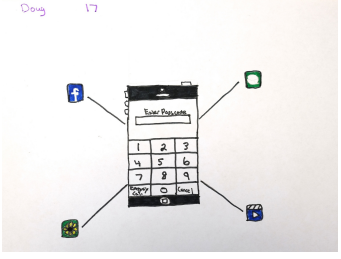

Fig. 16. By Doug, age 17

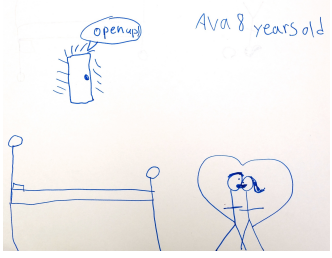

Fig. 17. "Parents kissing behind a closed door." By Ava, age 8

Fig. 18. "Privacy means space for intimacy, exploration, and growth." By Fox, grassroots privacy educator, age 35

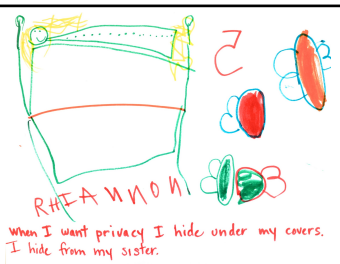

Fig. 19. "When I want privacy I hide under my covers. I hide from my sister." By Rhiannon, age 5

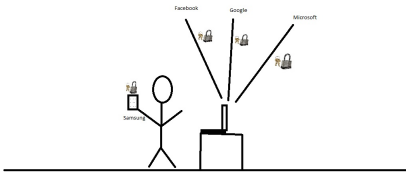

Fig. 20. "I believe that it is important for those companies that I use everyday to do what they can to protect my personal information both as an individual and as a consumer. For those scenarios where my information is shared, I believe that privacy policies should be upfront and transparent so that we know exactly what information we are giving and how it will be used." By Frank, age 31

Fig. 21. "This person's instagram account is private to keep them safe and not sharing personal info." By Audrey, age 12

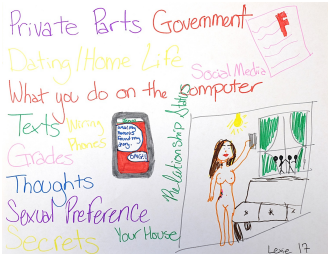

Fig. 22. "A girl taking a nude selfie while people watch through a window. Lots of words." By Lexie, age 17

Fig. 23. "This is me enjoying my privacy. This is the only time during the day, were I am truly alone and nothing bothers me. No man no children no dogs." By Cindy, age 54

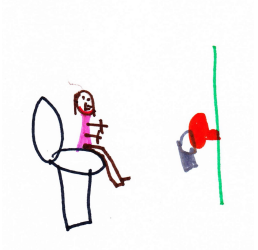

Fig. 24. "No one come in when I am in the bathroom!" By Sydney, age 7

Fig. 25. "Being able to enjoy the nature in total silence. Being able to inhale fresh air. To spend the night outside alone, enjoying the moon and the stars. To just be yourself without anyone noticing." By Pshyche, age 31.

Fig. 26. "Me in my bedroom. No one is up in my bedroom."

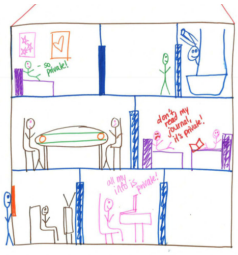

Fig. 27. "This is about privacy in the home! w/electronics and physical equipment." By Pranita Ramakrishnan

Fig. 28. "The picture is of a diary that has a mechanism to keep it shut. There is no key available within the drawing, so that no one can open it. If no one can open it, privacy remains intact." By Karen, age 43

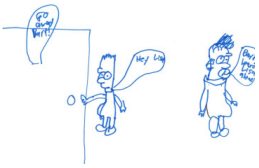

Fig. 29. "Bart knocking on Lisa's door" By Sammy, age 10-15

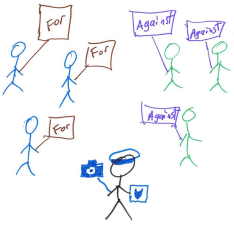

Fig. 30. "People should be able to express their views without surveillance & infiltration by the police." By anonymous, age "old"

Fig. 31. "Privacy is control over who I am and what I know, filtering it so that the right people get only what they need, and protecting it from the rest of the world." By Krista Maddigan, age 45

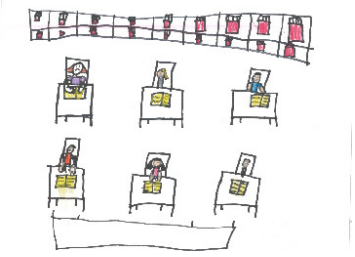

Fig. 32. "I don't want anyone to copy my work if I'm right - it won't show what they know." By Sofia, Grade 1

Fig. 33. "Privacy means that the thoughts in my brain are locked away. What I know does not have to go into the world, which I put an X over." By Thomas, age 19

Fig. 34. "I don't want people looking at my work. It makes me feel not very good." By Sasha, Grade 1

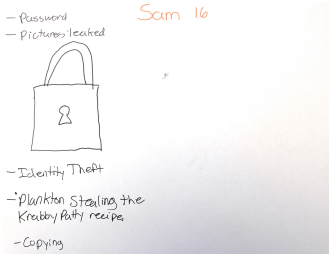

Fig. 35. By Sam, age 16

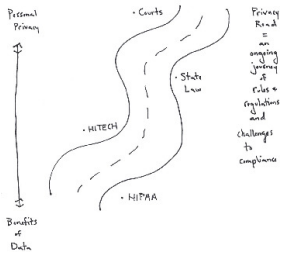

Fig. 36. "privacy Road = an ongoing journey of rules and regulations and challenges to compliance." By JB, age 28

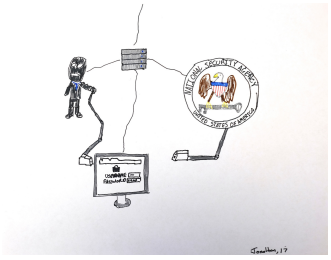

Fig. 37. By Jonathan, age 17

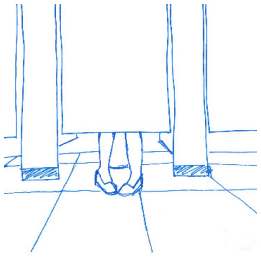

Fig. 38. By Rachel, age 20

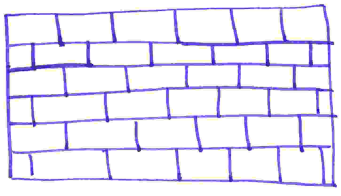

Fig. 39. "I drew a wall to illustrate a barrier between two entities. this can be a physical (wall) or virtual (firewall). This can be someone's backyard or between countries (Berlin Wall) but it basically allows you to control your interactions with others." By TLM, age 23

Fig. 40. "A shield that protects me." By HAP, age 24

Fig. 41. "I drew a door. A door means privacy for me. A closed door makes any room a private room!" By Pam, age 23

Fig. 42. "Privacy is defined by physical barriers." By AF, age 22

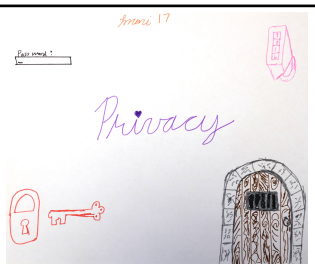

Fig. 43. By Mari, age 17

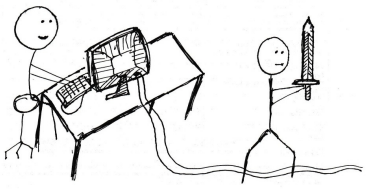

Fig. 44. "It is a representation of privacy on the internet. These days there is so much talk about what is safe and what isn't safe, I thought that this was the best representation of privacy at this moment." By Josh, age 25

Fig. 45. "Green data (non-private) goes through; red does not (private data). Some yellow goes through (ambiguous)." By Ryan, age 36

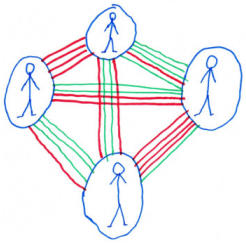

Fig. 46. 'Privacy is a network: I share what I want with whom I want and trust and what matches with those in the network, and don't share with those I don't want and trust to share with. Green = share. Red = don't." age 20s

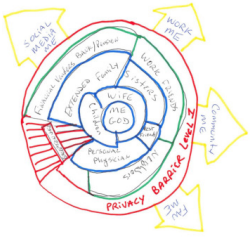

Fig. 47. "I give/receive based on my level of trust. Occasionally, I do not share with those I trust (i.e., my exception jail) as I do not trust what they will do with a specific piece of information. I accept that I must have a public persona." By Jim, age 51

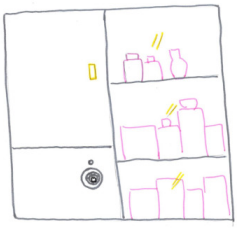

Fig. 48. "It is a big cabinet. Some goods are sheltered with transparent glass and open to the public. Some are sheltered from a board and some are locked." By Shanshan, age 23.

Fig. 49. "Home Sweet Home! A place to retreat from the world and allow people and digital media in as I wish." By Tony, age 45

Fig. 50. "Privacy is one of those things that today, we seek as a sort of comfort. But with social media, internet accounts, etc, there are always holes in our supposed security. So, I took this concept very literally and portrayed it as a cliche of sorts." By Caitlyn, age 24

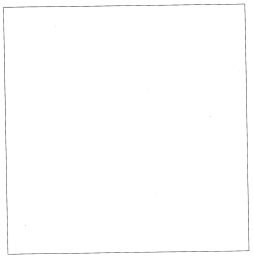

Fig. 51. "Privacy is the ability to share or not share information with any or none individuals or organizations within discrete societal spheres according to individual preferences and societal standards and norms. Absolute privacy means that no information is shared (depicted as the blank space below); while the opposite would be the transfer of all information across any medium." By Drew, age 23

Fig. 52. "We moved to an island to be alone" By Q, age 24

Fig. 53. "Privacy means nature, no fences, no boundaries. Man made constraints like houses, businesses, and resorts don't offer privacy in my mind. Privacy needs freedom and elements beyond our control. A curtain of rain offers more privacy than a solid door." By Aneta, age 45

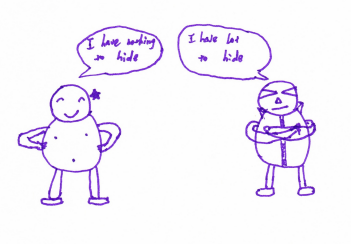

Fig. 54. By Lidong Wei

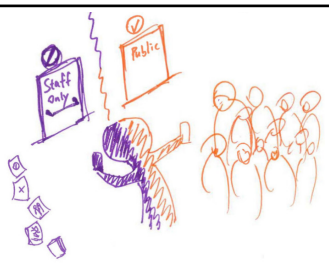

Fig. 55. "There are bright sides, and there are dark sides. Some of them we'd love to share; some we don't, and they are called 'privacy."' By Evan, age 21

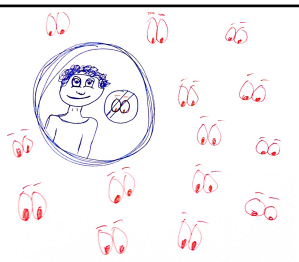

Fig. 56. "To me privacy means being able to get away from unwanted eyes. My drawing was quite literally a person escaping the unwanted attention from eyes around him by enclosing himself in his bubble." By NotAnArtist, age 19

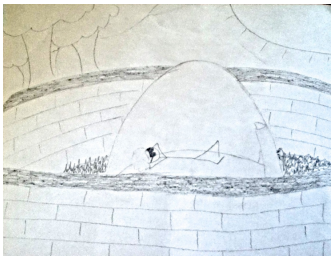

Fig. 57. "Privacy for me is like a place with a one-sided mirror. I can see outside but no one can see in unless I open the door. Also an extra wall on the outside just in case" By Kim, age 21

Fig. 58. "Privacy is to me the ability to filter and control the information relevant to you that you release into the world (and having some confidence in the ability of the status of such information as private)." By Isadora, age 20

Fig. 59. "I feel like my privacy is always being "pierced" by malicious companies and government entities online. This is a rotten egg being attacked by bacteria." By Cassidy, age 22

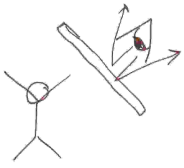

Fig. 60. "Stick figure is me. The barrier stops others from seeing my actions." By Sung Kim, age 22

Fig. 61. "Person implements IPerson. Implementation details are up to Person." By Josh Tan, age 25

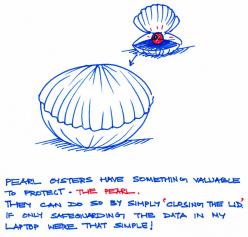

Fig. 62. "Pearl oysters have something valuable to protect - the pearl. They can do so by simply 'closing the lid.' If only safeguarding the data in my laptop were that simple!" By Sharon, age 25.

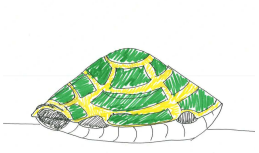

Fig. 63. "It's a turtle huddled up inside its shell." By John

Fig. 64. "Spiderman needs privacy to put on his costume." By Takshawn, age 5

Fig. 65. "Privacy means, my personal posts on social media or internet sites should be off limits to an employer. My posts should have no bearing on my ability to do my job. My posts are personal and private." By MHUT, age 37

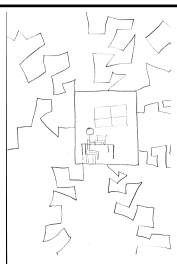

Fig. 66. "The person in the box represents someone alone doing something online. The lines that go out from the box represents that everything we do is connected to so many different things and places. It is the myth that we have privacy when we are alone online." Maria, age 35

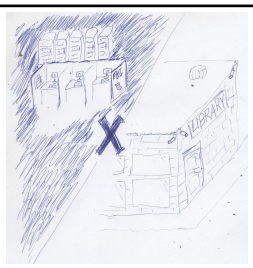

Fig. 67. "This is a quick ink pen sketch of the privacy I think should be afforded even in some public places. I show the separation between a library and the FBI as an example." By Jason, age 39

Fig. 68. "Being on my own." By Anabel, age 6

Fig. 69. "The private info is within the things you do (with tech or anything), but is it really private?" By David, age 17

Fig. 70. "A man and his dog companion take a walk to get away from everyone and have time alone for thinking and reflecting. Sometimes the only way to have privacy is to just get up and leave." By Paula, age 62

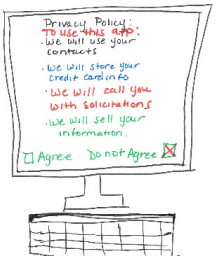

Fig. 71. "Privacy means using applications w/o giving away all of my info!" By T.T. Coleman

Fig. 72. "I'm taking a shower. You want privacy because you're washing your body." By Dagny, grade 1

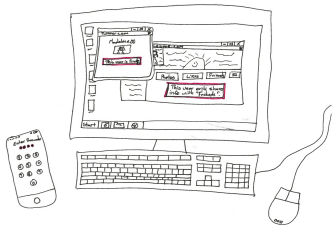

Fig. 73. "My picture shows a computer with someone view social media sites. They can't see any private information due to privacy settings. It also shows an iPhone with a pass code." By Madeline, age 26

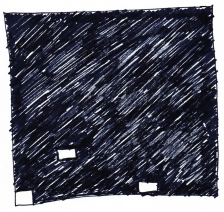

Fig. 74. "Privacy means my life is a black box, except for the items I choose to share with others." By Lauren, age 32

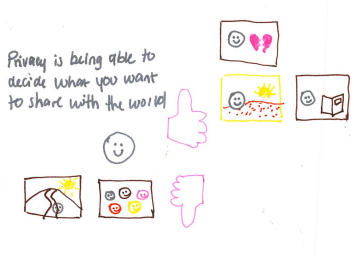

Fig. 75. "Privacy is being able to decide what you want to share with the world." By DA, age 28

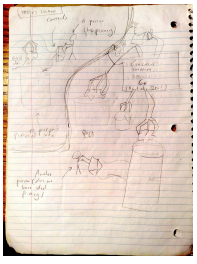

Fig. 76. "I see privacy as the ability to control who gets to know what about you. My drawing depicts an ideal figure on privacy island..." This long caption continues in A.1.1 By Robby, age 22

Fig. 77. "A man watched by cameras. He has no privacy." By Spartacus, age 33

Fig. 78. "In todays society we are constantly being watched. Both in person and the expanse of tech it has become almost impossible to be alone."

Fig. 79. "A mobius strip: Everything (every service) has something to do with privacy." By Jay, age 21

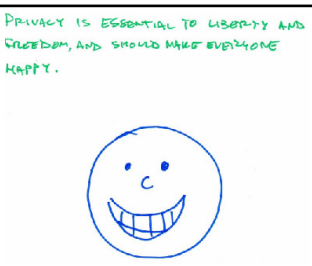

Fig. 80. "Privacy is essential to liberty and freedom, and should make everyone happy." By Michael, age 52

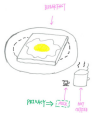

Fig. 81. "It's essential for some people, but may not be for all :-)" By Z-Food-C, age 22

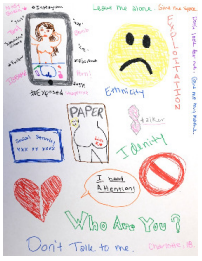

Fig. 82. By Charlotte, age 18

Fig. 83. "Privacy is an illusion." By Briana, age 16

A.1.1 Overflow Caption

"I see privacy as the ability to control who gets to know what about you. My drawing depicts an ideal figure on privacy island with exclusive control over his personal information bin. He's probably a computer science wiz millionaire with all his stuff encrypted on air-gapped servers protected by armed guards who are themselves under surveillance. He has the most ideal form of digital privacy available in current times. The other normal people who would rather spend their time doing other things and don't have the resources of Mr. own-private-privacy-island have to sign up with an Internet service provider which takes control over their personal info as a condition for being able to use it." By Robby, age 22 (Fig. 76)

A.2 Privacy Icons

Fig. 84. The AdChoices icon, a trademark of the Digital Advertising Alliance. This icon did not appear in any illustrations, despite its wide adoption in the online advertising industry and frequenct presence on major websites.

Fig. 85. This image depicted a privacy icon from Chrome. "Chrome incognito." By Joshua, age 22

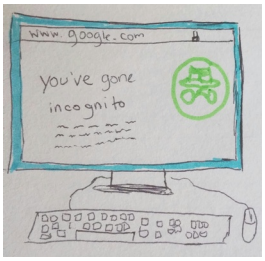

Fig. 86. "Privacy means having the ability to not be 'seen' online, to not be tracked or have all of your information remembered. Privacy is also important with security because you want to be safe online when making online purchases, or giving personal information away. I think the 'incognito mode' on a browser helps with privacy because your history or cookies aren't tracked." By George, age 18

B Codebook

To give a sense of relative scale of the codebook table elements, we use the following categorical scale of frequency for each code.

Frequency Groups

Frequency	Occurrences	Number of Codes
zero	0	2
very low	4-1	20
low	19-5	46
medium	39-20	20
high	69-40	12
very high	>=70	7

Metacodes

Code	Frequency	Description
Composite	medium	Multiple sub-drawings that should be considered independently, not intended as a comparison
Includes Words	very high	Words that are central to the drawing themes, excluding labels. If the words are the description itself, tag "Description Shown" instead
Description Shown	medium	The sentence description itself
No Description	high	Does not have an accompanying description
Only Words	very low	Only words, and does not contain any useful symbols

Metaphors

Code	Frequency	Description
Security	medium	Privacy as security
Home Space	low	Privacy as a personal place itself, especially the home
Secure Space	medium	Privacy as a personal place with explicit security
Secure Information	medium	Protected information
Hermit	low	Privacy as a space separated from society
Costume	very low	Privacy as a disguise or costume
Soft Barrier	low	Privacy as a physically soft covering or barrier
Hard Barrier	high	Privacy as an impenetrable, opaque barrier
Filter	low	A flow of information that only goes either in or out and cannot go in the opposite direction
Bubble	low	Privacy as a bubble
Flow	low	Privacy as a flow of information, excluding filters
Categories	low	Privacy as a series of buckets or categories, where no movement is depicted
Focus / Quiet	low	Privacy as an absence of undesired aural stimulus, excluding that from other people
Blank	very low	Privacy as blankness or nothingness
Dark	low	Privacy as darkness
Other	low	Privacy as some other metaphor

Contexts

	Code	Frequency	Description
Social Context	With Family	low	Family or domestic life
	Relationship / Dating	low	An intimate dyad, or social interactions with a group other than family
	In Crowd	very low	A crowd of unidentified people
	Copying / Cheating	low	Students cheating on an exam
	Under Authority	low	Subject depicted in relation to a government or powerful agency, excluding corporations or the NSA
	Under NSA	low	Subject depicted in relation to the NSA
	As Professional	low	A person in relation to their professional work
	As Consumer	low	A person as a consumer or in relation to companies
Information Medium	Social Media	medium	Refers specifically to a social media platform or post
	Digital	high	An act of digital communication other than social media use
	Thought	low	Media available only to themself
	Speech	low	An act of speech
	Print Media	low	A publication or formal media platform other than social media
	Censorship	low	Some type of media censorship
Information Types	Financial	low	Refers to financial information
	Demographics	low	Socially well-defined aspects of a person's identity such as race, age, or income
	Health	low	Health data, "PHI"
	Sexual	very low	The sexual orientation or sexual activity of a person
	Nudity	low	Refers to nudity
Physical	In Bathroom	medium	Elements of a bathroom or locker room, such as a toilet or shower
	In Personal Space	high	A physical space that appears to be intended for personal or intimate use in the larger context of the drawing, excluding bathrooms
	In Nature	low	A person in nature

Symbols

	Code	Frequency
Body	person	very high
	group	high
	couple	high
	eyeball	medium
	animals	low
Barrier	wall	high
	door	very high
	curtain	medium
	bubble	low
	safe	low
	box	low
Thing	camera	low
	window	medium
	bed	medium
	house	medium
	lock	very high
	digital device	high
	photograph	low
	ID card	low
	envelope	very low
	book	low
	lightbulb	very low
	weapon	low
	mailbox	very low
	alarm system	very low
	briefcase	very low
	"do not disturb" sign	medium
	game	very low
	satellite	very low
Abstract	speech bubble	high
	negation sign	medium
	password input	medium
	heart	low
	company or government logo	low
	digital/programming code	medium
	illuminati pyramid	very low
	arrows	medium
Other	Other novel or unexpected symbols	low

Frameworks

	Code	Frequency	Description
Solove	Surveillance	high	"Continuous monitoring" that can "cause a person to alter her behavior," such as self-censorship (Collection harm)
	Interrogation	low	A pressure to "divulge information... other than for criminal prosecution" (Collection harm)
	Aggregation	very low	"The gathering together of information about a person" (Processing harm)
	Identification	low	The "connecting of information to individuals" (Processing harm)
	Insecurity	very high	Problems "caused by the way information is handled and protected" (Processing harm)
	Secondary Use	low	Information being used for "purposes unrelated to" initial collection purpose (Processing harm)
	Exclusion	very low	A "failure to provide... notice and input about recors" (Processing harm)
	Confidentiality Breach	very low	A breach of confidentiality, "a betrayal of trust." The sensitivity or nature of the data is irrelevant; the trust is central (Dissemination harm)
	Disclosure	low	A leak of "true information" that "involves damage to reputation" (Dissemination harm)
	Exposure	medium	The "exposing of certain physical and emotional attributes" that are viewed as "deeply primordial." "Exposure rarely reveals any significant new information that can be used in the assessment of a person's character." Descriptive examples are "grief, trauma, injury, nudity, sex, and defecation" (Dissemination harm)
	Increased Access	very low	Increased accessibility of information "already available to the public." "Secret information is not disclosed" (Dissemination harm)
	Blackmail	zero	"A threat of disclosure rather than actual disclosure" (Dissemination harm)
	Appropriation	very low	"The use of one's identity for the purposes and goals of another" (Dissemination harm)
	Distortion	zero	"The manipulation of a way a person is perceived" through "false and misleading" information (Dissemination harm)
	Intrusion	very high	"Invasions or incursions" that disturb "the victim's daily activity" or "makes her feel uncomfortable and uneasy" (Invasion harm)
	Decision Interference	very low	"Unwanted incursion by the government into any individual's decisions about their personal life." We expand Solove's definition to include any entities with institutional power, such as companies or parents having power over children (Invasion harm)
Westin	Solitude	high	Someone being "free from the observations of other persons"
	Intimacy	low	Someone "acting as part of a small unit... so that it may achieve a close... relationship between two or more individuals"
	Anonymity	low	Someone "in public places or performing public acts" who still finds "freedom from identification and surveillance"
	Reserve	low	Someone who has a "psychological barrier against unwanted intrusion"
Info	Fine-Grained Access Control	high	Access to some data but not others, or to some people but not others. Information-focused rather than people-focused, unlike Westin's states. Possibly related to contextual integrity
Agency	Displays Control	very high	A sense of control by depicting control in action
	No Control	medium	A sense of no control over privacy
Other	Other	medium	Some expression, harm, interpretation, or function of privacy not listed above. It could be a meta-commentary on privacy, for example

The codes and quotes categorized as "Solove" are based on Daniel Solove's taxonomy of privacy [53]. The codes categorized as "Westin" are based on Alan Westin's four states of privacy [59]. This table contains direct quotes from both works.