Swing Compass: A Metaphorical and Embodied Approach to Structuring Choices for User Reflection

Abstract:

Information design aims to arrange and present not only information for people to retrieve and understand but sometimes also choices for them to select and reflect on. In this project, we extended a generative and interactive visual composition framework to a configurable, intelligent, and embodied selection system, Swing Compass. It is presented as a device on hand, allowing a user to select items spatially arranged on its compass-like interface. The available items shown are dependent on one's past selections, according to a configurable moderation logic. Meanwhile, one can turn the device to reveal other options. The spatial arrangement of items, turn action, and system intervention embody both the literal and metaphorical meanings of 'swing'. The design aims to provoke imagination, emotion, and also reflection in users on the topic of selection. Based on a vigorous theoretical framework, conceptual integration diagrams representing users' cognitive experiences were constructed, followed by simulated experience testing in the laboratory. While the diagrams represent the intended cognitive processes and describe possible imaginative and affective outcomes, the empirical tests generate real and particular cognitive phenomena emerging in participants, enriching the proposal and supporting the framework. This paper first articulates the theoretical framework and then the design of Swing Compass. Finally, a summary of the testing and discussion is given.

Introduction

Swing Compass is a configurable, adaptive, and embodied system turning a tablet computer into a compass-like reflective selection device, which allows users to select from a set of items spatially arranged at different directions on its compass-rose interface (Figure 1). It sometimes prompts the users to "swing" both their bodies and selections, and encourages them to reflect on their selection habits. Examples of choice making in everyday life include choosing how to spend the weekend, deciding what to buy in the supermarket, or selecting an app to launch among many others in the mobile phone.

Figure 1. Swing Compass arranges items at different directions on its compass-rose interface for user selection. Those shown inside the rose are the selection history.

Designers first configure a topology of information nodes (Figure 2), each of which consists of a set of possible options (e.g., various available fruits in the supermarket). Each option is annotated with user-defined attributes (e.g., high fiber) through which the system can compare differences or similarities (e.g., fiber vs. protein) between options at two connected nodes (e.g., fruit vs. meat). According to this information map with annotation, the system suggests choices of the next move at different directions (e.g., front, back, left, right) from the current position. When the user selects an option at certain direction, one makes a move to the next node along that direction in the map.
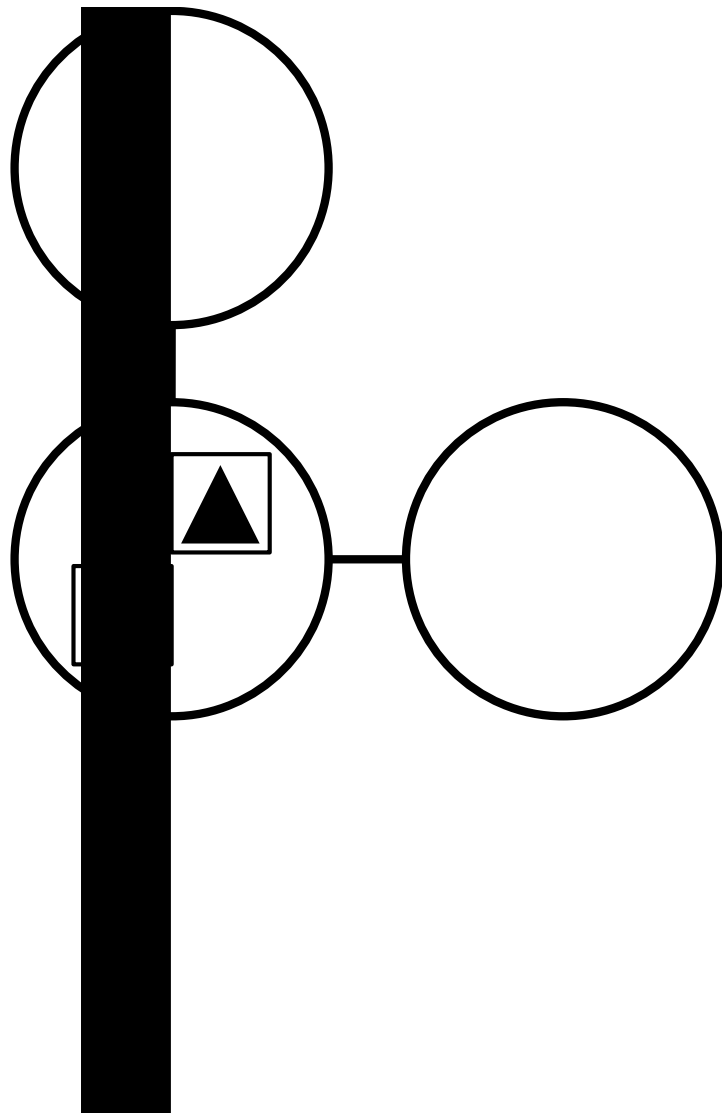
Figure 2. A topology of information nodes. Each circle represents a node, in which each tile represents an option, in which the graphic qualities (e.g., shape, tone, pattern, etc.) represent the annotated attributes.

Based on configured moderation logic, the system manipulates the available options for the user at every move. By default the system suggests options of similar kind, for instance, with same values in certain attributes (e.g., high protein), based on the user's last move. If the user indulges in the same kind for many consecutive moves (e.g., too much protein), the system reduces the available choices in order to prompt the user to turn with the compass. After the user makes a turn, the system reveals more options of contrasting kinds (e.g., high fiber). Through this intervention, the user turns the body to become aware

of alternatives. One may swing to another kind of choice and swing back soon in order to balance the choice behavior.

Swing Compass is an exemplar of lively interactive artifacts demonstrating the reflective potential in users. This paper introduces the theoretical framework, articulates the design concept, presents the intended user cognitive processes and diagrams, and discusses the empirical results of the user experience study. The whole process demonstrates how the framework assists designers or researchers in proposing intended user experiences, and how evaluation generates real and particular outcomes, and informs next step toward the design goals.

Theoretical Framework

Behavior Models of Swing Compass
The design of Swing Compass refers to a few influential models of human behavior.

Fogg's Behavior Model. B. J. Fogg (2009) introduced a behavior model (FBM) for designing persuasive systems. It states that the three determinants for a person to perform a behavior include motivation, ability, and triggers. Motivation covers factors related to one's intention, namely immediate effects (i.e., pleasure vs. pain), foreseeable outcomes (i.e., hope vs. fear), and social conforming. Ability is about other factors that affect whether the behavior is feasible. With sufficient motivation and ability, people become determined but still need triggers for taking action, which are important to design. Fogg introduces three types of triggers that are applicable to the design of Swing Compass. Spark is used to foreground the relevant motivators to the user (e.g., via critical reflection). Facilitator is to make a behavior easier or harder to do (e.g., by system intervention). Signal is to provide timely and relevant reminder (e.g., depending on the latest selections).

Swing Compass is designed to moderate users' choice behaviors. One design strategy is to apply facilitator and signal, making certain choices easier to be made while others harder to be found, based on one's latest selection

inclination. Those over-selected categories can be hidden, while those under-explored are introduced when the user makes a turn. Another objective of designing Swing Compass is to make this introduction of under-explored choices a critical reflection, and so a spark, in the user.

Choice Architecture Model. Richard H. Thaler and Cass R. Sunstein's model of choice architecture (2008) is very informative to the design of Swing Compass. While information architects or designers organize and present information for people to understand (Murray, 2012; Wurman, 1997), choice architects arrange options for people to select. To Thaler and Sunstein, this job can be an effective means to influence people's decision making. Starting from a few points similar to Donald Norman's usability principles (2002) like feedback and error tolerance, the model emphasizes the power of defaults, mapping from choice to welfare (or even wellbeing), and structuring complex choices for people.

A default is like a convenient recommendation, which is most welcome in case of complicated choice. Yet, defaults are sometimes precarious, and so making a few alternatives obviously available to users is required. Swing Compass recommends options to users at every step like setting up defaults, but it always allows one to have alternatives via turning.

Helping users understand the mapping from choice to welfare or wellbeing is important. Swing Compass allows categorization of choices in multiple dimensions and the options are then arranged correspondingly in different positions on the compass rose. According to Norman's principle of mapping (2002), spatial arrangement is a good mapping to choice type, which is discussed in the next section.

Thaler and Sunstein also notes that sometimes introducing people with choices they seldom explore can be good for them to know both sides. Swing Compass moderates user choice behavior by reducing options. Seeing limited options, the user is prompted to turn to uncover other categories, which did not come to his or her mind before, but would be worth considering.

In summary, the design strategies of Swing Compass pertaining to users' choice behavior include:

- Default choices are recommended like an enabler (positive facilitator), and alternatives are available via turning;
- Choices of over-selected kinds are harder to be found, like a barrier (negative facilitator);
- Choices of under-explored kinds are introduced when the user makes a turn, like a spark that illuminates something overlooked.

Design of Swing Compass

Natural Mapping: From spatial relation to choice category. Norman's principle of mapping (2002) suggests applying physical analogies or cultural practices to pursue immediate understanding. Spatial relation can be one analogy for constructing good mapping. A good example is the vertical arrangement of floor buttons on the lift control panel matching with the levels of targeted floors. Swing Compass allows configuration of choice categories in a chosen topology in analogy to the physical or metaphorical relation among the choices. For instance, food choices in the supermarket can be arranged in a corridor fashion in which left and right options belong to the same category while up (front) and down (back) directions lead to increasingly different groups.

Embodied Interaction: Metaphorical meaning of swing. Not only can spatial analogies be applied to build good mapping, but also physical and social experiences at large should be utilized to assist people in understanding. Drawing upon notions from phenomenology, Paul Dourish's embodied interaction (2001) is a notion for designers to bring familiar and meaningful actions or habits from the everyday world to designing interactive systems. Swing Compass incorporates the common act of turning, which people automatically perform in daily life whenever they do not satisfy with the current offer or want to look for something different. Users can understand the metaphorical meaning of the turn action by actually performing it.

Reflective Design: Turning from over-selected to under-explored. With understandable mappings from spatial arrangement of options to categorization

and so implication of options, users of Swing Compass can make choices among a few closely related categories, or just turn away to look for alternatives in other contrasting categories. When a user indulges in similar kinds of choices (i.e., without any turn), Swing Compass reduces options in those categories in order to prompt the user to turn. The bodily action makes the user feel like turning away from dislikes to likes or from familiar to new, and the moderation seems to provide guidance or make recommendations. This kind of embodied imagination aims to provoke critical reflection in users on their choice behavior.

Phoebe Senders and her colleagues' reflective design (2005) targets the potential of critical reflection triggered by design. Grounded in critical theory, the design notion emphasizes critical reflection as a means of exposing people's unconscious assumptions about everyday technologies and inviting them to look at possibilities other than the norm. It integrates a range of related approaches, including critical design (Dunne & Raby, 2001) and ludic design (Gaver et al., 2004), and proposes a set of design principles and guidelines, which designers can follow not only to stay in focus questioning entrenched practices but also to keep reminding users of the same. The strategies most relevant to designing Swing Compass include defamiliarizing the interface (rather than using common design patterns) and incorporating ambiguity (rather than making meaning that is always direct and clear). Some of these suggestions seem incompatible with the common usability principles. As Sengers and Gaver respectively put it, the interpretation of a design cannot be completely open, and ambiguity should not be an excuse for bad design. The design challenge of Swing Compass is to strike a balance between familiar and unfamiliar in the interface presentation, direct and indirect in the meaning construction. As an exemplar of lively interactive artifacts, Swing Compass can achieve these goals.

Lively Interactive Artifacts
Swing Compass is an exemplar of lively interactive artifacts (Chow, Harrell, & Wong, 2015). Lively interactions are reminiscent of users' past experiences and invite them to make meaning at multiple cognitive levels:

At the immediate, operational level, the user acts upon the artifact and perceives quick feedback. During these reactive moments, the interaction

between the user and the lively artifact, represented by two arrows in Norman's conceptual model diagram (2002, p. 16) (Figure 3(a)), is so instantaneous that turns into a sensorimotor feedback loop in the user (Figure 3(b)). The loop evokes a slice of life, and triggers a blend of the current and the past experiences. <mark>Blending, a notion introduced by Gilles Fauconnier and Mark Turner (2002), is a pervasive cognitive operation that integrates concepts and outputs new one.</mark> At this level, the output is an imaginative and embodied concept giving the user a sense of control between familiar (past experience) and unfamiliar (current experience).
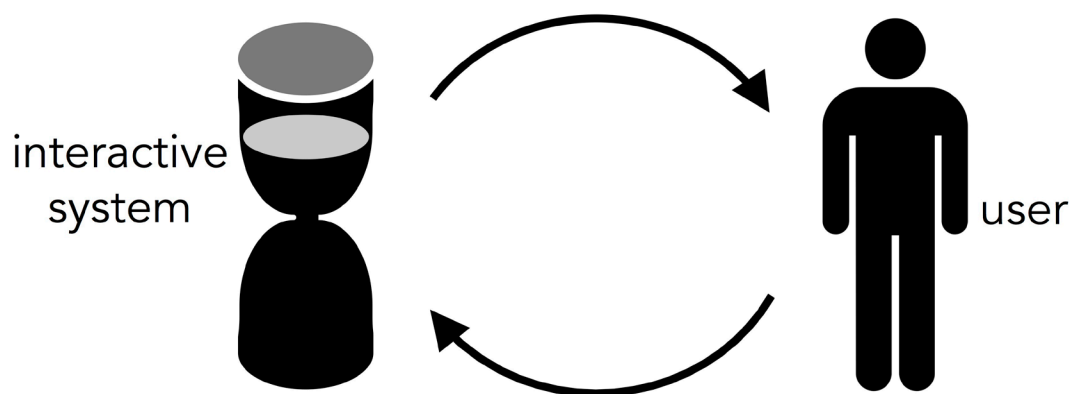

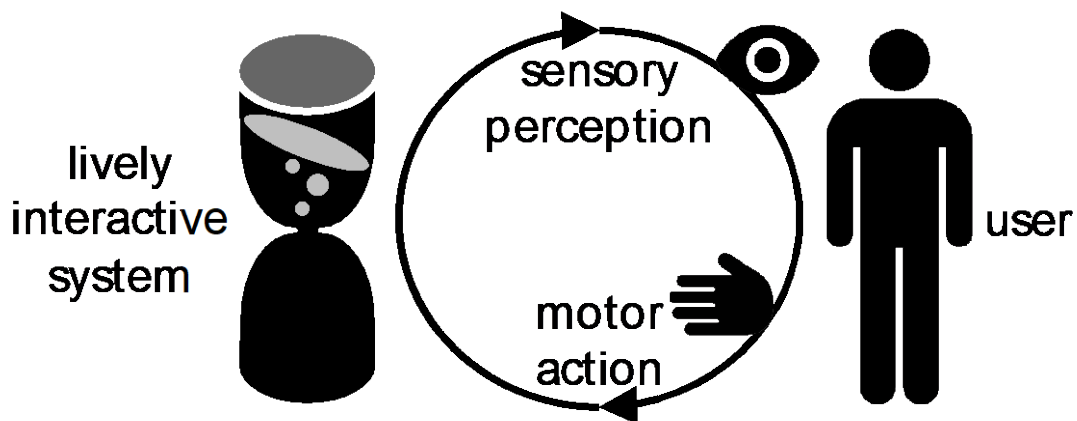Figure 3(a) Reproducing part of Norman's conceptual model diagram

Figure 3(b) At the immediate level, the sensorimotor feedback loop gives the user a sense of control.

Swing Compass allows the user to turn with it to look for alternatives. When the user starts to turn, the options displayed on the interface fade out gradually and then new options fade in. One can sneak a peek at the other

options "hidden" on the other side, and then decide to choose or turn back to the old set. This sensorimotor phenomenon is reminiscent of the user's past experience of shopping in the supermarket, or window-shopping in the mall. One has a glance at the products on the shelves or in the window. If not interested, one just turns away to look at other shelves or shops. Sometimes, one might swing back after seeing the adjacent shelves or shops. The user immediately understands the operational meaning of turning in Swing Compass.

At the reflective level, the lively artifact shows perceivable changes unintended by the user. The contingent changes cause the user to notice and become curious about their meaning (Figure 3(c)). The user invokes an interpretive frame to make sense of and account for the changes. A frame, a notion first introduced in artificial intelligence research (Minsky, 1974) and reinforced in cognitive linguistics (Fillmore, 1985), is a conceptual framework from long-term memory that provides the structure in terms of elements and their relations for understanding a scenario (Coulson, 2001, pp. 17-20). The user accesses a frame from memory and fills in local details to form a remembered or imagined scenario. By analogically mapping the scenario with the current experience of the contingent changes, the user elaborates a metaphorical blend, resulting in a blended scenario with reflective meaning.
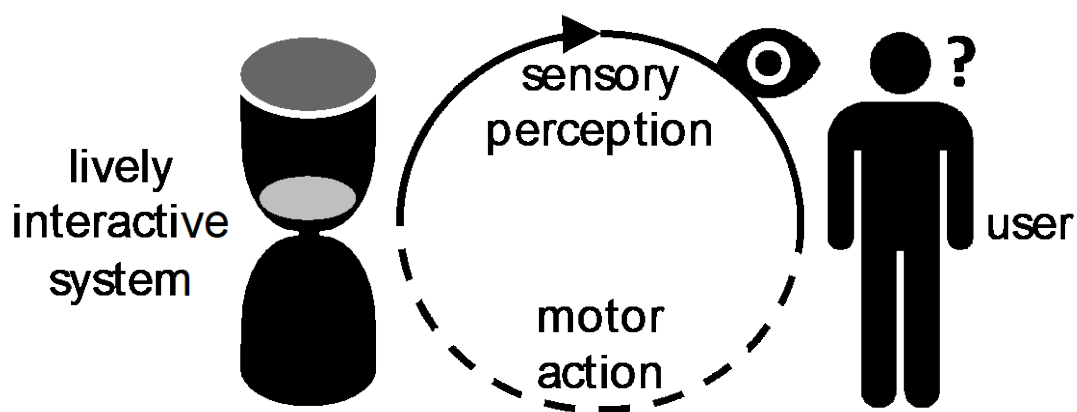

Figure 3(c) At the reflective level, the contingent changes cause the user to notice and become curious about their meaning.

Swing Compass reduces the available options of those over-selected categories based on user selection history. This change can be subtle to the user

at first. After a few rounds, however, the user might notice this curious change. The system seems to prompt the user to swing. The user may assume (with an interpretive frame invoked) that the system has made the change as a performative advice because of one's unbalanced choice behavior.

Configuration of Swing Compass

Topology

For natural mapping from the spatial arrangement of items to the corresponding categories, Swing Compass allows configuration (in an XML format) of a topology of choice categories for user selection. Each option is conceptualized as a 'tile' with four sides (up, down, left, right), each of which is annotated with a marker. Those tiles with opposite sides (i.e., up vs. down, left vs. right) sharing the same marker are connected (Figure 4). All the tiles are linked together, and this forms a graph. After a selection, the system considers only those tiles connected to the current choice and then prioritizes them for next selection. In other words, the user navigates in the graph by selecting one tile followed by another.
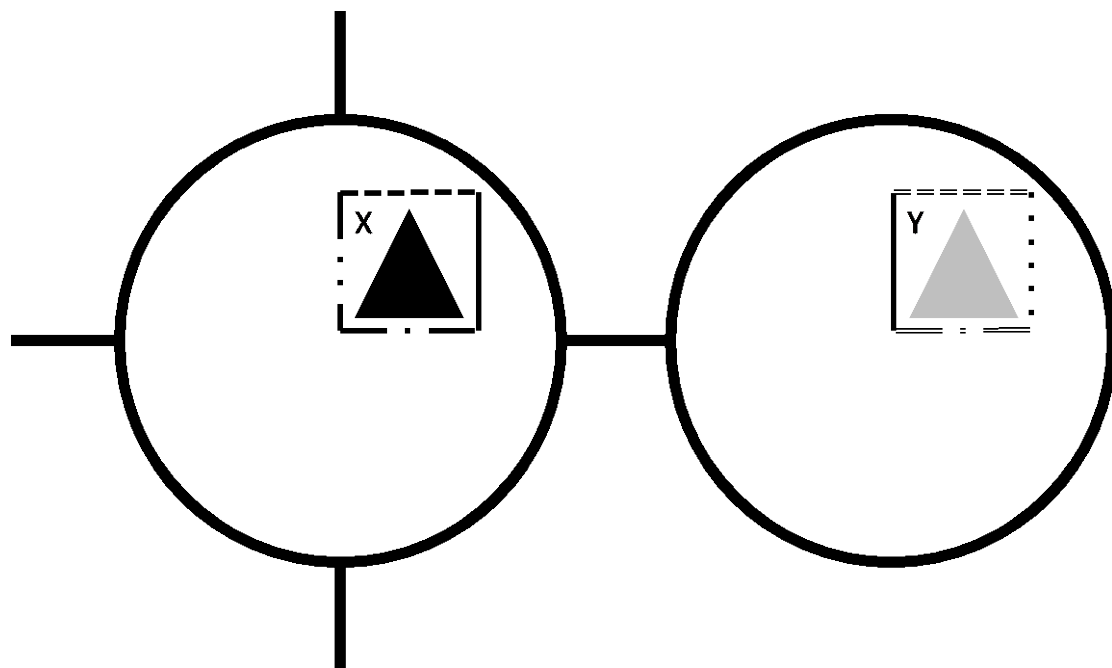

Figure 4. Each side of a tile is marked and illustrated in different line qualities. Two tiles are connected in the topology only if they share the same marker on the opposite sides. For example, Tile X has solid line on its right, while Tile Y has the same on its left.

Analogy

The choice categorization is not a 'box classification' in which each item is just simply 'put into' one particular category. Instead, each tile is annotated with multiple attributes specifying its kind in multiple dimensions. Two tiles are of the same kind if all their attributes share the same values. If only some attributes coincide, the two tiles are in partial similarity. For instance, a tile named 'cycling' has attribute 'activity' as 'doing' and 'welfare' as 'healthy', while another tile 'smoking' has 'activity' as 'eating' and 'welfare' as 'unhealthy'. The two tiles are of completely different kinds. Given another tile 'gambling' with 'activity' as 'doing' and 'welfare' as 'unhealthy', it is partially similar to both 'cycling' and 'smoking', but just in different dimensions, that is, in terms of different attributes. 'Cycling' and 'gambling' are similar in terms of 'activity: doing', while 'gambling' and 'smoking' are similar in terms of 'welfare: unhealthy' (see Figure 5).
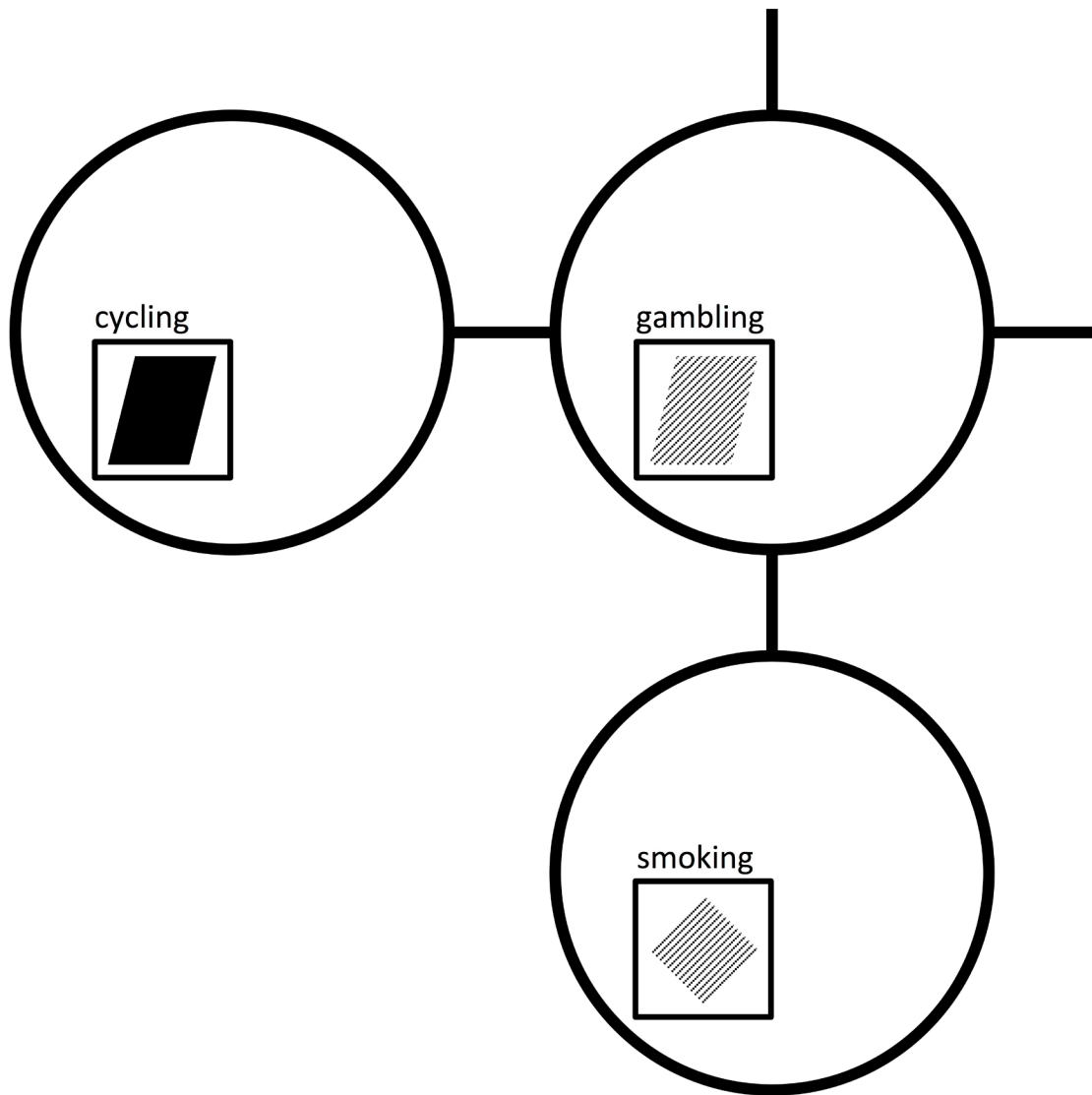
Figure 5. The attributes of each tile are illustrated in different graphic qualities (e.g., shape and pattern). Tile 'cycling' and Tile 'gambling' are similar in terms of 'activity' (i.e., shape), while Tile 'gambling' and Tile 'smoking' are similar in terms of 'welfare' (i.e., pattern)

Based on the topology of tiles, the system prioritizes the connected tiles as options for the user according to the analogy between each option and the current selected tile in certain terms. The user consecutively selects partially similar tiles sharing some attributes, until one makes a turn. The system then shifts to consider other partially similar tiles in contrasting terms. For example, 'smoking' is linked to 'gambling' because of 'unhealthy', which is then shifted to 'cycling' because of 'doing'.

CHESSBOARD: The Status Messenger

Different topologies and analogies of tiles result in different configurations. One configuration is CHESSBOARD. The topology is complete in that all tiles share the same marker on all sides. The analogy is based on two attributes each of which has two values. The two attributes cross-divide a matrix, in which tiles are distributed. The Status Messenger is an instance of Swing Compass with this configuration. It is like a tool for users to update status in terms of daily activities. The tiles are annotated as either 'eating' or 'doing' in the attribute 'activity', and either 'hedonic' (related to happiness, pleasure) or 'eudemonic' (related to human potentials, virtue) in the attribute 'welfare'. Figure 6 shows examples. The Status Messenger suggests options of similar activities in the 'welfare' dimension. If the current tile is 'gambling', 'smoking' may be shown on the compass rose because two tiles are similar in terms of 'welfare: hedonic'. If the user turns to make a shift, 'cycling' may be shown because both tiles share 'activity: doing'. Consecutive selections, with or without turns, result in navigation like walking across a checker floor or a chessboard.
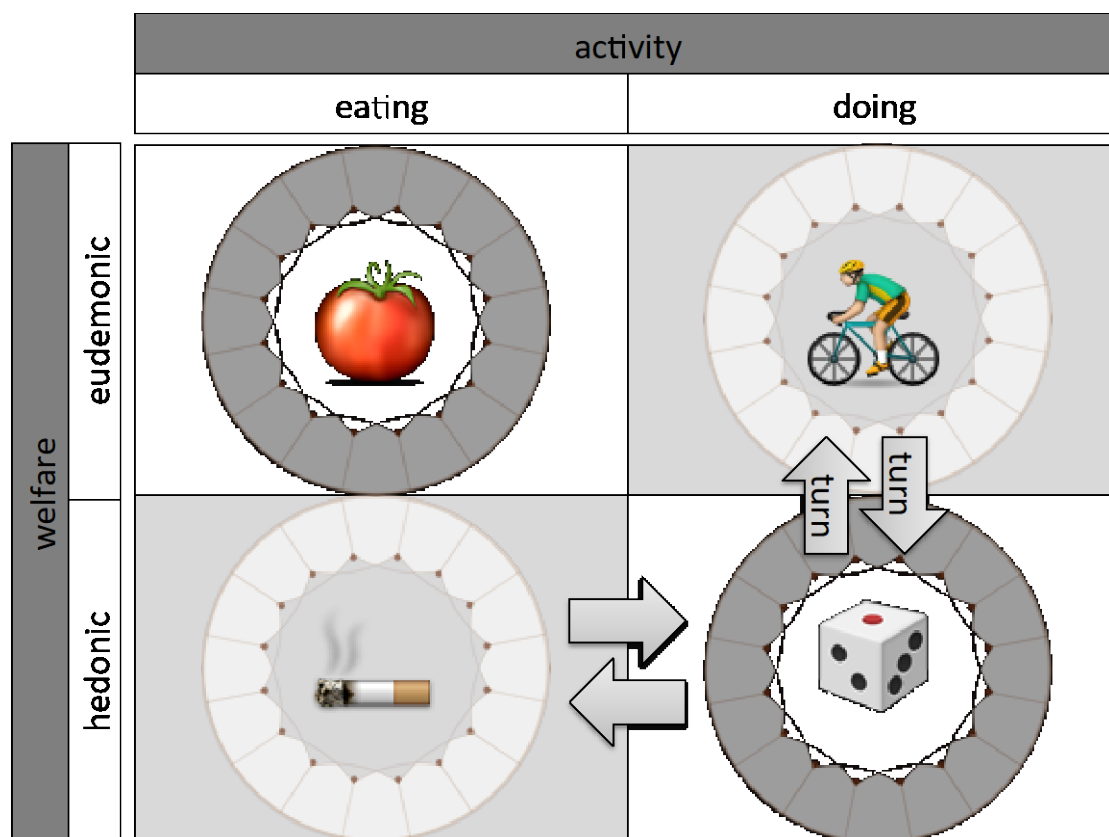

Figure 6. Both 'smoking' and 'gambling' are 'hedonic' in 'welfare', but the former is 'eating' and the latter 'doing'. Both 'gambling' and 'cycling' are 'doing' in

'activity', but the former is 'hedonic' and the latter 'eudemonic'. CHESSBOARD: On the compass rose at each step, one sees tiles from one cell only (e.g., 'eating' and 'hedonic'). The user moves horizontally across the cells without turning, or moves vertically after a turn.

CORRIDOR: The App Launcher

Another configuration is CORRIDOR. Tiles of the same kind are connected to each other horizontally (i.e., only left and right) and connected to partially similar tiles (i.e., same value in one attribute but different in the other) vertically (i.e., up and down). When choosing options on left or right, one sticks with options of the same kind. When selecting those in the up or down direction, one moves to partially similar kind. The navigation is comparable to walking along a corridor of shelves filled with commodities, as in a supermarket. Those on left and right are of the same category, while those in the front or at the back are increasingly varied. When turning, the user sees horizontal options of partially similar kind in another dimension, and vertical options of completely different kind (i.e., different in all attributes), which is like going to another floor of the supermarket.

The App Launching Compass is an instance with this configuration. It functions like an app launcher on common gadgets. It suggests the type of apps the user 'should' launch by displaying the app icons as options. The app tiles are marked as either 'casual' (including social networking and entertainment apps) or 'serious' (including news and productivity apps), meanwhile either 'extrovert' (social networking and news) or 'introvert' (entertainment and productivity). Figure 7 shows examples. Without a turn, the compass provides the same or similar kind of app. For instance, after selecting a social networking app, one may see horizontally other social networking apps and vertically entertainment apps (they share 'casual' with social networking apps but are 'introvert'). After a turn, the user sees horizontally news apps (they share 'extrovert' with social networking apps) and vertically completely different productivity apps ('serious' and 'introvert').
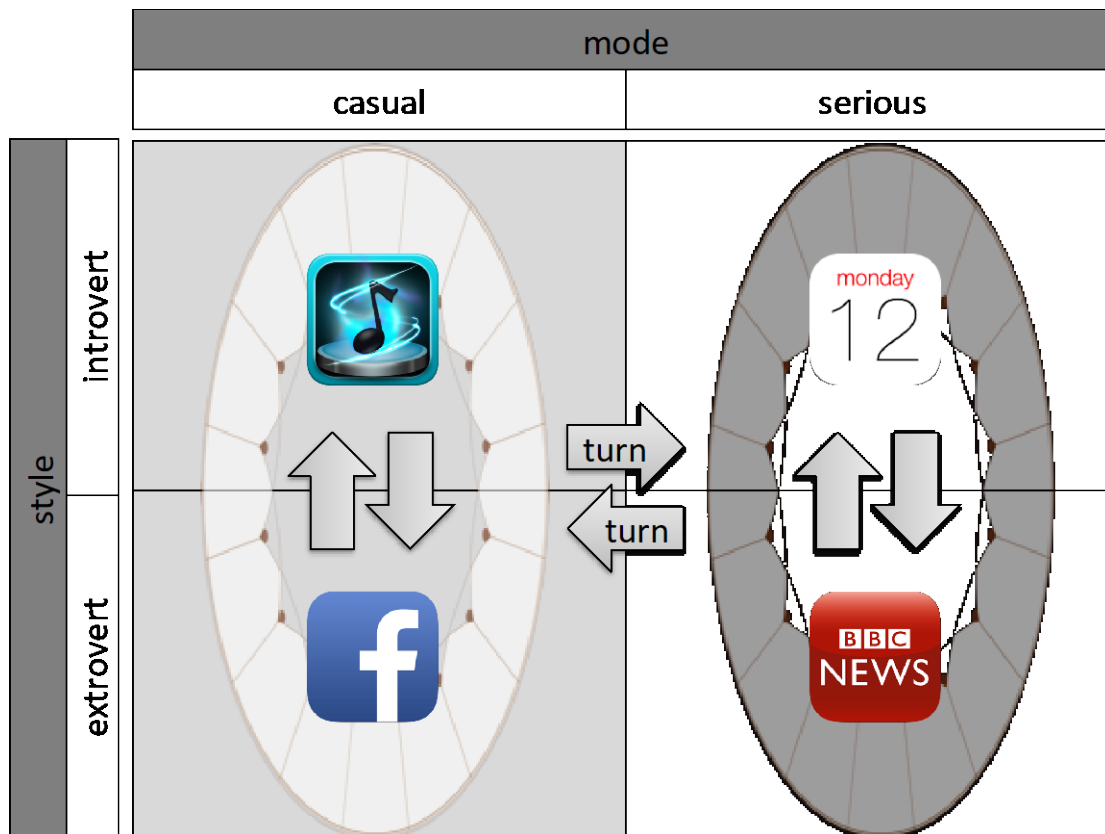
Figure 7. CORRIDOR: On the compass rose at each step, one sees apps from one column (e.g., 'causal'), with 'introvert' and 'extrovert' arranged in alternating rows. The user stays in one column without turning, or shifts horizontally across the columns after a turn.

Intended User Cognitive Processes

Both instances above show characteristics of liveliness. The compass 'disrupts' a user's habitual engagement in activities (because using an app implies a kind of activity) through manipulating the set of available choices. Meanwhile, it drives the user to actually 'swing' the body (to reorient the compass) to shift to other kinds of activities. There is an embodied analogy between a swing in physical action and a shift in behavior. We hope that this analogy will emerge in the user via imaginative blends with affective responses. The intended cognitive processes are delineated at two levels.

The Immediate Level

Given a set of options, the user may tap what is wanted; otherwise one turns the compass left or right to look for other options. Rotating incrementally, one can

see the old set fading out and the new fading in. The user may impulsively turn back for the old set or continue to turn further, which instantly depends on the appraisal of the new. The impulsive desire to swing and automatic appraisal of the options mobilize the sensorimotor feedback loop that is reminiscent of one's physical experience of looking around for a target. With the compass, the act of turning around is analogical to the act of moving and looking around, and the immediate blend results in an embodied imagination of turning around to look for options.

Figure 8(a) shows the blend with desire and appraisal. It is based on Fauconnier and Turner's conceptual integration diagrams (2002). An integration diagram consists of circles representing mental spaces, each of which contains conceptual elements of a scenario, such as actors, objects, or actions, and their relations, structured by a frame. The two horizontal circles (mental spaces) are input for the blend, while the one below is the output. The horizontal solid lines between the two input spaces are links mapping the counterparts respectively. These outer-space links are compressed into inner-space relations inside the blended space. Other elements are selectively projected from either input to the blend. We add to the integration diagram the sensorimotor feedback loop, which envelops motor action and sensory perception in the mental space. The left input is the current experience enabled by Swing Compass featuring a loop mobilized by impulsive desire and automatic appraisal, which is analogical to a past experience denoted by the right input. The texts in red represent imaginary thoughts and feelings of the user. The resulting blend gives the act of turning a new operational meaning, which is immediate and direct for the user to control. Turning is to look for new options.
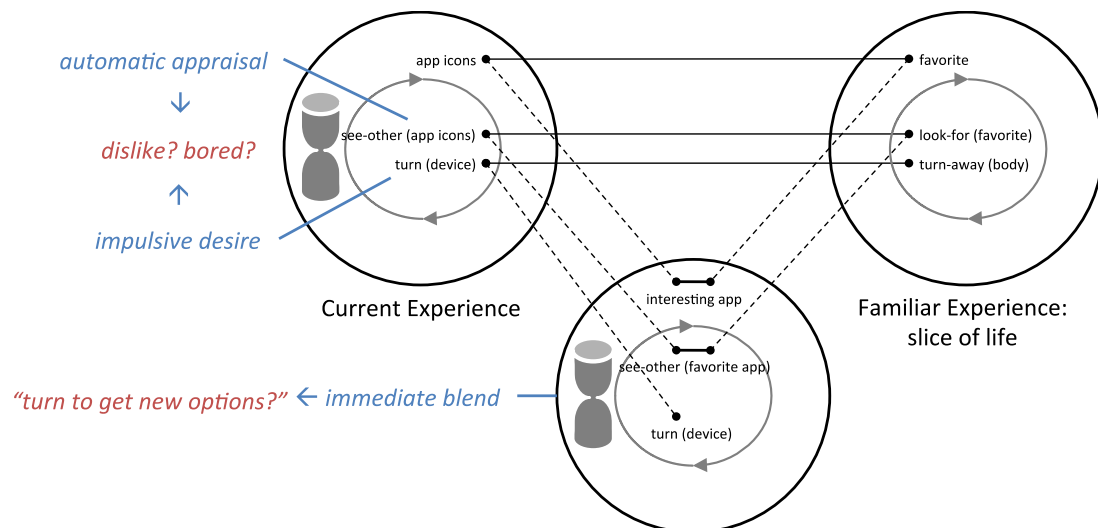
Figure 8(a) At the immediate level, the sensorimotor loop evokes the experience of turning away from dislikes, resulting in immediate understanding of the action.

The Reflective Level

After several rounds of selection, the user may wonder about the changing pattern of the compass's recommendation. Sometimes, number of options is reduced, and the user needs to turn to uncover more other options. One may invoke an interpretive frame to account for these unexpected changes, recalling some past scenarios that involve similar contingency. Some users might see the compass like an <mark>intelligent guide who advises turning occasionally</mark>, while others might feel like <mark>some authority is directing them</mark>. The interaction provokes different imagined narratives via different metaphorical blends. After extended appraisal, the user may feel thankful to the device for the suggestion, or conversely displeased with the limitation. Figure 8(b) illustrates a possible blend. The sensorimotor feedback loop is partly faded in the user's mind, but the subtle change of available options may cause the user to notice. The user invokes an interpretive frame (in red), and a metaphorical blend results. This gives rise to an imagined narrative (in red) and elicits emotions (in red).
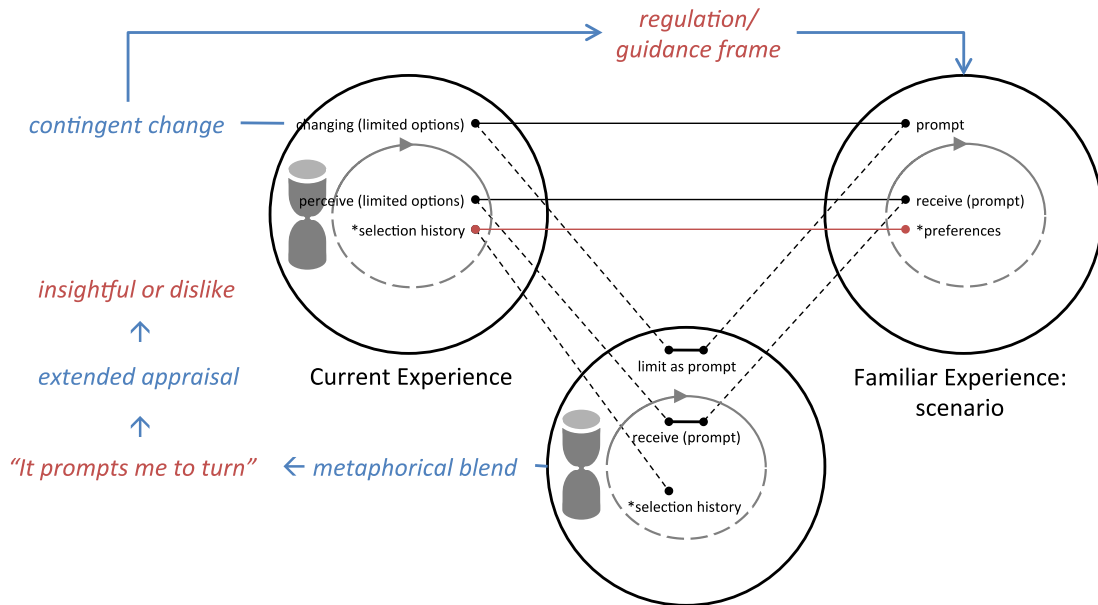
Figure 8(b) At the reflective level, an interpretive frame is invoked to account for the contingent change, leading to a metaphorical blend of a familiar scenario and the current experience.

User Experience Study

A user experience study on the above instances was conducted in order to collect empirical data of user imagination, emotion, and reflection. The research methodology and initial findings have been published elsewhere (Chow et al., 2015). In this section, we summarize the methodology and latest findings with a view to demonstrating how the empirical findings enhance the interpretive analyses and design of Swing Compass.

Each experiment was conducted with one participant at a time. It consisted of a questionnaire session and a series of activities, followed by an in-depth semi-structured interview.

The first activity is a warm-up exercise of the compass. The second activity was about the Status Compass. The participant was first shown with some images of everyday activities (42 in total), and was asked to identify those he or she likes or usually does. The participant was then invited to use the compass as if updating status on social media. In the third activity, the participant dealt with the App Launching Compass. One was first given the icons of all available apps (20 in total), and was asked to fill out the one-day app usage

map with those given apps according to one's own past experience. The participant then used the compass as if it was the usual way of launching apps.

The in-depth interview was semi-structured. The outline roughly matched the timeline of the expected user experience based on the theoretical framework. The questions include those related to immediate blends, impulsive desires, automatic appraisals, contingent changes, metaphorical blends, and extended appraisals. Researchers always refer to the interpretive diagrams to elaborate questions for further discussion. Table 1 summarizes the questions.

Table 1. Questions asked during interviews refer to the theoretical framework

Immediate blends	• *Which activities have you selected? What apps have you launched? Why?* • *How did you know the turning feature?* • *To turn or not to turn, what are the reasons behind?* • *Do you recall anything similar in everyday life?*
Impulsive desires and automatic appraisals	• *How did you feel before and after a turn?* (Emoticons are used to cross-check verbal descriptions)
Contingent changes and interpretive frames	• *Did you notice any patterns from the options?* • *Could you relate to any scenarios in daily life?*
Metaphorical blends	• *Do you prefer guidance or reminders?* • *How do you feel about intelligent agents?* • *Facing a dilemma, would you consult friends, mentors, fortunetellers, or even spiritual means?*
Extended appraisals	• *How did you feel about the compass's behavior? What would you say about the compass?*

There were 17 participants -- ten females and seven males. Five were between 18 and 25 years of age, 11 were between 25 and 35 and one was over 35. Six had a background in Design or related disciplines, one in Linguistics, one in Philosophy, one in Anthropology, one in Business, five in Engineering, one in Statistics, and one in Chemistry.

Qualitative Findings

The findings include qualitative data such as participants' quotes during the interviews, which reveal their thoughts and feelings. Table 2 shows a summary of the interview data with some sample quotes.

Table 2. Significant responses from 17 participants

Immediate blends	Participants spoke about what they recalled from the act of turning, revealing their imaginary concepts of the action.
	<u>Turning as choice making</u>
	Switching choices casually in daily life:
	"It's like shopping! If you don't like the items in a shop, or you haven't seen those before, you turn away!" (XJ)
	Changing choices with sacrifice:
	"It reminds me of attending seminar conference last week. Even though I found a presentation boring, I was hesitant whether to move to another concurrent panel. Just like I would not turn because the compass was heavy." (HU)
	<u>Turning as a mental activity</u>
	Shifting focus of attention:
	"I turned to ignore them, they didn't show up, but they were still there if I turned back. It's like in different drawers, or in my peripheral vision over a table" (MM)
	Changing thoughts in problem-solving:
	"Turning around when I got stuck in a lecture, in order to find a solution. Turning the body, turning my mind." (CB)
Impulsive desires and automatic appraisals	Participants felt bored or wanted to look for a target, and so they turned. If they found something good, they felt satisfied or found it excited and surprised. Otherwise, they felt disappointed or even annoyed.

	Some of them kept turning until they found something acceptable.
Contingent changes and interpretive frames	Participants tried to make sense of the options they were given by invoking different frames. <u>Compromise</u> <mark>"You have to select something you don't like in order to get something you like." (TK)</mark> <u>The like-minded</u> <mark>"I suddenly noticed the pattern. It quite accurately reflected my way! … like friends of similar taste." (MM)</mark> <u>Reminder</u> <mark>"If I eat something bad, I am reminded to do exercise." (MA)</mark> <u>Upselling</u> "It's like online advertising. Changing in their offers … It's suspicious, a bit uneasy. Does it target my data?" (KA) <u>Regulation</u> "It's like I hit the limit and need to relax." (WW)
Metaphorical blends and imagined narratives	Participants tried to describe the compass metaphorically, showing their imaginations of using it. <u>About striking a balance</u> "If you work on something so often, you become specialized and that may limit your options, you need to diversify your skills … Pendulum - stops you from being one sided, but it props you to another side." (RA) <u>About friends' suggestions</u> "It's like a companion, going with you everything. The suggestions might not necessarily be the right one.

	It's no harm to listen. Just selective listening." (KA)
	About guidance
	"Traffic light, sometimes you need to wait, sometimes it flashes and you need to walk faster." (WX)
	About regulation
	"Universities told we could have choices, but actually not many. We can change our majors after the first year, but actually they are all the same." (WR)
Extended appraisals	Useful and inspirational
	"It could be very insightful I think. For food, for health, it'd be great. For apps, I think it's good as well, because it kind of tells you that you've been staring at Facebook for too long … It keeps you from bad choices." (SC)
	All about self-discipline
	"People don't like being controlled. Don't make advice too obvious. Now it's just right … I try my best to do self-management. I reward myself after doing healthy activities." (HU)
	Too limited
	"I don't like someone set limit on me." (WW)

Discussion

The Immediate Level

All participants were able to 'act out' the meaning of 'swing'. If they did not see their targets, or they found the options not interesting or boring, which is in fact an automatic appraisal on the offers, they had an impulsive desire to turn. The appraisals result in emotions (e.g., frustrated, confused, bored, hesitant, satisfied, grateful, appealed, etc.) and actions (e.g., turn vs. stay, change vs. accept). The sensorimotor feedback loop evoked varied slices of life in the participants. At least nine participants described that turning is like choice making, including walking in a shopping mall, choosing among concurrent presentations, waiting for buses, finding places for lunch, spending weekends, accepting or rejecting an

offer, looking for jobs, and making friends. Two participants interpreted turning as a mental activity, like shifting focus of attention on the desktop and contemplating problems.

Among those seeing turning as choice making, the immediate blends tend to be divided into two kinds, those involving sacrifice or effort versus those without much cost except time. For the first kind, at least four participants found turning with the compass rather tiring, and the mental images provoked in their minds involved certain hurdles (e.g., getting out of a seminar room, walking away from a bus stop with some uncertainties, and asking boss for new work, etc.). At least three others mentioned that turning caused dizziness and it was like making an effort or being proactive in pursuit of something. The cost of turning, on the other hand, was not obvious in the imaginations of other participants (e.g., walking inside a shopping mall or shopping in the supermarket).

The Reflective Level

Not all participants were fully aware of the compass's moderation logic. At least eight participants, however, noticed the contingent changes that actually prompted a turn. Other participants, though did not fully understand the patterns, they to a certain extent felt that the compass had intervened. The interpretive frames invoked include compromise, the like-minded, reminder, upselling, and regulation. Participants metaphorically described and imagined the compass as a pendulum that keeps the user 'swing', a companion just giving the user suggestions, someone providing guidance or direction, and even a regulator. The imaginative blends show a continuum of reflection. They seem to vary from understanding the need for balance in life, through selective listening to advices, to following guidelines or being bounded, resulting in different degrees of appreciation.

Conclusion

Based on a rigorous theoretical framework, we have built Swing Compass, a configurable, adaptive, embodied selection system, and instantiated a few applications, followed by user experience testing. The results are summarized in

this paper. This demonstrates an approach to proposing reflective user experiences via provoking imagination and emotion by lively interactive artifacts. Researchers or designers start with configuring the topology and analogy of choices, cognitively walking through what one would perceive, act upon, and recall in the mind, which are then conceptualized in diagrams as blueprints of the intended user experiences. The proposal can be evaluated with user experience testing. The evaluation is exploratory, generative rather than validating, and affirmative. It is not to approve or validate the success of a design concept, but instead to look for real samples of users' cognitive processes for intended reflective meanings. Designers are informed of the emphases in making the designs more promising toward their goals.

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