Designing the Future of Personal Fashion

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ABSTRACT
Advances in computer vision and machine learning are changing the way people dress, and buy clothes. Given the vast space of fashion problems, where can data-driven technologies provide the most value? To understand consumer pain points and opportunities for technological interventions, this paper presents the results from two independent need-finding studies that explore the gold-standard of personalized shopping: interacting with a personal stylist. Through interviews with five personal stylists, we study the range of problems they address and their in-person processes for working with clients. In a separate study, we investigate how styling experiences map to online settings by building and releasing a chatbot that connects users to one-on-one sessions with a stylist, acquiring more than 70 organic users in three weeks. These conversations reveal that in-person and online styling sessions share similar goals, but online sessions often involve smaller problems that can be resolved more quickly. Based on these explorations, we propose future personalized, online interactions that address consumer trust and uncertainty, and discuss opportunities for automation.

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INTRODUCTION
Advances in computer vision and machine learning are changing the way people interface with fashion. With Amazon’s Echo Look, users can take a selfie to have their outfit rated [39]. Intel’s Magic Mirror allows consumers to virtually try on clothes [36]. Companies like Stitch Fix use data-driven models to curate a personalized selection of clothing every month and deliver it to your door [42]. Data-driven technologies can enable a host of new personalized fashion experiences, but what are the few, essential interactions that will define the next-generation of fashion ecommerce systems?

Past research has explored how to design for fashion applications that focus on body [6, 25], in-home [43], and in-store [4, 5, 33] interactions. To design the future of personal fashion, we look to the gold-standard of shopping experiences: interacting with personal stylists in both in-person and online settings.

High-end stylists offer in-person consultations for curating wardrobes and creating outfits. Consumers who can afford these services have better shopping experiences: they enjoy both functional benefits — quicker, easier selection — and symbolic benefits — greater confidence in the results [41].
Retailers also often offer free personal stylist services both in-store and online to help customers find available items that meet their needs [8].

This paper presents the results from two independent need-finding studies that explore in-person and online stylist interactions. In the first study, we interviewed five personal stylists that offer in-person wardrobe and image consultations. In a separate second study, we study online styling interactions by building and deploying a chatbot — PSBot — that connects users to one-on-one sessions with a stylist. We released PSBot for three weeks, and collected 88 organic styling conversations with 73 unique users (Figure 1).

We observe that styling sessions in both settings address similar consumer goals; however, online conversations often tackle self-contained, smaller problems that can be solved in minutes rather than hours or days. In-person consultations afford inferential data gathering, whereas in online conversations, stylists have to explicitly ask about a user’s physical appearance and style preferences to make more personalized recommendations. On the other hand, it is easier for an online stylist to quickly explore the space of options with a client through visual examples and adapt recommendations to changing requirements.

Based on these two studies, we propose design recommendations for future data-driven fashion systems: navigating user uncertainty by asking the right questions and showing visual examples, increasing user confidence by explaining solutions, and establishing trust by providing critical feedback — not only recommending items that users would like, but discouraging them from making bad decisions. Finally, we discuss how data-driven models can automate these capabilities to scale personal fashion.

**STUDY 1: IN-PERSON STYLING SESSIONS**

To understand the scope of in-person, high-end fashion services, we interviewed five personal stylists. We recruited them from fashion-centered US cities — New York, Los Angeles, Chicago, and San Francisco — through direct contact, generating leads based on alumni networks and Instagram. The stylists interviewed were all female and worked in ready-to-wear fashion, with diverse clients (men and women, middle to high income, in a variety of life stages). While some stylists had specialties (e.g., women over 50), most described styling sessions with a variety of different types of clients.

Interviews were conducted by the first author, using a semi-structured format focusing on ten key questions (Table 1). Interviews typically lasted 30 minutes. Interviews were analyzed by the first author using an iterative open coding approach; from five interviews consistent themes emerged.

All stylists agreed that fashion is “super, super, super personalized” (S4):

> It gets down to like […] I had a client who hates green, for no reason, and it’s a fabulous color. I need to know what fabric allergies they have. Do they abhor ruffles because they had a bad experience in second grade? (S4)

Some noted that there are general fashion design principles:

> There are certain basic ideas or principles that apply... For body types, for example, if you're styling someone who is a triangle shape [...] there’s certain style advice you would give that would be universal. (S5)

In general, however, stylists thought that fashion is highly personal, requiring a great deal of explicit and inferred data — a person’s body shape, skin color, budget, and color and style preferences — to make recommendations.

This viewpoint pervades their processes. Although stylists address a range of needs, from transitioning a client’s entire wardrobe after a major life change (i.e., re-entering the workforce) to creating new outfits with existing pieces, they still require similar, intense onboarding appointments to gather user data.

Meetings with stylists typically fell into three categories: initial introductory meetings, home “wardrobe” appointments, and in-store shopping experiences. In the introductory and home meetings, stylists had a number of ways they sought to understand users’ styles and needs, both in order to determine if it was a good match but also to provide good, personalized advice. Through these initial interactions, stylists try to establish a basis of trust that they can build on over a longer-term relationship.

### Explicit and Inferential Information Gathering

The onboarding process actually begins even before the first meeting. While the stylists themselves rarely prepared for an initial meeting, several had clients complete “homework” (S3): “I do have a list of probably like 10-15 questions” that “get very specific” about style, budget, and size (S1). These questions covered a client’s physical attributes such as height,
weight, eye and hair color, but also included questions like "what is your favorite color," "describe the attributes of that color," and whether the “attributes of that color are also how you see (or wish to see) yourself” (S5).

One stylist noted that this “eventually leads to refining words that define their style” that can be used to frame the rest of their advice (S5), while another framed it as “I’m trying to get a little bit of sense of who they are and what their life entails” (S3). This process not only helps the stylist better understand their client’s style, but also helps with self-reflection: “A lot of people, honestly, haven’t delved into their psyche [...] haven’t even thought about themselves” (S4).

Stylists did not entirely rely on self-reported answers since they are not always accurate. They also inferred relevant personal information using clients’ homes, current closets, and other features in their life. Inferential processes were particularly common for understanding body shape and coloring, which clients have trouble getting right. While stylists asked about these features in their questionnaires, they still verify: “I peek at what sizes they’re actually buying, because sometimes when they tell me what size they are, that’s actually not correct” (S3). One stylist noted that while she occasionally does initial meetings over the phone, “it’s a lot better when I can actually meet them in person because I actually take photos of them” (S1). Another said “one piece of information that would be really helpful is a standardized good picture [...] so I could see what her figure is” (S3).

There are also some questions stylists don’t want to ask explicitly, and instead use clients’ homes or existing wardrobes to infer information:

First things first, driving up to the house, I’m like this is a 10,000 square foot, six-plus million dollar mansion, so [...] I can already predict brands that were going to be in her closet. Going in, looking at the color palette [...] she’s totally neutral [...] with a lot of very modern art, minimalism, very clean, very organized. Just from that 30 second glance around, I can predict what her closet is going to be like (S4).

In some cases, stylist used this inferential approach to avoid asking awkward questions directly:

I do not ask what their income is. I can kind of just gather. Plus do they have kids? Where is their money going? Do they travel a lot? Is it a single guy? I gather all of those pieces of information, but I don’t ask them (S1).

In others, stylists used people’s homes and current wardrobes to understand their fashion style because it is hard for people to express their style preferences concretely. One stylist reported that clients “can say ‘oh I’m a bohemian style’ but let’s talk about the words – what does that mean to you?” (S5). Using the client’s existing wardrobe or home as a proxy can help, as:

Most of my clients have a sense of their style [...] a lot of people will have it in their interiors, but not in their wardrobe. I think a lot of people actually are afraid to stand out, a lot of people just try to dress like everybody else, and they’re honestly afraid to take a risk (S4).

Wardrobe Assessment

A lot of a personal stylist’s work revolves around managing a client’s wardrobe. After the introductory meeting, stylists often schedule a wardrobe appointment. One stylist even said, “I won’t shop with a client until I work in their closet” (S4).

These wardrobe appointments are typically intense, lasting several hours; it can often take multiple meetings to completely go through a client’s wardrobe: “you can spend a couple hours and make good progress, but usually it requires more appointments” (S5). After initially establishing the client’s goals and preferences, stylists have clients go through each item in their closet and decide whether or not to keep it:

We can get in there and just go through section by section and have them pull out clothes, and we say, ‘Keeping your style words in mind – is this going to work?’ And start trying things on. Things that don’t fit have to go; things that are damaged beyond repair, we pull out (S5).

This process can be extreme. As one stylist said, “When I go into their closet, I will get rid of over half of what they own. It’s very shocking to people, because most people wear 10/15% of their clothes” (S4). One noted, Clients generally know what looks good, but also generally have plenty of things that don’t. So maybe half their closet will be things that are the right shape, the right colors, and look okay on them (S3).

Once they know the items that fit, are in good repair, and match the client’s goals, they can “help them take a fresh look at their closet, see what they can do, working with what they have” (S5). One stylist noted, “That very day, that I’m in their closet, they end up with some new way to wear things for Monday” (S3). Future shopping trips will often reference the wardrobe sessions:

We’ll do wardrobe styling, and I see the gaps in their closet, of what they need, where they need a staple. And then I put together a shopping a list (S1).

While most of their appointments are intense and last several hours, stylists did mention some lightweight interactions they support. One noted that “my really wealthy ones will use me all the time” (S4) to pack for trips, select outfits for dates, and so on. Some clients send spur-of-the-moment texts, asking for help:

I keep pictures in my phone, so even if I’m out of state and they’re like ‘what should I wear tonight?’ I’ll just peek through their outfits and text them a picture and say, ‘how about this one?’ (S4)

Importance of Trust

Many stylists see establishing trust as one of the most important features of a personal stylist relationship because the client relies on the stylist to make good choices for them:

The women who have their shit together – they know where to shop, they’ve got it all figured out – in general, I really don’t work with women like that. My clientele are
Stylists saw the importance of it even in the smaller aspects of their interactions. For example, during a wardrobe appointment, clients may start by getting dressed in the bathroom, but quickly shift to getting dressed right in the same room:

“It’s honestly building a very personal, trusting relationship. Because most of these clients are in their underwear with me most of the time. How much more vulnerable can you be? It’s truly just really building up that trust and confidence in each other. And if it’s not there, I’ll refer them to another stylist that might be a better fit (S4).

Indeed, stylists noted that this extended beyond giving style advice, “Oh yeah, when people are in their underwear with you, they tell you about their marriages, divorces, their kids’ problems. They tell you everything” (S4).

To establish this trust, the stylists used humor (“I do, literally say, I’m like a doctor, I’ve seen every possible size and shape” (S3)), but focused primarily on being genuine and unbiased. By genuine and unbiased, they typically meant they focused on the client’s satisfaction and weren’t influenced by external factors like money:

“I mean I think a lot of that is just being very genuine in your approach. If you go to a Neimans’ or a Nordstrom, I have had clients say that to me, they just feel like they want to sell them whatever it is they have on the floor. I think my approach is different in that I really want them to love it, I want them to feel good about it. I want them to look in their closet and think ‘I’m excited to wear this’ [...] So I think trust just comes from being unbiased and really genuine and wanting them to feel good, whether they buy anything or not (S1).

This focus on being unbiased and separating the personal styling advice from purchasing was very important:

“I think there’s an advantage of working with a wardrobe consultant versus an in-store personal shopper. Because they are paid a commission on what they sell, I don’t always feel their interests are the best for the customer, there’s a built-in bias. So I try to stay neutral. Because it doesn’t matter to me, personally, where we find that item they need (S5).

This goal of being genuinely focused on the client’s happiness led to stylists rejecting items they felt were good choices:

“I don’t like talking them into things that I think they won’t wear... I can tell by body language and facial expressions when a client has something on, whether (even though I think it’s great) she won’t actually pull it off the shelf. And I’ll say to her, ‘I love that on you but I can tell this is not something you’re going to get up and look for’ (S3).

A second way of establishing trust with clients is by saying ‘no.’ Disagreeing with clients is a way of establishing that you truly have their best interests at heart. Stylists encountered this frequently; one stylist noted that when going through clients’ closets “some get a little argumentative...” (S3). When clients disagree, stylists have a few strategies, but the primary strategy is reminding the client of the stylists’ expertise:

“One thing I find myself saying a lot is ‘I’m so judgemental, aren’t I?’ and then they’ll come back, ‘but that’s why I’m paying you!’ So trying to remind them, that yes, they are paying for this. I’m so choosy and I want you to be too. They like when you’re not just placating them, what’s the point of that? (S4)

Another common strategy for saying ‘no’ nicely is setting a high bar initially. One stylist asks her clients to try on their favorite outfit “because it usually looks best. And that gives me a bar to surpass” (S3). Then the stylist can frame any choice in terms of how good the client could possibly look:

“Well I think a phrase I often use is, ‘I think we can do better than this,’ and I can tell them why. I can say, ‘This isn’t the spot you’re wanting to emphasize on your body.’ People are with you, because they want that feedback. That’s why they hired you, you know, to give them honest feedback. So they’re usually very receptive to that. (S5)

**CUIs, Chatbots, and Conversational Agents**

The goal of the first study was to understand the nature of high-end, personalized fashion services and the needs of their clientele. Since many retailers offer free online stylist services to help consumers, we wanted to also study the types of fashion problems people bring up in online settings. To capture and analyze online styling interactions, we developed and deployed a chatbot service that connects users seeking fashion advice with stylists.

Chatbots are simple interactive systems accessed through a conversational user interface (CUI). CUIs allow users to interact with natural language (speech or text) in text messaging, instant messaging, and command line apps. CUIs can support interactions with another human, with an intelligent agent, or with a bot (simple software program) [34].

Researchers and companies are exploring diverse ways in which chatbots can provide value in different domains. Recent work examines using crowd-powered chatbots as personal assistants [22]. Although general natural language understanding has not been solved, domain specific chatbots that can schedule meetings [35], provide weather reports [14], and even surface historical documents [23] successfully leverage automated (intelligent) conversational agents. They, however, still face challenges, especially around how the agent’s personality influences interactions [24].

Fashion-focused chatbots have received a great deal of industry attention in recent years. Several brands have developed chatbots that help users get feedback [2], shop their websites [18], and even buy items directly from runway shows [37]. In addition, more general chatbots have been developed to help users learn about trends, search for items across retailers, and see outfit suggestions [38].

While chatbots are finished products in their own right, they also make effective proxy systems — lightweight prototypes that can be drastically different in form and function from the
When a user first messages PSBot to start a styling session, with a second message, “Happy to help with that! Anything else you’d like to add?” This initial interaction serves three purposes. First, the user receives confirmation that the bot is online and working since they at least received two messages. Second, it allows us to collect data for every user that tries the bot even if they decide not to wait for an available stylist. Third, by pushing these initial responses to available stylists, we can help them prepare before diving into a conversation. If all stylists are busy with other users, PSBot adds new users to a waiting queue and gives frequent updates notifying them of their place in the queue. Once an available stylist claims a user, they communicate directly with each other.

After a stylist logs into PSBot, her status is set to “available.” If there is an unclaimed user in the queue, PSBot immediately pushes the user’s request to the stylist. A user request contains some personal data — name, gender, locale, and timezone — and the user’s problem description. User requests are broadcast in first-in-first-out order to ensure that stylists treat all users fairly and do not prioritize easier or more interesting requests. Once a stylist claims a user, other stylists cannot be paired with that user and are shown the next user in the queue. Users often disappear after their questions are answered, so PSBot delegates the responsibility of officially ending the conversation to the stylist. Stylists log off the bot when they are unavailable to handle requests.

PSBot allows stylists and users to send text, images, and links to each other. As in Hsu et al.’s system [13], PSBot provides partial support within a broader ecosystem: if users want to purchase items, for example, they must do so outside the chatbot.

**Implementation**

To support the described one-on-one interactions, we use Facebook Messenger essentially as a telephone switchboard, connecting “calls” between a user and a personal stylist using the Messenger platform. PSBot functions as the switchboard operator, tracking personal stylist accounts, user accounts, and user-stylist pairs (Figure 2).

When a user starts a conversation, their Facebook Messenger ID is added to the queue of waiting users and a user data object is created to store information like the start time of their conversation. Initially, the user’s request is broadcast to all available personal stylists. When the user is claimed by a personal stylist, PSBot adds the two Facebook Messenger IDs as pairs in a lookup table. If a user or stylist’s ID is in this table, messages are sent directly to the paired user.

PSBot stores conversations locally on a server until the personal stylist indicates the conversation has ended. At that point, the conversation log is saved to AWS S3, along with any images sent during the conversation. PSBot saves images with file names corresponding to randomly-generated 32-character alphanumeric strings, which are injected into the appropriate places in the conversation logs so that a conversation can be fully reconstructed afterward.

In addition to claiming users and ending conversations, stylists can indicate that an interaction has “expired.” This feature is useful in instances where a user returned later to say something like “thanks” or “bye” after the conversation had been terminated — a problem also encountered in prior work [15]. This reject mechanism deletes the user request from the queue, so that other stylists will not see it and the message will not be archived.
STUDY 2: ONLINE STYLING SESSIONS

We deployed PSBot to collect online conversations between consumers and stylists. Since the primary goal of the study was to understand the most common styling goals discussed in online settings, we did not recruit professional stylists. Instead, we recruited 10 students to serve as stylists from a college campus both directly and via referrals from existing stylists. These students were all female and self-reported prior (informal) styling experience. They staffed the backend of PSBot for three weeks and were on-call during “office hours” (6 am – 12 am CDT) to provide advice.

To acquire users, we advertised “free fashion advice” on social media platforms and fashion-relevant blogs. At the end of three weeks, we had collected 87 conversation logs with 73 organic users: we attracted a surprisingly gender-neutral set of users (50% male) and most (90%) were from the United States. On average, conversations comprised 10 rounds of back-and-forth between users and clients. Most centered around a single question; however, 15% of the conversations (n=13) addressed more than one problem.

We conducted an iterative open coding over the conversations’ content, identifying common user goals and online interaction patterns. Conversations were analyzed by the entire research team, which after an initial coding met to discuss themes until agreement was reached.

Styling Goals

Through qualitative coding, we identified seven categories of fashion problems. Online and in-person styling sessions involve many of the same fashion problems at different scale. For example, an online session might involve styling one item in a user’s closet, whereas an in-person consultation would go through a client’s entire wardrobe.

Dressing for Occasions, Activities, and Seasons

The most common user goal was getting advice on clothing for specific occasions, activities, and seasons such as dressing for a conference, a wedding, a hiking trip, or winter (n = 30). While some users were looking for particular items (e.g., warm pants), many were simply looking for inspirational photos. As one user asked, “do you have any photos showing people actually attending a wedding” (P3).

Some users framed their questions as “dressing for x but not looking y” (n=5). For example, one user wanted “business casual clothing styles that aren’t boring or boyish” (P20); another user asked, “How can I make the winter look more elegant?” (P52). These questions indicate that many users have a core understanding of how to dress for events, activities, and seasons, but cannot reconcile it with their style aspirations. They look to stylists for help blending what is appropriate for that context and their personal style. One of the interviewed stylists mentioned similar goals were common among her clients: wanting “to look professional without looking really boring” or “professional but fun” (S3).

Matching or Styling Items

Another common fashion problem was matching or styling clothing items together (n = 16). For example, several conversations began with a user describing something he owns — “I have grey slacks” (P58) — and then asking how to style it, either generally — “What goes well with grey slacks?” (P58) — or with other specific items — “What about a lime shirt?” (P58). Some users wanted to understand style rules for pairing specific items. For example, one user wanted to understand how to pair skinny pants with ankle boots: “Are they supposed to be higher than the boots? or tucked into the boots?” (P5).

The stylists interviewed mentioned that matching slightly off-color or off-style is often a major challenge for clients: “If it doesn’t exactly match, they don’t think it goes. And yet, it may be even better if they don’t quite match, either in style or colors” (S3). Similarly, many stylists noted the phenomenon of “closet orphans,” where clients “didn’t take the tags off such-and-such” because they couldn’t figure out how to wear it, but with the stylists’ help, they found “it turns out it goes with something else that they can wear” (S3).

Searching For Products

Some users utilized PSBot as a wrapper for a search engine when shopping for specific items (e.g., boots, rain jacket, t-shirt) (n = 16). Unlike a search results gallery, a stylist communicating online provided information serially, and produced the next selection choice based on the reaction to the previous one. Working with a stylist helped users understand the underlying structure of the search space, learn the vocabulary to describe their requirements, and figure out what they want. For example, a user looking for men’s dress shoes learned that there were broad subcategories such as oxfords, loafers, hush puppies, etc.

Becoming Self-Reliant

Most conversations had an educational undertone, where users were hoping to learn more generally about fashion, in addition to solving their specific problem. In some conversations (n = 13), users were explicitly trying to understand the vocabulary to do better searches, where to shop, and style rules (n = 13). Style-based questions ranged from general — “Can I wear brown and black colors” (P53) — to more personal — “What style pants look good on me – blue or black” (P33).

Transitioning Wardrobes

Some users wanted help transitioning their wardrobe based on personal and environmental changes (n=8); the majority of clients who hired in-person stylists shared this same goal. For example, one user’s goal was to get clothing for a new job: “Starting a job soon – need recommendations for business casual clothing” (P20). Others’ questions were tied to dealing with changing seasons or even body shapes: “I am trying to lose weight. What style pants look good as I change sizes?” (P69).

Minor Categories

Looking “trendy” was only important a few users (n=4): “Hey I’m looking for trendy fashion sneakers” (P60). Another user asked, “How can I make pajamas look trendy and wear them for all the daytime activities?” (P52). For many users, trends were of secondary importance, and the goal was not to stick out. Interviewed stylists mentioned similar goals for their clients: “my goal for them – and I tell them this specifically –
is ‘you don’t have to be in style, but you shouldn’t be noticeably out of style’” (S3).

Similarly, only a few conversations focused around outfit suggestions for that particular day (n = 3). One user asked for an entire outfit, “What should I wear to college today?” (P25); others wanted feedback on one part of their outfit. Users were willing to describe what they owned to get help with this question.

Finally, a few users wanted advice on hair, makeup and skincare (n = 4): “What sort of makeup looks good on brown skin” (P53). We suspect that this category is much bigger than the numbers suggest, since users were unsure if these topics fell under the purview of fashion. One user explicitly asked, “I was wondering whether the style elements cover fashion or even skinhealth or make up tips” (P22).

**Interaction Patterns**

We also coded common interaction patterns we observed between users and stylists in their conversations. While in-person styling sessions afford inferential data gathering, in an online setting, stylists have to use other strategies to gather enough data about a user to make personal recommendations. On the other hand, it easier for an online stylist to more quickly produce recommendations and adapt to users’ changing requirements. Online stylists took full advantage of PSBot’s affordances, providing advice through text descriptions and illustrative visual examples, and connecting them to products via links.

**Communicating with Images and Text**

Images played an important role in conversations: on average, three images were sent during a conversation, and 70% of exchanges involved at least one image. Since users seemed to “know it when they see it,” stylists often presented image-text pairs to explore and refine the search space with the user.

Half of the images shown in conversations fit this visual-verbal framing, which were used to scaffold user uncertainty and to explain why. For example, one user wanted a dress for a...
wedding, but did not know how to describe the silhouette she preferred — a shift (i.e., a dress with clean lines, ending around the knee, and less fitted around the waist and hips than a sheath). By iterating with images and questions, the stylist and user were able to determine what type of dress she was looking for (Figure 3). Similarly, another user looking for a spring outfit had some ideas of items he wanted to try — “How about jeans?” — but was not sure how to wear them (P9). The stylist paired images and text descriptions to show styling ideas and suggest new types of items (Figure 4). This example also illustrates that every detail cannot be communicated visually: through text, the stylist described the weight of a fabric, which is hard to judge just from the image.

Gathering Personal Data
While many of the in-person stylists collected extensive information from clients prior to their meetings, online stylists did not spend time asking lengthy personal questions upfront. Instead, they collected additional information during the course of the conversation necessary for solving the problem at hand. Stylists frequently asked users to additionally specify desired color (n = 24), style (n = 17), budget (n = 14), print or pattern (n = 12), silhouette (n = 6), and length (n = 4). Stylists also asked for a user’s location (n = 8) and skin color (n = 4).

Saying No (Nicely)
Many PSBot conversations involved giving users critical feedback: those color combinations do not match, avoid certain silhouettes, that outfit might not be appropriate for an event, etc. While users were comfortable saying no bluntly — “I don’t like heels” (P30) or “those shoes are terrible” (P16), — stylists used strategies to say “no” nicely. These strategies included using humor — “Maybe for a costume party?” — hedging — “It’s a little too colorful maybe,” — personalizing — “I’d go with something a bit dressier,” — and providing explanations and alternatives — “This a more elegant look that would pair well with a beret.”

DESIGN REQUIREMENTS FOR DATA-DRIVEN SYSTEMS
Based on the two need-finding studies, we distilled a set of recommendations for designing future data-driven fashion systems. These requirements highlight the opportunities and challenges for future fashion conversational agents.

Scaffolding User Uncertainty
While most users had a general problem in mind when they engaged with PSbot, these problems were often underspecified. Often, users might not understand their own needs, they may lack the requisite language and parameters to specify a problem, or they may simply be lazy. In one conversation (Figure 5), the user initially asked for “clothes” (P4). Therefore, solving fashion problems — in both in-person and online settings — often involves helping consumers define their needs and enumerate their constraints. The iterative line of questioning in this user’s case ended with them highly satisfied: “Damn yeah. That shirt is amazing” (P4).

In the future, automated agents should similarly scaffold user uncertainty: when the question is underspecified, they should probe users with relevant examples that lead to information gain, which can be used to update the search space. There are several challenges that agents will have to overcome such as understanding the relevant parameter spaces for different types of problems and products and recognizing when a user specifies or changes the value of a parameter explicitly or implicitly [29].

On the other hand, data-driven models backed by sufficiently large databases are well-equipped to deal with content generation, and can provide an endless supply of visual examples and corresponding questions while users figure out what they want. Consumers need not worry about taking up too much of a stylist’s time or being charged by the hour: they can change their mind as often as they want until they are satisfied.

Explaining Why
For every recommendation made and every piece of critical feedback given, a stylist explains why. Providing rationales is a key component of every interaction: “a phrase I often use is, ‘I think we can do better than this,’ and I can tell them why” (S5). In online settings, PSBot was often used as a wrapper for a search engine to find a specific type of product (e.g., “rain coat”). Given the number of fashion items available today, there are often hundreds of products that belong to the same equivalence class even after filtering by average ratings and price ranges. A stylist can help users make purchasing decisions more efficiently and with greater confidence by offering fewer choices and explaining why they are the best.

Rationales are more of an embodied experience with in-person styling. A stylist can ask clients to “feel the material” or “try it on,” and offer explanations that combine language with visual and tactile feedback. In an online setting, rationales can be both textual and visual.

In general, people know obvious rules — you wear coats in winter, and black with everything. Both the interviews and online conversations illustrate that clients are asking hard questions — “matching slightly off-color or off-style” (S3) — with contradictory elements: people “want to fit in and stand out at the same time” (S2). Therefore, when stylists present solutions, they will never appear obviously right unless the stylist does a good job explaining why it makes sense.

Therefore, data-driven models face the challenge of producing rationales to accompany their predictions. Without explanations, models trained on real, good outfit data, might appear to be generating recommendations at random to the untrained eye! In the future, conversational agents can leverage multimodal fashion embeddings developed by AI researchers to generate textual explanations for visual recommendations and feedback [9, 12, 16, 21].

Offering Unbiased and Critical Advice
In addition to increasing user confidence, explicative models also help build trust, which is a central design consideration for personal fashion interactions. Past work has shown that chatbots can perform emotional work when helping users [49]. Trust can be built through transparency and through critical feedback. Today’s search and recommendation engines only “push” products, and never prevent users from making bad decisions. On the other hand, stylists dissuade clients from
making bad purchasing decisions all the time — that’s what they are paid to do.

In both PSBot and in-person personal stylist interactions, being an unbiased, third-party allowed for greater possible trust. Stylists highlighted the difference between in-store and third-party personal stylists, arguing that their unbiased nature allowed them to care more deeply about clients, since it did not matter to them directly whether or where an item was purchased. Similarly, PSBot (unlike chatbots operated by brands or retailers) can offer advice that is unrelated to purchasing: what colors look best on your skin, how to style items you already own, and providing general inspiration.

To gain a user’s trust, a conversational agent should offer both advice educating users and critical feedback preventing them from making bad decisions. While other conversational agents may encounter this situation rarely, to establish trust with users and give good advice, stylist agents will often need to say ‘no.’

In both online and in-person contexts, stylists have strategies for giving constructive feedback. Linguists have extensively studied best practices around saying ‘no,’ in English and cross-culturally [1, 3, 19], stressing the importance of balancing clarity and politeness. Again, since data-driven models are well-equipped to generate, if an agent needs to toss out a user’s idea, it can provide alternative, preferable solutions: a strategy already used by humans.

Building Long-Term Personal Relationship

The interviews and online conversations illustrate that fashion is personal. As a designer noted in a phone conversation:

> What makes [fashion] personal, is how you take something and translate it to your own. You can give ten different women, in different subcultures, the same blazer. But they’re all going to digest it in a particular way. So the punk girl might cut the sleeves off, another girl might wear it buttoned up, and another person might wear it with the collar popped, one might roll up the sleeves and wear it with jeans, another one might wear it with a mini dress, another might wear it with big, giant sweatpants. That’s what’s personal about fashion. [Jay McCarroll, personal communication]

Most personal stylists try to build longterm relationships with their clients. Initially, they do an intense onboarding process so that they can offer better, personalized advice. Clients are willing to partake in this process because they are investing time and money, and potentially also want a longterm relationship. After the makeover, they might interact with the stylist for more lightweight needs like a wardrobe refresh or outfit ideas for an event, which are more typical of lightweight online interactions.

The attractiveness of a chatbot service is precisely that it does not require a lot of time and money: people can use it to get quick solutions to fashion problems. Still, users had expectations of personalized interactions, and found it disruptive when online stylists did not provide more personalized advice or results. One user wrote, “Do you have any non-white models?” (P29). Others shared personal information in the context

Figure 5: Underspecified queries were common. Personal stylist interactions online need to use questions to resolve uncertainty and gather the information needed to provide good personal style advice.
of expressing a concern with some advice: one user wrote “I have dark skin” (P71) when given advice that “darker colors will make you look slimmer.” Since users cannot “try it on” in online settings, it is important to personalize their experience by showing photos of products on people with a similar figure or skin color to help them understand whether an outfit would work for them. In the future, computer vision work done in the area of extracting skin color and body shape can be adapted to automatically finding images — and videos — that contain models that most closely fit the user’s profile [17, 26].

Indeed, a few users even seemed to expect the bot to make much more substantial inferences about them. For example, two users began interacting with the system by asking for “My style” (P10). We hypothesize that these users believed that Facebook Messenger apps have access to more Facebook data than is provided by default — a system might be able to proactively estimate style preferences from users’ photos posted on Facebook, for example, or from other Facebook content. The Messenger platform provides stylists with basic information such as name, gender, and approximate location. Additionally, it can provide a person’s profile photo, which could be useful for inferential data gathering about body type and coloring. While PSBot did not have data beyond what the platform provided, users did not seem uneasy with the idea that it might. This result is surprising given that prior work has shown that data aggregation used to target advertisements can cause such feelings of unease and revulsion [48]. PSBot conversations indicate that users are more concerned with an accurate model than their privacy.

Although the interactions are more lightweight than in-person styling sessions, chatbot systems have the opportunity of offering longterm personalization of the same caliber as working closely with a personal stylist. Every interaction with a conversational agent can offer additional information about a client’s style preferences and existing wardrobe. Therefore, a conversational agent can build a personalized model of a client through several small interactions while avoiding an upfront onboarding investment. This strategy allows chatbots to remain low-cost and low-overhead but offers deeper personalization over time.

CONCLUSION

These personalized fashion interactions have the potential to revolutionize ecommerce. Users enjoyed using PSBot; although we did not measure satisfaction explicitly, 13 users (15%) spontaneously mentioned how happy they were with the results and three returned days later for follow-up advice.

The next step towards building fully automated fashion recommendation systems is equipping knowledge workers with data-driven models exposed through queryable web-based interfaces, and comparing their performance to personal stylists who have access to the web. There is a rich understanding of the model side of fashion problems: understanding styles [7, 40, 44, 46], trends [10, 11, 47], substitutes and complements [32, 31] and how to build outfits of matching items [45, 50]. Chatbots can slowly integrate these models to help real users by providing free, private, constantly-available fashion advice — driving a future of frequent, widespread, everyday use.

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