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The Lens of Intrinsic Skill Atoms: A Method for Gameful Design

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The idea that game design can inspire the design of motivating, enjoyable interactive systems has a long history in human-computer interaction. It currently experiences a renaissance as *gameful design*, often implemented through *gamification*, the use of game design elements in nongame contexts. Yet there is little research-based guidance on designing gameful systems. This article therefore reviews existing methods and identifies challenges and requirements for gameful design. It introduces a gameful design method that uses skill atoms and design lenses to identify challenges inherent in a user's goal pursuit and restructure them to afford gameplay-characteristic motivating, enjoyable experiences. Two case studies illustrate the method. The article closes by outlining how gameful design might inform experience-driven design more generally.

1. INTRODUCTION

1.1. Design for Motivation and Enjoyment

In recent years, human–computer interaction (HCI) has become increasingly interested in designing for enjoyment and motivation (e.g. Blythe, Overbeeke, Monk, & Wright, 2004; Jordan, 2002; Zhang, 2008). This is fueled by multiple currents: With growing affluence and stable institutions, societies are shifting toward post-material values of self-realization, self-expression, and experience (Inglehart, 2008). Together with the commoditization of utility and usability, this leads consumers to choose products and services based on experience (Pine & Gilmore, 2011)—and enjoyment or "fun" are among the most desired experiences. With the rise of digital

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networked technology, user engagement is integrated into value chains, from user-led innovation to user-generated content and word-of-mouth marketing. Hence, organizations have to motivate "produsage" on a continuing basis (Bruns, 2008). Finally, as interaction design expands into contexts like self-management, personal finance, health, or sustainability, behavior change and its motivation become frequent design goals (Fabricant, 2009).

Simply put, *motivation* describes the psychological "processes that direct and energize behavior" (Reeve, 2009, p. 8), whereas *enjoyment* describes a complex of positively valued experiences and connected physiological-affective-cognitive states (Vorderer, Klimmt, & Ritterfeld, 2004). In search of foundations for designing motivating, enjoyable experiences, HCI has turned to multiple fields, especially psychology (Hassenzahl, 2010; Zhang, 2008). Yet although psychology provides ready constructs for theorizing and measuring motivation and enjoyment, it is also highly generic and analytic: It

says little about potential specifics of interactive systems, nor does it easily translate into guidance how to design motivating, enjoyable interactive systems in "messy" real-world settings.

1.2. Game Design as Inspiration

Early on, researchers like Thomas Malone and John M. Carroll pointed out that video games are interactive systems purpose-built to afford motivation and enjoyment. Therefore, HCI should study games to tease out the specific "motivational techniques" (Carroll, 1982) and qualities that make games "enjoyable interfaces" (Malone, 1982), and how to design for them in nongame systems (Carroll & Thomas, 1988). A similar intuition underlies Csikszentmihalyi's (1990) study of flow, arguably one of the most influential models of enjoyment. Because activities like gaming are "*designed* to make optimal experience easier to achieve" (Csikszentmihalyi, 1990, p. 72), one should "explore ways in which even routine activities can be transformed into personally meaningful games that provide optimal experiences" (p. 51).

However, these early intuitions did not catch on in HCI. As the field broadened to matters of experience in the mid-2000s, scholars started studying the user experience of games (Bernhaupt, 2010), as well as methods for evaluating their usability and playability (Isbister & Schaffer, 2008). Yet none of this work was adapted to make nongame systems more engaging (see Hassenzahl, 2003, and Niebuhr & Kerkow, 2007, for two exceptions). Where HCI took inspiration from game design, it has been for intuitive forms of information display (Chao, 2001; Weisscher, 2001).

Instead, researchers began studying *playfulness*, especially in the context of interactive art (e.g. Arrasvuori et al., 2011; Fernaeus et al., 2012; Gaver, 2009; Morrison, Mitchell, & Brereton, 2007). Yet following play scholars like Caillois (2001; cf. Barr, 2007; Deterding, Dixon, Khaled, & Nacke, 2011), playfulness captures only one of two modes of play, namely, *paidia*, or free play: the unstructured, curiosity-driven exploration and recombination of behaviors, objects, and meanings. Valuable as research on playfulness is, it has not unpacked and sometimes explicitly opposed the second pole, *ludus,* gaming, or gamefulness: the rule-structured, challenging pursuit of goals. Yet it is this pole to which Malone, Carroll, and Csikszentmihalyi were pointing.

Using the motivating, enjoyable qualities of gaming has a long tradition as serious games and serious gaming: the design and use of full-fledged games and gaming-related practices for nonentertainment purposes (Michael & Chen, 2005). Yet again, the serious games movement has not explored the transfer of game *qualities* or game *design* into other contexts.

It is only in the past few years that practitioners and researchers have become interested in affording the motivating, enjoyable qualities of gameplay in nongame systems. This trend has become known as gameful design or gamification. Following Deterding et al. (2011, p.11), who suggest a 2 × 2 matrix of *ludus/paidia* and *wholes/qualities* to differentiate game-related design practices, and *means/ends* to distinguish gamification from gameful design, *game design* and *toy design* aim to create *ludic* and *paidic wholes. Playful design* aims to afford *paidic qualities. Gameful design* is defined by the

end of affording *ludic qualities* or gamefulness (the experiential qualities characteristic for gameplay) in nongame contexts. In contrast, *gamification* describes the *means* of using game design elements in nongame contexts, typically for the end of gameful design. Industry publications promise "revolutionary" gains in customer and employee motivation through gamification (Paharia, 2013). According to a recent review, the majority of empirical studies shows at least partially positive results (Hamari, Koivisto, & Sarsa, 2014). However, there has been little research on methods for gameful design (Deterding, Björk, Nacke, Dixon, & Lawley, 2013). Several design frameworks have emerged in the industry but also been critiqued as the indiscriminate implementation of a small set of design patterns that fails to afford gaming-characteristic experiences (e.g. Bogost, 2011; Deterding, 2011; Nicholson, 2012; Robertson, 2010).

1.3. Article Goal and Outline

To make good on Malone's, Carroll's, and Csikszentmihalyi's early intuition and address the lack of research-based methods, this article introduces a gameful design method that has been iteratively developed and refined in 19 projects and workshops across domains. After a conceptual analysis of challenges and requirements for gameful design (Section 2), a review of existing gamification methods identifies their commonalities and shortcomings (Section 3). Section 4 presents and justifies an alternative approach: teasing out the learnable challenges inherent in a user's goal pursuit, to then iteratively prototype and improve skill atoms that restructure these to afford motivation and enjoyment. This is illustrated in two case studies (Section 5). The final Section (6) discusses wider ramifications of the method for HCI.

2. CHALLENGES FOR GAMEFUL DESIGN

As stated, the goal of gameful design is to afford the motivating, enjoyable experiences characteristic for gameplay in nongaming contexts. This goal can be broken down into four questions: (a) What are the enjoyable, motivating experiences characteristic for gameplay? (b) What game structures and processes afford these experiences? (c) How does game design create these structures and processes? (d) How can we integrate this into design methods for nongame systems?

2.1. Motivating and Enjoyable Qualities of Gameplay

"Fun" and "enjoyment" are widely used labels for the main desirable experiences and driving motives of gameplay, yet they are also notoriously elusive and overdetermined constructs (Taylor, 2006, pp. 67–92). Multiple models have attempted to explain them in terms of other constructs (like flow or immersion), or deconstruct them into subcomponents (see Boyle, Connolly, Hainey, & Boyle, 2012, for a review). These models variously try to capture gameplay experience (Poels, de Kort, & Ijsselsteijn, 2007), game enjoyment (Klimmt & Blake, 2012; Malone, 1981; Sweetser &

Wyeth, 2005), or gaming motivation (Ryan, Rigby, & Przybylski, 2006; Sherry, Lucas, Greenberg, & Lachlan, 2006; Yee, 2006). Unfortunately, many fail to clearly separate and relate (a) enjoyment as an experience and cognitive-physical-affective state; (b) interactional, physiological, and psychological processes that give rise to (a); (c) motivational processes; (d) structural features of games that afford (b) and (c); and (e) principles how to design games with these features. This is already true for flow theory, on which several models draw (Bowman, 2008). In addition, many models use the same terms with different meanings. For instance, the nine dimensions of digital game experience by Poels et al. (2007) entail enjoyment, flow, and control, whereas flow theory suggests that flow is the experience of enjoyment and that control is an aspect of and/or precondition for flow.

One framework that evades these issues is the player experience of need satisfaction (PENS) model (Przybylski, Rigby, & Ryan, 2010; Rigby & Ryan, 2011), itself based on self-determination theory (SDT; Deci & Ryan, 2012). SDT argues that human beings are intrinsically motivated to seek out and engage in activities that satisfy three innate psychological needs: *autonomy,* the experience of acting with volition and willingness, in congruence with one's own goals, needs, values, and identity; *competence,* the experience of one's (growing) ability to achieve desired change in the world; and *relatedness,* a sense of intimate connection with others. PENS explains game selection as motivated by spontaneous interest grounded in previous experiences of need satisfaction and/or the acute deprivation of needs that leads individuals to want to replenish them. Ongoing gameplay is motivated by the actual experience of need satisfaction—this is what is meant with the activity being autotelic (its own goal) or intrinsically motivated. Game enjoyment and immersion are explained as experiential signatures of need satisfaction: What players label "enjoyment" or "fun" is the experience of need satisfaction, which leads to spontaneous attentive absorption and emotional investment in gameplay, constituting immersion (Ryan et al., 2006). Put differently, "fun" is an everyday language label for the experience of enjoyment, arising chiefly from need satisfaction.

Several reasons speak for using PENS to model gaming enjoyment and motivation. SDT is a well-established theory of human motivation with empirical support across contexts (Deci & Ryan, 2012). Need satisfaction accounts not only for a significant part of gaming enjoyment and motivation (e.g., Przybylski et al., 2010; Reinecke et al., 2012) but also for positive experiences in life (Sheldon, Elliot, Kim, & Kasser, 2001) and with interactive products (Hassenzahl, Diefenbach, & Göritz, 2010). Hence, SDT finds increasing usage in research on hedonic and motivational experiences (Hassenzahl, 2010; Zhang, 2008). Finally, PENS can account for constructs of competing models such as flow theory or Yee's (2006) motivations for online play (Przybylski et al., 2010).

More recent models complement PENS with mood management theory (users selecting media to optimize arousal and affect) and appreciation (the satisfaction of eudaimonic needs for meaningfulness and insight), and have found first empirical support for their superior explanatory power (Oliver & Raney, 2011; Reinecke et al., 2012). Still, PENS remains their bedrock; provides a well-operationalized, robust

nomological network that accounts for most gaming-characteristic motivations; avoids the conceptual conflations just outlined; and offers an explanatory model for the linkage of game features, motivational processes, and enjoyment (Rigby & Ryan, 2011).

2.2. Structures and Processes Underlying Gameplay Motivation and Enjoyment

Formally, most common definitions of games agree that a game consists of one or more interconnected *challenges* a player is trying to overcome, which emerge from the player taking *actions* in pursuit of *goals*, and *rules* and *objects/opponents* that make attaining those goals challenging (Juul, 2005, pp. 29–43). Challenge here means a specific kind of difficulty or resistance requiring nontrivial effort and skill to overcome—such as hand–eye coordination in shooter games. Most game design literature agrees that a game's challenge is at the heart of its gameplay experience (e.g. Fullerton, 2008, pp. 77–78, 86–91, Schell, 2009, p. 179).

Challenges give rise to motivating, enjoyable experiences through multiple routes: First, overcoming nontrivial challenges creates the pleasurable experience of competence (Rigby & Ryan, 2011). Second, by *choosing* to tackle a challenge for the sake of enjoyment (provided no other consequences are attached) and by choosing which challenges to tackle with which strategies (provided multiple are offered), players perceive themselves as acting with high autonomy (Deterding, 2014a; Rigby & Ryan, 2011). Third, overcoming challenges collaboratively and/or in service of significant (virtual) others satisfies relatedness needs (Rigby & Ryan, 2011). Fourth, the outcome of a nontrivial challenge is by definition uncertain, stoking curiosity, interest, and arousal (Malone, 1981; Silvia, 2012). Fifth, following mood management theory, nontrivial challenges bind attention and cognition, leaving few resources to ruminate on unpleasant thoughts (Reinecke et al., 2012). This is what Csikszentmihalyi (1990) referred to as the "deep but effortless involvement that removes from awareness the worries and frustrations of everyday life" (p. 49). Several heuristics for designing challenges and their component goals, rules, and so on, have been developed (Isbister & Schaffer, 2008). For instance, challenges should be balanced relative to the player's perceived current ability such that they appear neither too hard (inducing anxiety) nor so easy that they generate no uncertainty before nor competence upon overcoming them (Csikszentmihalyi, 1990, pp. 49–53, 74–77).

2.3. The Systemic, Emergent Quality of Gameplay Enjoyment and Motivation

Notably, challenge, motivation, and enjoyment are systemic, emergent properties. A historical look into serious game design can help clarify this point: The first generation of "edutainment" games assumed that instrumental activities like learning entail inherently unpleasant properties and games inherently enjoyable properties (Egenfeldt-Nielsen, 2007). By analogy, sugar has inherent chemical features that, when imbibed by a living being with the respective dispositions (taste receptors, etc.), will

infallibly result in the experience of sweetness. The resulting design paradigm has been called "chocolate-covered broccoli" (Bruckman, 1999): Presumed-inherently unenjoyable learning is made palatable by adding presumed-inherently enjoyable gameplay, either through inserting learning tasks into an entertainment game or by "spicing up" learning tasks with game feedback like the sound and sight of a popping balloon.

Due to lacking success, this inherent-additive paradigm has been largely abandoned. The current generation of serious games subscribes to emergent theories of enjoyment, and as a result, systemic design paradigms (Egenfeldt-Nielsen, 2007; Squire, 2006). By analogy, the taste of a piece of pastry depends not on its sugar content but on the mixture and preparation of all ingredients, and how the resulting whole suits the sensitivities of the eater, her sociocultural background, current satiety, and so on. This aligns with current views of user experience as subjective, holistic, emergent, situated, and dynamic (Hassenzahl, 2010, pp. 6–31). In this paradigm, *all* activities can be motivating and enjoyable. It is just that good games are purpose-built to optimally afford motivation and enjoyment, whereas, for example, most contemporary formal education is not (Gee, 2004).

2.4. Game Design for Motivation and Enjoyment

In game design, the emergent, systemic quality of game enjoyment has been formalized in the mechanics, dynamics, aesthetics (MDA) model (Hunicke, LeBlanc, & Zubek, 2004): A game's *mechanics*—the rules specifying possible actions—form a system that players interact with, giving rise to interactional *dynamics*, which in turn give rise to experiential *aesthetics*. For instance, the mechanics of *Monopoly* state that players roll two dice and move their game piece the rolled number of fields. If they land on a field owned by another player, they have to pay that player, which may require selling their own fields to generate the necessary cash. This leads to the dynamics of a slowly widening poverty gap, which engenders the aesthetic of frustration for the losers, as losing becomes foreseeable early on but is dragged out. Challenge is a fundamental player–system dynamic: As much as a game might explicitly suggest goals, unless players intentionally pursue them, neither gameplay nor challenge come about (Björk & Holopainen, 2005, p. 317). Balancing of challenge similarly depends on the dynamic relation of game and player states.

The systemic, emergent quality of game experience has resulted in "iterative design" (Zimmerman, 2003) or "playcentric design" (Fullerton, 2008) as the dominant game design method, characterized by *iterative experiential prototyping*: The designer defines an experience she wishes to evoke and then ideates first mechanics that might generate it. Because both player–system interactions and resultant player experiences are highly emergent, they cannot be reliably predicted. Therefore, the designer builds and tests rough functional prototypes to observe what dynamics and aesthetics actually emerge, evaluates how and why these diverge from the intended experience, ideates promising design changes, and revises and tests the prototype again. This cycle is repeated until the desired experience emerges.

2.5. Bridging Game and Interaction Design

To summarize, central components of gaming motivation are basic psychological needs for autonomy, competence, and relatedness, and a central component of gaming enjoyment is the experience of having these needs satisfied. As noted earlier, gameful design is specifically concerned with the ludic, gameful pole of gameplay. The chief enjoyment and motivation of such ludic gaming is the sense of competence (effectance, control, mastery) that arises from overcoming challenges (Klimmt & Blake, 2012)—a view shared by game designers (e.g. Koster, 2004). Malone (1981) and Csikszentmihalyi (1990) similarly have articulated challenge as a central dynamic for optimal experiences. In fact, Hunicke et al. (2004) suggested that challenges are core to *any* gaming experience. Evoking different experiences and motives means designing different challenges "tuned" to them.

Gameplay experiences are doubly emergent: They are aesthetics that emerge from the dynamics of a player interacting with a game, which in turn is a systemic whole of its mechanics. Specifically, they arise from players tackling and overcoming well-balanced challenges constituted by a system of goals, rules, actions, objects/opponents, and feedback. Game design therefore targets an experience and then engages in an iterative cycle of ideation, prototyping, testing, and analysis until the delta between intended and actual experience is closed.

With this thumbnail sketch of game-characteristic experiences, structures, processes, and design methods regarding motivation and enjoyment at hand, how does one translate them into interaction design—how to move from game to game*ful* design? Conceptually, gameful design is defined as affording gameful experiences in any nongame context (Deterding et al., 2011). Practically, it is almost always a form of design with intent (Lockton, Harrison, & Stanton, 2010) that also has to support functional needs—like a printer that both allows printing and motivates users to print less. In short, gameful design attempts to design systems that serve specific functions and uses *and* facilitate both through motivating, enjoyable experiences.

Closest to gameful design in this regard are serious games: games designed and/or used for non-entertainment purposes. Analyses of the challenges of serious game design thus provide a useful entry point into the challenges of gameful design.

Tension of Experiential and Instrumental Goal

First, both face an inherent goal tension: delivering on an experiential goal (enjoyment, motivation) to serve another instrumental goal. The literature typically articulates this as a trade-off, balancing, or constraint: Entertainment games can focus exclusively on enjoyment. In serious games, enjoyment must be balanced with, is constrained by, and ideally converges with concerns for instrumental outcomes and requirements such as assessment or realism (Harteveld, 2011; Isbister, Flanagan, & Hash, 2010; Khaled & Ingram, 2012, Michael & Chen, 2005; Winn & Heeter, 2006).

Synthesizing User Research and Requirements for Game Design Ideation

Second, to bring instrumental goals and requirements into the design process, both serious game and gameful design have to bridge interaction and game design. Interaction design is primarily concerned with supporting people's work and every-day needs (Rogers, Sharp, & Preece, 2012, p. 9). It has developed robust methods for understanding the goals, needs, and contexts of system owners (stakeholders decid-ing over a system) and end users (stakeholders using the system; Rogers et al., 2012, p. 171) and assessing how well systems support these. Although there are increasing efforts around "experience-driven design" (Desmet & Schifferstein, 2011), these have been mostly concerned with formative research identifying and modeling *what* experi-ence to design *for*, not *how* to get from the identified target experience to a design that affords it.

Game design in contrast is concerned with just that: designing interactive systems around experiential goals. Iterative design provides a robust, formalized method for doing so. (Where HCI has worked on experience design methods, suggestions again revolve around iterative prototyping; Buchenau & Suri, 2000). However, as Khaled and Ingram (2012, p. 76) observed, whereas game design provides little guidance on "early stage design research with end users (players), or how to fold these insights back into the design process," interaction design "unsurprisingly sheds little light on how to move from user insights to game mechanics and game concepts." In the design work informing the present article, this lacking bridge was also by far the most frequent issue. Gameful design needs a *design synthesis* (Kolko, 2010)—shared artifacts, practices, and understandings fertile for generating ideas, and able to guide the following iterative refinement.

Mobilizing the Professional Vision of Game Design

This bridge from research to ideation is part of a larger required epistemic and practical bridging: Design teams need a shared language, a joint way of seeing to articu-late, evaluate, and coordinate concerns, observations, and actions. Such a "professional vision" (Goodwin, 1994) entails (a) *coding* observed phenomena into objects of knowl-edge, (b) *highlighting* certain objects as relevant and certain problems as problematic, and (c) *material representations* that ground perception, discourse, and interaction. Yet "ways of seeing" and their epistemic objects do not travel easily: They are indexically embedded in and constituted by the total web of embodied experiences, practices, tools, and discourse of their profession. Many game design patterns (like "zone of influence") not only draw on further game design patterns (Björk & Holopainen, 2005) but they also only make sense within the context of a game. To straightforwardly speak of the "zone of influence" of a shopping application is simply meaningless. If the main tactic of gameful design is to apply game design elements (i.e., gamification), then these elements have to somehow be *mobilized, translated* such that they can travel to interaction design.

In serious games, this mobilization typically happens through multidisciplinary teams that include game designers; joint work over time establishes a shared way of

seeing (Winn & Heeter, 2006). Yet this is by definition resource intensive, is friction laden, and has to happen with each team anew. Ideally, interaction designers should be able to create gameful systems on their own. This asks for an accessible formalization of the epistemic objects of game design that can be easily integrated into standard interaction design practice.

The Challenge of Challenge

Taken at face value, interaction design and game design are anathema. A core tenet of interaction design is to make systems usable, to *remove* any unnecessary challenge. Game design, as seen, is about the deliberate *creation* of challenges. After all, "playing a game is the voluntary attempt to overcome unnecessary obstacles" (Suits, 2005, p. 55). As Cook (2008) put it, if a usability engineer were to redesign *Super Mario Bros.* with the sole goal of usability, the result would be a single button, labeled "Rescue Princess." By easing the avowed instrumental goal into a single button click, the actual experiential goal of enjoyment is destroyed. This issue was already pointed out by Malone's (1981) distinction between *toys* and *tools*:

> Toys can be defined as systems used for their own sake with no external goal (e.g., computer games, puzzles, etc.). Tools can be defined as systems used as a means to achieve an external goal (e.g., text editors, programming languages, etc.). The requirements for good toys and tools with respect to challenge are mostly opposite. . . . In a sense, a good game is intentionally made difficult to play to increase its challenge, but a tool should be made as easy as possible to use. (pp. 359–360)

Psychologically, things we call "games" and "toys" we typically engage with autotelically (for their own sake), whereas things we call "tools" we typically engage with exotelically, for the sake of some instrumental purpose (Csikszentmihalyi, 1990). Autotelic, autonomous engagement is a defining part of people's conception of "playing" (Deterding, 2014a). However, as Csikszentmihalyi's (1990) workplace studies show, "working" with tools is often autotelic as well. Conversely, exotelic, in-autonomous engagement with games and gamified applications leads people to label it "work" and impedes enjoyment and performance (Deterding, 2014a; Mollick & Rothbard, 2013). It ultimately depends on the users' situational framing—afforded but not determined by objects and context—whether they experience an activity as "work" or "play" (Deterding, 2014a). *Reframing*, therefore, is itself an important part of gameful design (Deterding, 2014b).

Of course, game design is not about *indiscriminately* adding challenge: Good games combine difficult gameplay challenges (evoking competence) with easy-to-use interfaces (as whatever gives access to gameplay; Juul & Norton, 2009). Yet the fact remains that the value of challenge in interaction and game design is diametrically opposed.

Serious games resolve this issue through *intrinsic integration* and *transfer*. Intrinsic integration means that learning material is embodied in the game world as the most "fun-to-play" core gameplay (Habgood & Ainsworth, 2011). In such "endogenous

games" (Squire, 2006), overcoming the core challenge of the game requires and supports acquiring the concepts and skills to be learned. This makes pedagogical sense because gameplay embodies good, experientially grounded, explorative, scaffolded learning by doing (Gee, 2004; Squire, 2006). Evidence supports that intrinsically integrated serious games are motivationally and educationally more effective (Habgood & Ainsworth, 2011). Serious games can work with intrinsic integration because they achieve their instrumental goal through *transfer* (Mestre, 2005): Mastering game challenges affects beliefs, concepts, attitudes and skills, which in turn affect ultimate activity beyond gameplay, for example, choosing healthier food. Learning (and game challenges) are separate from and thus don't add friction to the ultimate target activity.

In sharp contrast, gameful systems have to *both* directly support end user activity (be easy to use) *and* facilitate it through enjoyment and motivation. Hence, "tacking on ad hoc complications will not evoke fun" (Carroll & Thomas, 1988, p. 21). Few users would enjoy having a ticket vending machine gamified by adding a puzzle challenge to the already puzzling purchase process. The notion of intrinsic integration has to take a different bent here. Rather than *creating* new challenges that evoke enjoyment (entertainment games) or embody learning goals (serious games), gameful design has to *identify* the challenges already inherent in the user's pursuit of her needs and *restructure* them in a motivating manner (cf. Csikszentmihalyi, 1990, p. 51). That is, what are the already-present challenges of her activity that in the given constraints can neither be hidden or automated away nor made any easier? To engender competence, these inherent challenges are ideally skill based: something a user can learn and improve in (cf. Cook, 2008). Creating an online classified advertisement, for instance, involves the inherent challenge of writing persuasive copy, which is a learnable skill. Figuring out where to enter the written copy in an online form is neither inherent nor skill based. Having to solve a math equation to unlock the form field would be skill based—one can learn mathematics—but not inherent to the activity.

This means that gameful design has far less creative control over challenge. Entertainment game designers can create whatever challenge they consider most conducive to enjoyment. Gameful designers usually can neither fully control nor predict the goals (and entailed challenges) of their users. In *Super Mario Bros.*, designers create goals and environments. With a word processor, overall context and user expectations chart a corridor of likely goals and activities, but the actual goals and objects a given user works on at a given time are widely divergent (Pagulayan, Keeker, Fuller, Wixon, & Romero, 2008, p. 743). Hence, gameful design will often have to be underspecified, open to customization, or support dynamic personalization.

2.6. Summary

This section established the motivating and enjoyable qualities of gameplay, the structures affording them, how game design creates them, and the challenges of translating this into interaction design. We can summarize the main findings in six requirements for gameful design:

1. *Design for basic need satisfaction*: Enjoyable, motivating experiences characteristic for gameplay are competence and, to a lesser extent, autonomy, relatedness, curiosity, arousal, and attentive focus. Gameful design should target these experiences.
2. *Design around inherent skill-based challenges*: Games afford these experiences through nontrivial challenges arising from a system of goals, objects, rules, actions, and feedback. Because gameful design typically involves a system that supports existing functional activity, it ought to contour the skill-based challenges already inherent in said target activity, rather than adding new ones.
3. *Design for systemic emergence*: Because enjoyment, motivation, and challenge are emergent properties of a systemic whole of user–system interaction, gameful design therefore has to design and test such whole systems.
4. *Formative research*: Because gameful design needs to support existing user goals and needs, it requires formative research that identifies their goals and needs as well as the challenges inherent to their pursuit.
5. *Design synthesis*: Formative research has to be synthesized into a form that informs the ideation and evaluation of gameful design ideas.
6. *Epistemic mobilization*: The epistemic objects of game design have to be translated into a form that is intelligible and easily adoptable for interaction designers.

3. REVIEW OF EXISTING METHODS

3.1. Academic Methods

With these requirements in hand, we can review existing work on gameful design. Academic research on gamification and gameful design methods is still in its infancy (Deterding et al., 2013). Nicholson's (2012) "user-centered theoretical framework for meaningful gamification" articulates useful design values (user centricity, transparency, personalization) but no actual method. The social gamification framework by Simões, Redondo, and Vilas (2013) similarly remains a declaration of objectives and future outcomes. Gears and Braun (2013) merged object-oriented systems analysis and design with SDT and the theory of 16 basic desires (Reiss, 2004) into a business gamification process. A "role-motivation-interaction framework" articulates the interactions and possible underlying motivations for each user role, which then shall guide the choice of fitting game design patterns. Yet not only are SDT and basic desires incompatible theories (Reiss, 2004), the framework doesn't provide guidance how to identify fitting patterns.

The four-step gamification process by Aparicio, Vela, Sánchez, and Montes (2012) tries to identify the main user task and a "transversal objective." This appeals to "games with a purpose" (Von Ahn & Dabbish, 2008), where an overt gaming goal (guess what word another user might think of when seeing this image) covertly solves human information tasks (tag images). Designers should select game mechanics that match both main and transversal objective and support autonomy, competence, and relatedness. However, many gameful applications do not feature diverging main and

"transversal" objectives (e.g., fitness apps); Aparicio and colleagues also don't explain how they matched mechanics with basic needs, or how to choose the right mechanics.

Popa (2013) suggested using a traditional user-centered design (UCD) process involving research-based personas (Pruitt & Adlin, 2006) to create "gamey personas." These include information about a user's personality type (using the BrainHex player typology), emotions the user enjoys in playing games, and the user's experiential goals, and they serve as brainstorming triggers. Apart from basic issues with player typologies (see next), there is again little guidance how to move from experiential goals to a design solution.

3.2. Industry Methods

Arguably the earliest documented industry method is "smart gamification" by Kim (2010). She suggested to first identify the preferred "engagement style" of the target audience based on four "social engagement verbs" and the system owner's goals. Then designers create a "player persona" entailing a "player journey" with goals and activities on three stages: newcomers, regulars, and enthusiasts. Preferred social engagement verbs are mapped to fitting stages, as are game design patterns that display user progress. These should be connected to rewards like virtual items or feature unlocks. Next, customization options for the main "social objects" (e.g., user profiles) are chosen. Finally, for each supported social verb, a "social engagement loop" is devised: a feedback loop of a call to action, social action, system feedback, and underlying motivation.

The majority of later methods follow in Kim's tracks with slight amendments. Zichermann and Cunningham (2011), Werbach and Hunter (2012), Kapp (2012), Kumar and Herger (2013), Paharia (2013), and Burke (2014) all suggest a design process of more or less the following form:

1. Identify system owner goals.
2. Identify trackable behaviors of end users that support these goals; quantify their relative contribution in a metric.
3. Profile and segment end users using player typologies (usually "Bartle Types").
4. Select and specify game design patterns:
   a. Translate the quantified system owner value of end user behaviors into point values displayed back to users.
   b. Articulate an ordered sequence of explicit goals for end users, consisting of sets of behaviors or point thresholds (quests, challenges, levels).
   c. Define feedback to display upon single user actions ("engagement loop") as well as reaching point thresholds or goals (achievements, badges, leader boards), including potential rewards (virtual items, customization options).
   d. Choose additional game design patterns.
5. Playtest.

6. Build and deploy.
7. Use analytics of user behaviors to monitor system performance and guide the improvement and release of new content and features.

An interesting alternative, Dignan's (2011) "game frame" suggests to identify the core user activity to be facilitated, create a player profile entailing its main hindrances and motivational drivers, choose long-term goals for the user, identify skill(s) required, and determine a "resistance" that makes achieving the objectives difficult, as well as resources, objects, and spaces with which the user engages. Finally, designers need to define a skill cycle, select rewards and punishments, and playtest and refine. Two further edge cases worth mentioning are Ferrara (2012) and Kapp (2012), who both overtly present models for gamification yet in the end revert to educational serious game design.

3.3. Characteristics and Issues

One may safely assume a dark figure of unpublished methods in use in the industry, but the high similarity of the publicly available methods and their reach through widespread deployments (Paharia, 2013) and training programs (Werbach & Hunter, 2012; Zichermann & Cunningham, 2011) suggest that they can be taken as representative. Beyond their basic procedural commonality, several further commonalities are worth teasing out.

Little Formative Research

In the reviewed methods, formative research is neither deeply integrated nor well specified. Although all profile end users, typically using personas, the majority recommends imaginary rather than data-driven personas—a common problematic practice (Chang, Lim, & Stolterman, 2008). Data collection methods are glossed over at best. Some explicitly recommend basing personas on educated guesses (e.g., Burke, 2014, p. 102; Werbach & Hunter, 2012, pp. 91–93; Zichermann & Cunningham, 2011, p. 21). Partial exceptions are Paharia (2013, pp. 192, 208–213) and Kumar and Herger (2013). They recommend using interviews and site visits but provide no guidance on how to conduct these to identify motivations or player types.

Reliance on Player Typologies

Almost all reviewed methods portray classifying end users by "Bartle Type" as a useful activity (Kapp, 2012, pp. 132–137; Werbach & Hunter, 2012, pp. 92–93; Zichermann & Cunningham, 2011, pp. 21–24): "Understanding the type of player will help you choose the game mechanics that will be most appealing to your target audience." (Kumar & Herger, 2013, n.p.) Bartle (1996) suggested that most players of Multi-User Dungeons (MUDs) stably prefer one type of enjoyment in MUD play: Achievers enjoy achievement within the game context, explorers exploration of the

game world, socializers socializing with others, and killers imposing themselves upon others. Kim's (2012) "social engagement verbs" are also based on Bartle but (she claims) better capture people's main "social engagement style," namely, competitive, explorative, cooperative, or expressive.

A general problem of typologies is that they are far less context-specific than data-driven personas. Building personas from typologies, as suggested by Kumar and Herger (2013) or Popa (2013), loses the very advantage personas bring in contrast to typologies (Pruitt & Adlin, 2006, p. 99). Game designers therefore often warn of relying on player typologies (Schell, 2009, p. 111).

Second, as Bartle (2011) himself argued, the gamification literature frequently misconstrues player types: It ignores his later refinement of eight player types and falsely assumes that player types suggest what kind of activity players should receive points and badges for, whereas only achievers care about the latter to begin with.

Third, Bartle's (1996) typology, based on the unsystematic review of one bulletin board regarding one MUD, has been superseded by a plethora of alternative typologies, based on empirical studies with representative samples and rigorous methods (Hamari & Tuunanen, 2014). Research into game genres beyond MUDs regularly highlights motivations not accounted for by Bartle (e.g. Sherry et al., 2006).

Fourth, the applicability of player types beyond MUDs is an unproven, fraught hypothesis. To assume that a classification of MUD players captures motivations in any context beyond MUDs is as much a non sequitur as assuming that a typology of milk drinkers captures people's reasons for watching movies. This also holds for Kim's (2012) social engagement verbs: covering "modern social gaming and social media," they won't account for, for example, solitary activities.

Appeals to Motivational Psychology

The reviewed methods frame gamification "as a means to design systems that motivate users to do things" (Werbach & Hunter, 2012, p. 30). SDT is by far the dominant theory appealed to, with the notable exception of Zichermann and Cunningham (2011, pp. 15–34). However, SDT is chiefly received through popularized representations (most notably Pink, 2009), leading to partially erroneous representations. It is also variously mixed with other models into new, idiosyncratic, untested models of motivation (Burke, 2014; Dignan, 2011; Gears & Braun, 2013; Kumar & Herger, 2013; Paharia, 2013).

Inherent-Additive, Pattern-Based Approach

Gamification has been accused of applying the same few design elements to any given problem—elements not even central to games (Deterding, 2011; Nicholson, 2012; Robertson, 2010). Although most reviewed methods distance themselves from the "indiscriminate" application of the same design elements, they in fact largely consist in their cataloguing, that is, points, achievements, leader boards, levels, virtual items, quests/missions, avatars, collections, unlocking, engagement loops, onboarding,

competition, cooperation, or feedback (Dignan, 2011, pp. 111–164; Kapp, 2012, pp. 25–50; Kim, 2010, pp. 22–28; Paharia, 2013, pp. 73–83; Werbach & Hunter, 2012, pp. 69–83; Zichermann & Cunningham, 2011, pp. 36–58).

More important, the reviewed methods portray gamification *as* the choice of pre-existing elements: "Putting all these [game] elements together is the central task of gamification design, and having knowledge of these game elements will make your gamification project compelling" (Werbach & Hunter, 2012, p. 81). In essence, they recommend a *pattern-based approach to design* (Seffah & Taleb, 2012) and subscribe to an inherent-additive paradigm of motivation and enjoyment: Activities are made enjoyable by adding inherently enjoyable game elements. "Once you have nailed that [core value proposition] down, the gamification mechanics can layer on top of it and drive engagement, activity, and loyalty around it" (Paharia, 2013, p. 69).

Thus, although the reviewed methods commonly label the catalogued elements "mechanics" and mention the MDA approach, their portrayal ignores its systemic-emergent thrust. For instance, Werbach and Hunter (2012, p. 80) mistake mechanics and dynamics as "orders of abstraction." Kim (2010, p. 20) misidentifies dynamics as "time-based patterns" such as "reward schedules" rather than emergent properties. The majority of elements listed by the reviewed methods are in fact interface design patterns for displaying goals, reputation, and progress feedback (Deterding et al., 2011).

An important facet of this neglect of systemic emergence is that most methods directly classify design patterns by motivation, assuming a deterministic one-to-one pattern-effect relation (Aparicio et al., 2012; Kim, 2011; Kumar & Herger, 2013; Paharia, 2013; Zichermann & Cunningham, 2011). However, the motivational "functional significance" (Ryan, 1982) of an event results from situated, active interpretation—for example, whether feedback is perceived as informational (supporting competence) or controlling (thwarting autonomy). As Antin and Churchill (2011) outlined, a simple design element like a badge can be functionalized for at least five different motivational processes (goal-setting, group belonging, etc.).

Also, by definition, design patterns are "invariant solution[s] to address a recurrent design problem" (Seffah & Taleb, 2012, p. 95). They allow to quickly create best practice solutions in a well-explored design space. This efficiency is an important selling point of gamification (Paharia, 2013). Yet whatever efficiency and reliability gains there may be, they are necessarily bought with foregoing the exploration of novel, potentially more effective solutions. That is, the reflexively denied "indiscriminateness" of gamification is inherent to the pattern-based approach of the reviewed methods.

Lacking Guidance in Game Design Pattern Choice

The reviewed methods provide little guidance in choosing and customizing patterns for a given context—a common problem of pattern-based design (Seffah & Taleb, 2012). In other words, the presumably central design step in gamification is glossed over. Kim (2010) suggests simply picking mechanics from a list. Zichermann

and Cunningham (2011, pp. 36, 142–151) first state that gamification always involves points, levels, achievements, and rewards, to then literally recommend throwing two dice on a table of 12 game mechanics. If the result doesn't fit the problem, one should "leverage that creative dissonance" (Zichermann & Cunningham, 2011, p. 79). Werbach and Hunter (2012, p. 82) emphasize the importance of picking the right mechanics and claim that engagement loops "should give you the skeleton of your system" (p. 99), but again provide no guidance how to devise engagement loops or how to move from loops to elements.

In this, the reviewed methods also fail to synthesize formative research into a useful ideation and evaluation basis. In some instances (Werbach & Hunter, 2012; Zichermann & Cunningham, 2011), player personas and player type classifications remain token exercises the results of which are never manifestly used later. Kumar and Herger (2013) suggest choosing mechanics that fit player types but without any specification what mechanic fits what type. The exceptions here are Paharia and Kim. Paharia (2013, pp. 218–219) recommends walking through scenarios of personas interacting with a system, at each step asking what pattern from a master list of 10 patterns might apply (then again, the remainder of his design process seems to suggest always using some form of goals, points, and achievements; Paharia, 2013, pp. 213–228). Kim (2010) used the four social engagement verbs to derive explicit recommendations which interaction functionality to offer at which stage of a user's engagement with a system. But as with all other reviewed methods, this functionality-verb (or pattern-motivation) link is never really justified (let alone empirically tested).

No Iterative Prototyping

Reviewed methods vary in whether they involve an explicit evaluation phase, and whether this phase is separate from postdeployment monitoring. But in all, iterative prototyping and evaluation of alternative design directions are noticeably absent. Neither Kim (2010) nor Paharia (2013) even mention iterative prototyping. Kumar and Herger (2013), Zichermann and Cunningham (2011, p. 73), and Burke (2014, p. 124) chiefly recommend postlaunch monitoring and development of a gamified system. Werbach and Hunter (2012) spend exactly one sentence on the matter: "The best way to tell if your system is fun is to build it and test it and refine it through a rigorous design process" (p. 99). The same holds for Dignan (2011).

Data-Driven Design

In tune with current lean startup and big data trends, the reviewed methods emphasize the quantitative tracking and monitoring of end user engagement. Granular data on individual user behaviors are in fact a major value proposition of gamification (Paharia, 2013). There is one crucial difference, though: Lean startups (Ries, 2011) extensively use data already in the iterative design of prototypes or "minimum viable products." The reviewed methods suggest tracking and monitoring only after deployment.

3.4. Summary

Gamification, as manifested in the reviewed methods, is a pattern-based, data-driven design approach grounded in an inherent-additive paradigm of motivation and enjoyment. By foregoing formative user research for problematic player typologies, and iterative design exploration for patterns and postlaunch tracking, it appears to be optimized mainly for speed and cost. It also fails the identified requirements for gameful design:

1. *Design for basic need satisfaction*: Although most reviewed methods appeal to basic needs, they typically blend popularized versions of SDT with other models into untested "homegrown" motivation models.
2. *Design around inherent skill-based challenges:* With the partial exception of Dignan (2011), none of the reviewed methods focuses on skill-based challenges inherent in the user's goal pursuit.
3. *Design for systemic emergence*: The pattern-based, inherent-additive paradigm of the reviewed methods is anathema to systemic emergence.
4. *Formative research*: With the partial exception of Popa (2013), formative research is either not sufficiently specified or replaced with tokenist categorizations of users into "Bartle Types."
5. *Design synthesis*: No reviewed method provides sufficient research-grounded instruction for the presumed-essential step of selecting fitting game patterns. Kim's (2010) social engagement verbs come closest but, like all reviewed methods, lack validation.
6. *Epistemic mobilization*: In grafting on game design concepts, translation errors abound, ranging from minor ones (misrepresenting "mechanics") to the fundamental issue that central game design processes like iterative prototyping are absent.

In sum, none of the reviewed gamification methods is set up to create systems affording the motivating, enjoyable experiences characteristic for gameplay or to mobilize the professional vision of game design.

4. A METHOD FOR GAMEFUL DESIGN

Analyzing the role of challenge (Section 2.5), we concluded that a promising strategy for gameful design is to restructure challenges inherent in the user's goal pursuit into a systemic whole that optimally affords enjoyable, motivating experiences. The following section explicates this strategy into a design method, *the lens of intrinsic skill atoms*. As the name suggests, the method draws on three concepts: design lenses, skill atoms, and intrinsic integration. The latter we already encountered: Gameful design should focus on challenges inherent in the user's goal pursuit. The next subsections explain the two remaining concepts and the resulting design process.

4.1. Design Lenses

Design lenses were initially developed by Schell (2009) for game design, but Scott (2010) quickly adapted them to transfer game design concepts into interaction design. As Schell (2009) put it, a lens is "a way of viewing your design" (p. 732–733). Practically, it combines a memorable name, a concise statement of a design principle, and a set of focusing questions that allow the designer to take on the "mental perspective" (Scott, 2010) of the lens. By binding together a principle with focusing questions, a lens becomes self-contained. This enables lenses to "travel" between designs and domains. By using questions rather than guidelines, lenses instruct designers how to see a design space. They provide terms to *code* observed phenomena into epistemic objects and *highlight* certain objects as relevant and certain problems as problematic. Thus, lenses instantiate part of the "professional vision" (Goodwin, 1994) of their discipline. Take the following example (Schell, 2009, p. 181):

Lens #32: The Lens of Meaningful Choices

When we make meaningful choices, it lets us feel like the things we do matter. To use this lens, ask yourself these questions:

- What choices am I asking the player to make?
- Are they meaningful? How?
- Am I giving the player the right number of choices? Would more make them feel more powerful? Would less make the game clearer?
- Are there any dominant strategies in my game?

This lens instructs designers to code a design space in terms of meaningless versus meaningful choice. It then highlights as problematic an imbalance of offered choice or the presence of dominant strategies. The lens doesn't prescribe specific solutions how to offer meaningful choice (like a pattern does), nor is it limited to identifying issues (like a heuristic would). It provides a design guideline that is both generative and evaluative, and devised to be self-contained. This makes design lenses an ideal starting point for gameful design.

Existing game design lenses (Schell, 2009) unsurprisingly speak to games and game designers. Take "dominant strategy" in the previous example: It is a game theoretic term describing a choice where one option is reliably better than the other, effectively rendering the choice meaningless (Schell, 2009, p. 180). Using this term presupposes that the designer is embedded in the vernacular of game design. Also, existing game design lenses give no clear starting points for analysis, and many are not easily applicable beyond games. To address these issues, we rearticulated game design lenses into *motivational design lenses* that are fully self-contained and organized by motives (Deterding, 2015; see Figure 1; Supplementary Material 1). Second, we suggest to start gameful design by viewing the given design space through the lens of *skill atoms*—which focuses design on inherent challenge and provides a base anchor and vocabulary for all lenses.

FIGURE 1. Example of a design lens.
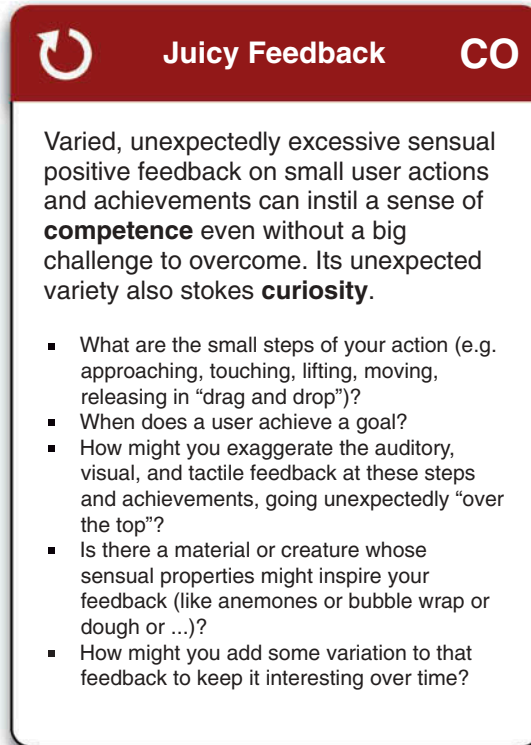
4.2. Skill Atoms

The concept of skill atoms (Cook, 2007) stems from an ongoing effort in game design to develop a formal "game grammar" (see Dormans, 2012, pp. 49–65, for a review). As an "atom," it consists of smaller reoccurring particles yet cannot be broken into these without losing its systemic "gaminess." A skill atom describes a feedback loop between user and system that is organized around a central challenge or skill: A user takes an action, which forms an input into the system's rule engine that determines state changes of its tokens, which get put out as feedback to the user, which she integrates into her mental model of the system. Through repeated interaction—multiple run-throughs of the atom—the user masters its skill: training hand–eye coordination, understanding the rules, and so on (Cook, 2007).

Because Cook's original model articulates process phases more than structural features designers can work with, it was slightly amended. A skill atom as understood here (Figure 2) consists of goals, actions and objects, rules, feedback, emergent challenge, and motivation. Note that in digital systems, rules are rarely explicitly accessible: They are implied in what actions, objects, and feedback are offered to the user.

FIGURE 2. Schematic of a skill atom.
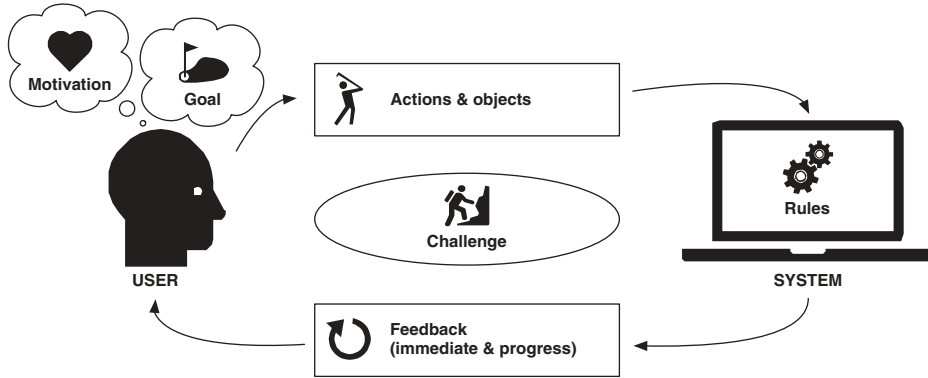
Skill Atom Components

- *Goals*: System states the user attempts to achieve. Goals are typically explicitly suggested by the system but must be actively pursued by the user to be goals.
- *Actions*: What the user can do to approach her goals.
- *Objects*: Entities the user acts upon; their configuration embodies the system state.
- *Rules*: Specifications what actions the user can take and how they affect the system state. These may be algorithms, humanly enacted rules, physical laws, or a combination thereof.
- *Feedback*: Sensory information that informs the user of system state changes resulting from her actions or autonomous system processes; entails immediate feedback on each action and progress feedback on the user's accumulated progress.
- *Challenge*: The perceived challenge of achieving the user's current goal, posed by the current system state relative to the user's perceived current skill.
- *Motivation*: The psychological needs energizing and directing the user to seek out and (continue to) engage with the system—typically competence.

To give one example: In the game chess, the *goal* is to deliver checkmate to an opponent. The *actions* are moving her figures on the game board (*objects*). The *rules* specify which figures a user can move when and how, and how this affects the game state (a pawn being exchanged for a queen, etc.). The user receives *feedback* in the form of changing figure positions on the board. The inherent *challenge* of chess is choosing the move that will put the user in the most advantageous position toward checkmating her opponent, assessing different strategies and predicting likely countermoves by the opponent. The *motivation* is typically competence need satisfaction.

4.3. The Lens of Intrinsic Skill Atoms

Combining design lenses with skill atoms and intrinsic integration, we arrive at the following (Figure 3):

FIGURE 3. The lens of intrinsic skill atoms.

In pursuing her needs, a user's activity entails certain inherent, skill-based challenges. A gameful system supports the user's needs by both (a) directly facilitating their attainment, removing all extraneous challenges, and (b) restructuring remaining inherent challenges into nested, interlinked feedback loops of goals, actions, objects, rules, and feedback that afford motivating experiences.

1. What motivations energize and direct the activity?
2. What challenges are inherent in the activity? What challenges can be removed through automation or improving usability? What challenges remain that the user can learn to get better at?
3. How does my system articulate these inherent challenges in goals? (How might it articulate them to connect to the user's motivations?)
4. What actions can users take in my system to achieve these goals?
5. What objects can the user act in my system on to achieve these goals?
6. What rules does my system articulate that determine what actions are allowable and what system changes and feedback they result in?
7. What feedback does my system provide on how successful the user's actions were and how much progress she has made toward her goals? (How might I make this feedback clear, immediate, actionable, speaking to the user's motivations, affording a sense of competence?)

This lens articulates the basic structural components of a gameful system and thus sits at the center of our gameful design method. Two modes can be distinguished: The *innovating* mode serves to create a new system around a target user need, whereas the *evaluating* mode serves to improve an already-existing system. Both identify the inherent challenges of the target activity and ideate and iteratively prototype and test (new or amended) skill atoms that structure those challenges in a motivating, enjoyable form, involving additional design lenses.

4.4. Design Steps in Gameful Design

The design process entails five steps (Figure 4): First, the designer determines goals and parameters of the design. Formative research identifies user needs, motivations, and hurdles underlying the target activity. If gameful design is appropriate, the designer moves on to synthesis and ideation. In innovating mode, triplets of activity, challenge, and motivation are teased out and translated into brainstorming triggers for new skill atoms. In evaluating mode, the lens of intrinsic skill atoms is used to tease out the skill atoms already entailed in the existing system. Further design lenses are then used to identify issues and generate ideas for improvement. In both modes, the designer storyboards (new or revised) skill atoms and iteratively builds, tests, and evaluates prototypes of them.

FIGURE 4. Five steps in gameful design.

INNOVATING	EVALUATING
1 Strategy	
a. Define target outcome and metrics	
b. Define target users, context, activities	
c. Identify constraints and requirements	
2 Research	
a. Translate user activities into behavior chains (optional)	
b. Identify user needs, motivations, hurdles	
c. Determine gameful design fit	
3 Synthesis	
a. Formulate activity, challenge, motivation triplets for opportune activities/behaviors	a. Identify skill atoms of existing system for opportune activities/behaviors
4 Ideation	
a. Brainstorm ideas using innovation stems	a. Brainstorm ideas using design lenses
b. Prioritze ideas	
c. Storyboard concepts	
d. Evaluate and refine concept using design lenses (optional)	
5 Iterative Prototyping	
a. Build prototype	
b. Playtest	
c. Analyze playtest results	
d. Ideate promising design changes	
Repeat steps a-d until desired outcome is achieved	
Increase prototype fidelity as playtest results approach desired outcome	

1. Strategy

a. Define target outcome and metrics

Designers first define the target outcome of the design intervention and how it can be quantified—for example, reducing household energy consumption as measured by household electricity meters.

b. Define target audience and activity

Desk research, interviews, observation, or other forms of data gathering identify activities of target audiences that contribute to the desired outcome. The resulting list of audiences and activities is prioritized by (a) presumed effect on the target outcome and (b) which is best facilitated by improving motivation. Based on project scope, one or several activities may be targeted.

c. Identify constraints and requirements

Standard requirements and constraints are assembled: applicable laws and regulations, scope (time, budget, personnel), technological requirements, and so on (Rogers, Sharp, & Preece, 2012, pp. 352–388).

2. Research

a. Translate user activity into behavior chains

To structure research, a behavior chain analysis (Lynch, Chapman, Rosenthal, Kuo, & Linehan, 2006) or similar method (like customer journey mapping) deconstructs complex activities into chains of behaviors by different actors. For instance, if the target outcome is weight loss, one supporting activity would be healthy eating. A behavior chain analysis might then uncover how healthy eating is preconditioned on both not satiating with unhealthy snacks and cooking healthy meals, which is preconditioned by planning meals and buying healthy foods, and so on.

b. Identify user needs, motivations, and hurdles

With this model in hand, motivations and hurdles for the target activity and its behaviors are identified. Motivations and hurdles are elicited with an amended form of laddering interviews (Vanden Abeele, Zaman, & De Grooff, 2012), mitigating typical issues of subjective reports (like postrationalization) by activating memories of and focusing on recent actual events. Thus, for each target activity or behavior, participants are instructed to first recall and describe in detail a recent actual engagement. Only then are they asked why they did so, instructing them to stay with the recalled engagement. For each reason given, the interviewer follows up with "Why is that important to you?" and repeats this multiple times until a terminal motive is reached. This is repeated for motives and circumstances that kept the participant from the activity (see Deterding, 2012, for a full account).

c. Determine gameful design fit

The analysis of needs, motivations, and hurdles allows one to check whether gameful design is an effective and efficient strategy to achieve the target outcome. This is the case if the following questions can be answered in the positive (cf. Werbach & Hunter, 2012, p. 49):

- Does the activity connect to an actual user need?
- Is lacking motivation a central issue or opportunity (and not, e.g., poor usability)?
- Does the target activity involve an inherent challenge with a learnable skill?
- Is affording experiences of competence the most effective and efficient way of improving motivation (and not, e.g., defusing fears)?

3. Synthesis

a1. Innovating mode: Formulate activity-challenge-motivation triplets

For each targeted activity or behavior, motivations and inherent skill-based challenges are identified. The first guiding questions from the lens of intrinsic skill atoms can be used for this:

- What motivations energize and direct the activity?
- What challenges are inherent in the activity? What challenges can be removed through automation or improving usability? What challenges remain that the user can learn to get better at?

Results are presented as clusters in the form *Activity > Challenge > Motivation* and serve as the main input for ideation.

a2. Evaluating mode: Identify skill atoms of existing system

In evaluating mode, the full skill atom lens is used to tease out the implicit skill atom(s) of the existing system. In the case of analyzing an existing car assembly training, for instance, the analysis would ask, What are the goals currently articulated? What actions and objects are learners given? What rules and feedback exist? What challenge and motivation (don't) emerge from this implied skill atom as a result?

4. Ideation

a1. Innovating mode: Brainstorm using innovation stems

One main challenge during developing and using this method was providing a design synthesis that enables non–game designers to create apt ideas. A generally useful means for idea generation is innovation stems (VanPatter, 2012). Instead of simply asking people to "have ideas," innovation stems provide prompts that frame the design problem in an inspiring manner. A known commercial game that entails the same challenge as the target activity proved an especially effective stem. For instance, assembling cars and the early electronic game *Simon* share the core challenge of memorizing sequences. Forced association of two elements also proved useful—specifically, insight combination (Kolko, 2010) of one synthesis result and one design lens. Figure 5 presents the innovation stems that have been most effective in past projects and workshops.

Innovation stems are used as inputs for facilitated brainstorming (Paulus & Coskun, 2012). The facilitator reads one innovation stem aloud and then gives all participants a target number of ideas (e.g., 10) to solitarily write on sticky notes in a set time (e.g., 2 min). Sticky notes are then posted on a wall and explained to the group, allowing individuals to add additional ideas in response.

a2. Evaluating mode: Evaluate skill atom and generate ideas with design lenses

If designers are interested in small amendments, they can ideate promising design changes by applying motivational design lenses (Deterding, 2015) to the identified motives and skill atom components of the target audience existing system. The designer walks through each component of the skill atom and applies the lenses that pertain to that component and/or identified motivations.

FIGURE 5. Innovation stems.

Template:	*"It's like a <commercial game with same challenge> for <target activity>."*
Example:	"It's like Simon for car assembly."
Template:	*"How might we spark <motivation> in <challenge>?"*
Example:	"How might we spark a sense of joint pride in quickly assembling a car without errors?"
Template:	*"How might we use <lens> to make <challenge> more enjoyable?"*
Example:	"How might we use scaffolded challenge to make car assembly more enjoyable?"
Template:	*"How might we spark <motivation> with <lens>?"*
Example:	"How might we spark a sense of joint pride with an underspecified environment?"
Template:	*"How might we alleviate <de-motivating quality> with <lens>?"*
Example:	"How might we alleviate boring repetition with surprising feedback?"

b. Prioritize ideas

Ideas are clustered into affinity diagrams and clusters are prioritized, for example, using group dot voting based on likely effectiveness and efficiency.

c. Storyboard concepts

Prioritized ideas are sketched into initial concepts, allowing the same idea to be developed into multiple concepts. Experiments with supporting this step have led to a template storyboard with six panes and instructions to visualize goal, actions and objects, rules, feedback, challenge, and motivation (Supplementary Material 2). This structured forcing of the systemic whole of a skill atom proved useful for non–game designers.

d. Evaluate and refine concepts with design lenses

If desired, sketched concepts can be evaluated and refined using design lenses (Supplementary Material 1). Again, this has proven useful especially for designers new to game and gameful design.

5. Iterative Prototyping

Concept sketches are translated into working, low-fidelity prototypes and playtested (see Fullerton, 2008, pp. 248–271, for a detailed guide). Failing concepts are discarded, promising ones iteratively developed. The only rule for the kind and fidelity of prototypes is that they should enable testers to actually interact with the core challenge of the skill atom. Paper and craft prototypes often suffice for this. Once the

actual "feel" and usability of individual interactions is tested, digital interactive proto-types are usually in order, using, for example, in-browser prototyping with Javascript or one of the many available game and app prototyping toolkits. For instance, in a project involving gameful learning with online videos, one challenge was betting on an answer related to the content of a running video, with diminishing returns and abil-ity to revise one's bet the closer the video was to completion. A video playing in the browser, a question written on paper, some poker chips for betting, and a timer on a mobile phone sufficed to playtest this core challenge.

4.5. Evolution of the Method

The presented method was developed and refined in 19 design projects and training workshops with more than 300 participants (Supplementary Material 3). Participants were product managers, creative technologists, user experience design-ers, domain experts, and digital advertising creatives. Briefs included financial self-management; online video exploration; car assembly, analytics software, and travel agent training; posting classified ads online; using cloud storage; using social business networks; online dating; and online question-and-answer platforms.

Project teams spanned from two to 12 members, involving typically one gameful designer and, on the client side, product managers, user experience designers, and subject matter experts. Typically, an initial client briefing was followed by establish-ing project goals and constraints, and either reviewing existing or conducting new user research, which was then synthesized into behavior chains, activity-challenge-motivation triplets, and/or skill atoms. Ideation and prototyping was done either by the gameful designer or jointly with the client team in 1- or 2-day sprints typically resulting in playtested prototypes accompanied by a design document outlining goal, rationale, and specifics of the prototyped concept.

Training workshops usually lasted a full day and alternated presentation and design, involving one facilitator and 12 to 120 participants, split into teams of four to six. After an hour-long introduction to gameful design, participants received a brief specifying a target outcome and audience. A workbook offered instructions for each step of gameful design, a template skill atom and storyboard, and a set of 26 design lenses. All participants had access to pens and sticky notes for brainstorming and craft materials for prototyping. Each design step was first explained in a 15-min presentation. Participants then had 10 to 45 min to exercise its instructions.[1]

Projects and workshops were bookended with structured feedback gathering on the method. Participants individually answered four questions on sticky notes: (a) "What did you take away?" (b) "What remained unclear?" (c) "What would you change?" (d) "What would you keep?" Answers were clustered on a wall and dis-cussed in the group. Both sticky notes and discussion results were recorded for analysis, together with informal field notes. After each project/workshop, main issues of the method were identified, promising changes ideated, and tested in the next iteration.

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1. Find a sample presentation and workbook at http://codingconduct.cc/Lens-of-Intrinsic-Skill-Atoms.

The initial version of the method simply presented participants with a skill atom template and examples for each component of the atom (e.g., *CityVille* quests as a form of goals). As a result, participants often imitated whatever game example they thought of, typically creating a competition between users, trying to motivate them with rewards that appealed to material self-interest or social status. There was no concern for underlying user needs or for the challenge inherent in the target activity.

The first revision introduced laddering interviews to sensitize participants to user needs and instructed them to identify the core challenge of the activity. To avoid a myopic focus on components, participants had to develop a high-level idea before refining its individual components, using a storyboard. Yet participants found it difficult to move from identified motivations and challenge to a high-level idea. Concepts mostly mimicked the example presented by the instructor.

In the next iteration, explicit synthesis and ideation steps were introduced, with the innovation stem "How might a game around <challenge> look?" This proved to be too abstract for participants without game design experience. This resulted in the present iteration that introduced commercial games with comparable core challenges and design lenses as parts of the innovation stems. The following case studies demonstrate what kinds of results it produces.

5. CASE STUDIES

5.1. Innovating Gameful Design

The client of this case was an online dating platform for heterosexual adults with more than 11 million users across Europe (2011). Apart from me, the design team included the company's head of product, three product managers, and its user experience design lead.

Strategy

The initial brief was to increase overall user engagement, as measured by the frequency of targeted user actions. The team first prioritized five high-level activities (registration, initiating contact, etc.) for design. The target audience was the total platform population, and the target channel was the online desktop version of the platform.

Research

Drawing on existing in-depth user interviews by the company, each high-level activity was broken into behaviors with connected motivations and hurdles. Checking against the criteria for gameful design fit, three activities were found to (a) support platform goals and user needs, (b) suffer from lack of motivation, and (c) involve a

FIGURE 6.   Profile of target activity "initiate contact".

Activity:	Initiate contact
System owner goal:	high site activity
Metric:	Number of sent contact initiations/day/user cohort
User need:	Find partner
Behavior chain:	Set filters > browse partner suggestions > view partner pro-file > decide to contact > choose form of contact > write contact message > send message
Motivators:	Romantic interest in the other person (relatedness); curiosity in the other person (revealing of hidden images, information)
Hurdles:	Fear of making a bad first impression; uncertainty about ability to make an interesting impression (self-efficacy, competence); fear of rejection (relatedness); fear of disappointment, rein-forced by bad past experiences; lack of inspiring conversation starters; belief that "women don't start conversations, men do"; romantic hope to be "discovered"; unclear what contact options exist and how well they work; unclear what contact options are socially appropriate; unclear whether the other person is still active on the platform

learnable skill, one of which is focused on here: initiating contact. Strategy and research resulted in short profiles of each target activity (see Figure 6).

Synthesis

The overt user need was finding a partner, and the underlying motivations were relatedness and curiosity. Research also indicated countermotives: fear of rejection, disappointment, and failing to write the "right" introductory message. Using the lens of intrinsic skill atoms, the challenge of this activity was identified as choosing and crafting effective introductory communications. Thus, the triplet for ideation was as follows:

> Activity: Initiating contact > Challenge: crafting an effective introduc-tion > Motive: curiosity (+), relatedness (+), fear of failing (−)

The lens further suggested that challenge was poorly balanced: The perceived stakes and difficulty of the activity were enormous and users' perceived ability small, creating a sense of anxiety palpable from the user research data. The connection between activity and goal was unclear for some users, who expected their counterparts to initiate contact. Available actions were poorly articulated: The platform offered a large number of contact options, with no clear indication which were proper or when they are promising. Also, feedback was highly unclear, as users never knew whether a nonresponse was due to a poorly phrased message, the receiver disliking the initiator,

the receiver being busy, and so on. Feedback did not make transparent that one typically needed to initiate contact with multiple users to get a response. Browsing through the available lenses, *templates, constrained choice*, and *actionable feedback* were chosen as lenses that seemed to speak directly to these identified issues.

Ideation

The whole design team brainstormed over mixed forced pairings of stem parts, such as

How might we alleviate fear of failing with constrained choice?
How might we spark curiosity in writing an effective introduction?
How might we use templates to make writing an effective introduction more enjoyable?
How might we spark curiosity with templates?

A facilitator posed a single innovation stem to the team, and the team then had 2 min to note as many ideas as possible, after which the facilitator moved on to the next stem. For initiating contact, 26 ideas were generated. These included suggesting random, over-the-top starting phrases; a scaffolded series of recommendations how to write messages that would be progressively unlocked as users adhere to them; a counter comparing the user's current total of sent messages with the average number of messages it takes to receive a response; and a random challenge generator that would combine a piece of information from the other user's profile with an absurd constraint (e.g., "ask about his/her holiday without using the letter 'a'"). Team members then distributed three points among ideas for each target activity to mark favorites, prioritizing 10 ideas for storyboarding. A total of 20 storyboards were developed with some ideas receiving multiple treatments. The following concept, "picture match," was eventually not chosen for implementation but can therefore be freely shared (see Supplementary Material 4 for the storyboard).

"Picture match" was inspired by the forced pairing of *lacking competence* (motivation) and *constrained choice* (design lens). In short, it is a gamelike challenge offered as an additional contacting form. The initiator takes the following actions upon the following objects: She randomly generates a series of postcards depicting various places, objects, and people. She then writes a question like "Where would I most like to be right now?", orders the postcards accordingly (from most to least fitting), and sends the result as an invitation. When the recipient opens the invitation, she sees the initiator's question, a link to her profile, and the postcards as a scrambled heap next to an array of slots. Her goal is to put the images in the order in which the initiator put them. The inherent challenge is to infer the initiator's preferences based on her profile. After submitting a guess, the recipient can order the images according to her own preference. After the initiator receives her response and guesses her order, both guesses and orders are revealed. The reveal screen entails invites the user to respond with follow-up messages on each (mis)matching couple of images.

Prototyping

The interaction was later prototyped and playtested: two oversized cardboards presenting a "mad lib" form with blanks for questions and photos, and a result screen, papers with brief fake user profiles for the designers, pictures printed from an online image search for "holiday photos," and paper cutouts for screen overlays and messages. Results indicated that the core interaction was working. However, "cheesy" stock images were felt to potentially reflect badly on the sending user (suggesting building a good image pool). Also, coming up with a good question was seen as potentially too effortful or anxiety inducing (suggesting that the system could suggest sentences).

5.2. Evaluating Gameful Design

In this case, the client was an online social network for business contacts with more than 12 million users (2012). The design team consisted of me and a user experience designer, with occasional help from the larger user experience design team.

Strategy

The brief was to increase registered users through contact requests by existing users, measured by successful invites sent per user. Using existing data-based personas, the target audience was identified as tech-savvy young professionals who had just started their career: intent on (online business) networking but new to it. We focused on the network's desktop web presence.

Research

We created a behavior chain of the existing web presence for users sending contact requests. Using laddering interviews with target audience members, we identified motivations and hurdles for each step (see Figure 7). The main identified motives were being able to quickly retrieve contact information of even older contacts and social status gains in being visibly connected to "relevant" persons. The network also offered a free month of premium services for successfully inviting a number of new registrants.

We determined that adding contacts was a partial fit for gameful design: Of all involved behaviors, writing fitting invitation messages (and to a lesser extent, choosing the right people to invite) were the only ones that involved any challenge and learnable skill.

Synthesis

We translated choosing whom to invite and writing invitations into a skill atom (Figure 8) whose individual components we evaluated with design lenses. It immediately became apparent that the current interface did not provide goals that structure user activity and provide a sense of progress, something all the more important as the

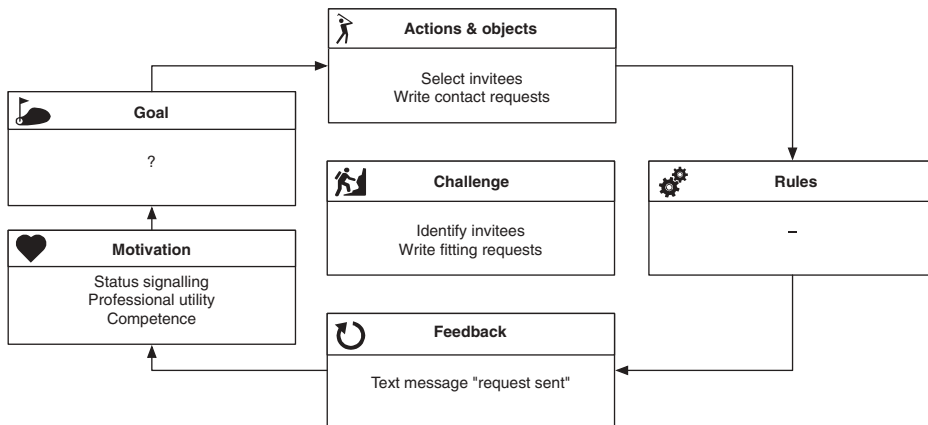**FIGURE 7. Behavior chain of adding contacts with motivations and hurdles.**
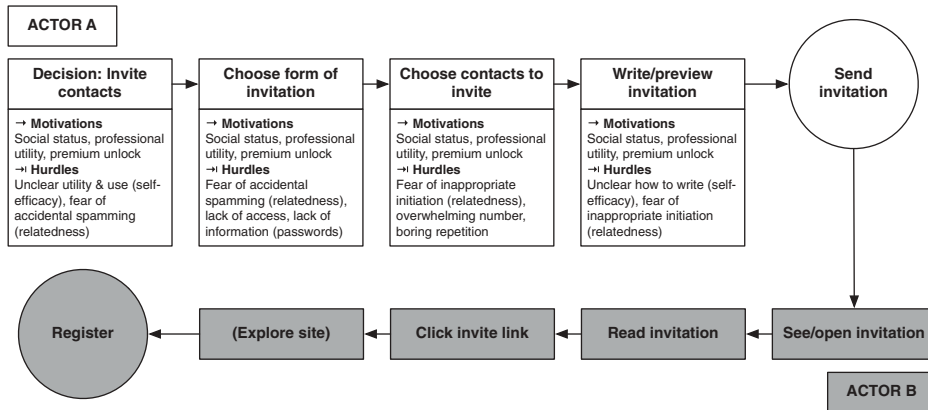
FIGURE 8. Skill atom of inviting contacts.

number of contact discovery options (address book, Facebook contacts, etc.) and lists of invitees were perceived as overwhelming (lens of *interim goals*). Also, the system did not offer any calls to action what to do next after having added contacts (lens of *next best actions*).

The actions and objects of choosing whom to invite failed to limit, highlight, and structure choices into clear and easily doable chunks (lenses of *bite-sized actions* and *limited choice*). Instead of one uninterrupted one-click loop of action and feedback (lens of *microflow*), users had to wade through long lists, marking/unmarking contacts to invite, constantly moving the cursor across the whole screen. Contacts (and marking them) were presented in a standard, bland web form look that did not invite interacting (lens of *sensual objects*).

The feedback on sending a contact request consisted of a single text line stating "contact request sent." It was neither juicy, nor varied, nor surprising (lenses of *juicy, varied*, and *surprising feedback*). It was also protracted and insufficiently helpful (lenses of

immediate and *actionable feedback*): The user could wait days to see whether an invitation was successful, and only if she intentionally clicked her way multiple steps through the menu to see a list of outstanding invitations. Users likewise received no progress feedback of any kind (lens of *graspable progress*).

The challenge of inviting contacts in the existing interface was an exercise in pure diligence, with no increasing complexity (lens of *scaffolded complexity*) or variation (lens of *varied challenge*). Nor were users introduced to and guided through inviting contacts (lens of *onboarding*). Finally, neither feedback nor the overall skill atom appealed to the underlying motivations of signaling social status or "saving" contacts to an auto-refreshing contact list (lens of *appeal to motives*).

Ideation

We generated ideas for selected issues, using the focusing questions of the respective lenses, noting down and clustering a total of 25 ideas. One cluster revolved around social comparisons to reduce the fear of impropriety and appearing "spamming," for example, displaying "XX% of your contacts have synchronized their address book to always keep their contacts up to date" together with a linked call to action. Other clusters revolved around appealing to motivations, juicy feedback, and guiding and chunking contact options to create a sense of progress.

Prototyping

Using presentation and prototyping software, we created clickable prototypes for the user flow of a newly registered user adding contacts that integrated the developed ideas. We focus here on one single interface element that illustrates the kinds of ideas generated. Figure 9 shows one feedback overlay displayed on successfully inviting users through importing contacts from other platforms. It showcases an *appeal to motives* ("34 addresses that will soon be automatically kept up to date for you") and *next best action* ("synchronize contacts from your address book?"), but also *juicy feedback*: the number of invited contacts dissolves into an animation of butterflies that

FIGURE 9. Screenshot of a success message prototype.
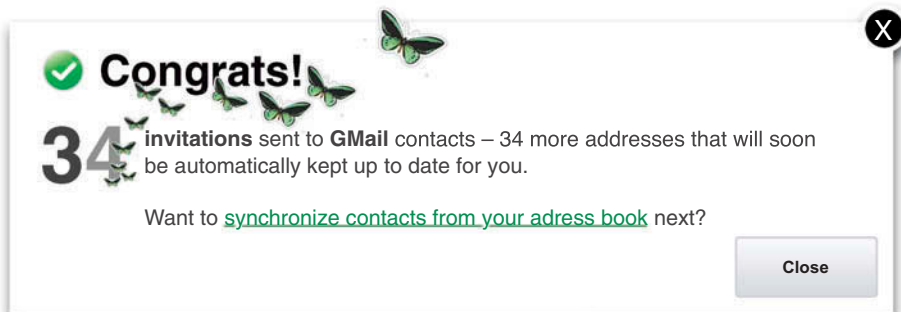
fly across the interface. The more contacts invited, the bigger the number displayed, and the more butterflies rise up. Also, butterflies change unexpectedly with the kind and number of invitations, creating *varied feedback*. Animated butterflies fly and "disappear" into the "contacts" wing of a larger butterfly in the sidebar, which visualized progress in the four dimensions of a "well-rounded" profile: contacts, profile completion, events, and group memberships. This provided *interim goals* and *graspable progress* (see Supplementary Material 5).

6. DISCUSSION

6.1. Evaluation of the Method

Gameful design aims to facilitate users' pursuit of their work and everyday needs through interactive systems by affording the motivating, enjoyable experiences characteristic for gameplay. To address the lack of research-based guidance on gameful design methods, we analyzed the characteristics of gameplay experience, how game structures afford them, how game design creates these structures, and how to translate this into interaction design, arriving at a list of six criteria (see next).

A review of existing gamification methods showed them to be pattern-based, data-driven, and wedded to an inherent-additive paradigm of motivation and enjoyment, failing the criteria. In response, we presented an alternative method for gameful design, the lens of intrinsic skill atoms: Its core premise is to identify the skill atoms of the challenges inherent in the user activity and restructure them to optimally afford motivating experiences, using design lenses and iterative prototyping. This method meets all six criteria:

Designing for basic need satisfaction, specifically competence (because these are the motivating, enjoyable experiences characteristic for gameplay): Laddering interviews identify user needs and underlying basic needs. The skill atom incorporates these as target experiences and is purpose-designed to afford competence need satisfaction through overcoming challenges.

Designing around inherent skill-based challenges (because overcoming challenges is the core gameplay dynamic affording competence, and because adding artificial challenge to a system supporting functional needs engenders frustration): The method explicitly teases out the target activity's skill-based challenges. The skill atom is organized around this inherent skill-based challenge, and it serves both as ideation input and evaluation focus.

Designing for systemic emergence (because challenge, motivation, and enjoyment are emergent affordances): The skill atom brings together the systemic whole that affords a central challenge and motivation. Design lenses target qualities of the systemic whole of an interaction. Through iterative experiential prototyping, the method helps observing and designing toward actual emergent challenges, motivations, and experiences.

Formative research (because gameful systems need to support given user needs, activities, and challenges inherent in them): The method explicitly includes formative

research with specific instructions how to elicit user needs and inherent challenges in a given activity.

Design synthesis of formative research into a form useful for ideation and prototyping (because such bridging has been lacking, even in serious game design): The skill atom and activity, challenge, motivation triplet synthesize research into a form useful for ideation, complete with specific instructions how to do so.

Epistemic mobilization of game design (because its epistemic objects otherwise remain unintelligible to interaction designers): The lens of skill atoms offers a conceptual tool to view a given activity as a game(like) systemic whole. Design lenses further articulate insights and concepts of game design into a self-contained form that is easily intelligible and applicable for interaction designers.

6.2. Limitations and Future Work

Although the presented method has been tried and refined in many practical settings, it lacks a formal empirical evaluation of its utility and usability. This is the next intended step.

Second, the method intentionally focuses competence experiences through challenge, although the spectrum of motivating and enjoyable experiences in gameplay is larger by far. Like game design, the method in principle allows skill atoms to be "tuned" to different motives, using design lenses. Still, the structure of skill atoms remains chiefly concerned with competence. Connected to this, the method intentionally focuses on gameful design not playful experiences, although entertainment games regularly afford both. In recent projects, participants were invited to alternatively create playful "possibility atoms" organized around an explorable possibility space, together with supporting lenses. Yet it remains to be seen whether the presented method can be expanded to fully accommodate for playful and motivational design writ large.

Finally, gameplay enjoyment and motivation are deeply contextual (Deterding, 2014a). As noted, the social *reframing* of situational engagement with a system is likely just as important as its material *restructuring* to facilitate gameful experiences (Deterding, 2014b). However, we are just at the beginning of understanding the contextual dimension of game enjoyment.

6.3. Outlook and Ramifications: Toward Interaction Aesthetics

In 1988, Carroll and Thomas (1988, p. 23) called for "a research program in fun and motivation." A quarter century later, Hassenzahl (2010, p. 43) replied: "User Experience is this program." Yet when it comes to actually *designing* for fun and motivation, game design has long been (more) forthcoming than HCI. Together, they give us the necessary pieces: here the formative research and evaluative assessment, there the experience-centric design process. Gameful design is a first example of how to put HCI and game design together. Thus, its larger promise is to offer a blueprint for experience-driven design in general.

We used design lenses to translate game design insights for interaction design. An obvious area of future work beyond gameful design is using lenses as vessels for insights from other fields. Skill atoms provided an abstract framework for the emergent nature of gameplay, and iterative prototyping a method to approach the experiential goal set out in a skill atom. This might also be a generalizable approach to designing for any kind of experiential quality: iterative experiential prototyping grounded in a formal abstraction of the material-social-psychological system underlying an experience. Although these endeavors leave the realm of gameful experiences behind, game design might remain a fruitful source of insight: After all, games integrate visual design, music, narrative, and so on, into one *Gesamtkunstwerk*. If games are interactivity *as* aesthetic language (Lantz, 2011), gameful design might be a first Rosetta Stone that helps us in deciphering it.

NOTES

Supplementary Data. Supplementary data for this article can be accessed at www.tandfonline.com/doi/10.1080/07370024.2014.993471. The supplementary material includes sample design lenses, a storyboard template, a list of design projects, a picture match storyboard and details about the second case study.

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Supplementary material for the article, "The Lens of Intrinsic Skill Atoms: A Method For Gameful Design," by Sebastian Deterding, published in *Human-Computer Interaction*

Supplementary Material 1: Sample design lenses

Challenge lenses

Scaffolded complexity — CO

To neither bore nor frustrate, good challenges grow with the user's skills.

•How might you track the user's skill growth?

•How can you increase the difficulty and choice of available goals and actions with the user's skill?

•How might you turn »more of the same« into »different«, »more complex«?

•How might you automate away what the user has mastered?

Varied challenge — CO

Good challenges vary to give the user experiences of mastery and not become boring.

•How might you vary the challenge – in used elements, themes, constraints, or ways of doing things?

•How might you give the user moments of excelling at something?

Onboarding — CO

Good challenges make learning the system intentional part of the experience for newcomers.

•How might you create a strong want in the user to start?

•How might the user experience success in the first minute?

•What is the core goal-action-feedback loop of your system? How might the user learn it by doing it in the first minute?

Icon for atom component (**here: challenge**)

Name of lens

Onboarding — CO

Short code of main motive(s) supported (**here: COmpetence**)

Good challenges make learning the system intentional part of the experience for newcomers. → **Design principle**

•How might you create a strong want in the user to start? → **Focusing questions**

•How might the user experience success in the first minute?

•What is the core goal-action-feedback loop of your system? How might the user learn it by doing it in the first minute?

Goal & motivation lenses

Interim goals   CO

To support a sense of progress and direction, structure the user's path with clear interim goals.

- How might you show the path to mastering the core challenge through explicit or implicit goals?
- How might you break down over-sized tasks with interim goals?
- How might you give the user a sense of freedom of choice what goal to pursue when?

Viral calls to action   RE

Good games use A's actions to call B to action – and vice versa.

- What actions by other users would prompt a user to act?
- How might you make these actions of others visible to the user?
- How might you offer to the user to directly react to that in response?

Next best action   AA

To maintain flow, good goals suggest the next best actions.

- In the given context, what would be the next best actions to take?
- How might you suggest these actions to the user – without taking away interesting choice?

Intrinsic rewards   MO

To avoid coercing users or devaluing the activity, rewards should support intrinsic needs.

- How might you reward the user's success with …
  - more possibilities & choices?
  - a sense of social connection?
  - a palpable growth of skills?
  - more potent tools & content?
  - in general, satisfying the driving motivation & emotion?

Secrets   CU

Good calls to action stoke curiosity by hinting at something hidden.

- What would your user be genuinely interested in?
- How might you hide that – and then hint at its existence?
- How might you leave open, how something works – such that the user finds can find it out through exploration, without becoming frustrated?

Templates   CO

Things to adapt are easy invitations that ease over the fear of the blank page.

- Can you provide a construction manual?
- Can you provide some randomly generated starting point?
- Can you provide a constrained set as starting point?
- Can you offer something half-done?
- Can you offer something to adapt?

Traces of others   CO

Traces of what other people did are inspiring invitations to follow them.

- How might you show what other users did?
- How might you allow users to take and adapt what others did?

Action & object lenses

Bite sized actions — CO

Well-designed actions are split into an immediately doable size that gives the good feeling of having accomplished something.

•How might you split activities into immediately doable chunks?

•How might you reduce actions into single clicks/swipes?

Interesting choices — CO AA

Well-designed actions provide only interesting choices.

•Does the action have a real impact on future events relevant to the user?

•Are there trivial, mindless, routine decisions or steps you can hide or automate away?

•Can you offer multiple different ways to the same result that differ meaningfully?

Limited choice — CO

Well-designed actions do not overwhelm users with too much choice.

•How might we limit the number of actions offered?

•How might we highlight important actions?

Micro-flow — CO AA

Well-designed actions form an uninterrupted loop of immediate action and feedback.

•Is there a small repeated activity in your application or service?

•How could you reduce it to a tight loop of one click/swipe and one immediate feedback comprising congratulation and next suggested action?

Small pieces, loosely joined — AU

Resources inviting exploration and creativity are like Lego bricks: They can be easily assembled, reassembled, and disassembled.

•What is your »Lego brick«?

•How might you enable users to easily (re)assemble it?

Expressive objects — ID

With good resources, users can express who they are, want to be, and belong to.

•How might your users create something that is definitely them?

•How might your users create something unique?

•How might your users create something that shows who they belong to?

Under-determination — AU

To invite exploration and creativity, good resources have no clearly prescribed space of possible uses and configurations.

•How might you leave blanks to fill out for your users?

•How might you design resources so that you cannot fully predict what users will do with them?

Sensual objects — CO

With good resources, exploring their (pseudo-)physical properties is a joy.

•Digital: How might you make clicking, swiping, typing »tactile«?

•Physical: How might our object be a joy to touch, listen to, look at?
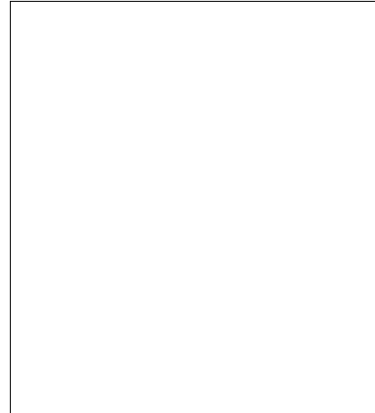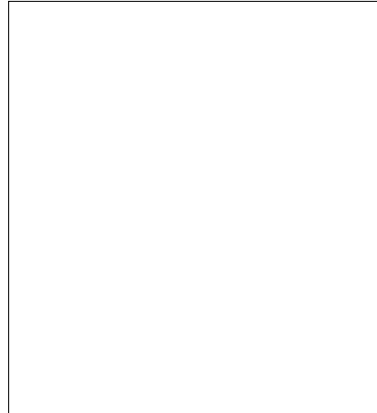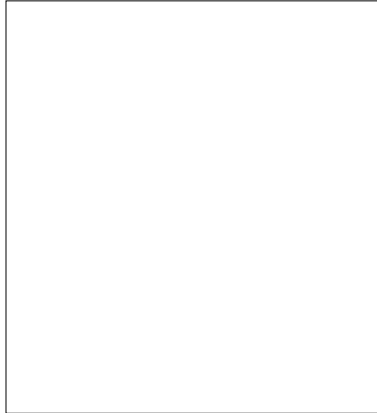
Feedback lenses

⟳ Immediate — CO

To reduce friction and not break flow, good feedback occurs right where and when the action occurs.

• How might you provide feedback *immediately* after the action?

• How might you provide feedback *right* where the action occurs?

⟳ Juicy — CO

Excessive, varied sensual positive feedback can instil competence, curiosity and surprise.

• What are the small steps of the action? When does a user achieve some goal with that action?

• How might you exaggerate the auditory, visual, and tactile feedback at these moments – without getting in the way of a user's goal pursuit?

• Is there a material or creature with enjoyable sensual properties that might inspire your feedback?

⟳ Actionable — CO

To foster learning and competence, good feedback tells users how successful they were – and how to improve.

• How might you vary feedback based on the users degree of success?

• How might you include tips for improvement in feedback?

⟳ Appeal to motives — MO

Good feedback elicits the emotions and motivations that drive the activity.

• What motivations and emotions driver your users to engage in your target activity?

• How can you appeal to them in image, sound, text?

⟳ Glanceable — CO

To not break flow, good feedback does not get in the way of taking the next action.

• How can you give feedback without covering the main object of attention?

• How can you give feedback without getting in the way of the user taking the next action?

⟳ Varied — CU

To remain interesting, good feedback varies without being unlearnably or confusingly inconsistent.

• How can you create meaningful variation in feedback with minimum effort?

• How might you make the variation juicy, actionable, and informative?

⟳ Surprising — CU

To stoke curiosity, good feedback is surprising.

• Are there pleasant unexpected surprises you can integrate?

• How might you vary feedback using a probability distribution?

• How might you hide some easter eggs to drive exploration?

• How might you pleasantly supersede expectations to induce amazement?

▭ Graspable progress — CO

Good feedback makes the current status and progress of the user graspable.

• How might you make sensual, tactile what the user has already achieved?

• How might you use progress indicators to suggest next goals to the user?
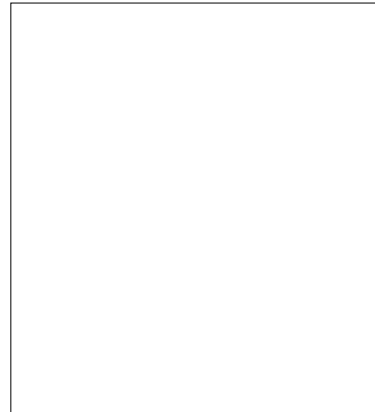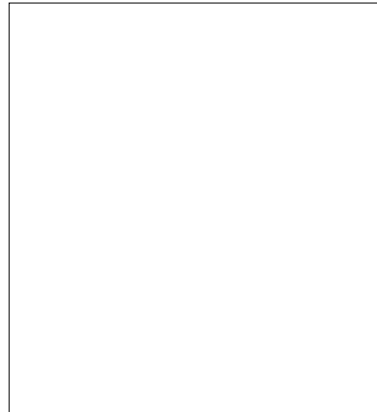
Supplementary Material 2:

Storyboard template

Skill Atom Storyboard

Title

Core idea

Elements

Motivation What motivation fuels the user? How is that motivation satisfied?

Goal What goals does the user pursue? How are they suggested to the user?

Action & object What does the user do with what to achieve that goal?

Challenge What's the learnable challenge inherent in the activity?

Rules What are rules & constraints?

Feedback *Immediate*: How does the user learn about the success of her action? *Progress*: How does the user learn about her progress toward her motive over time?
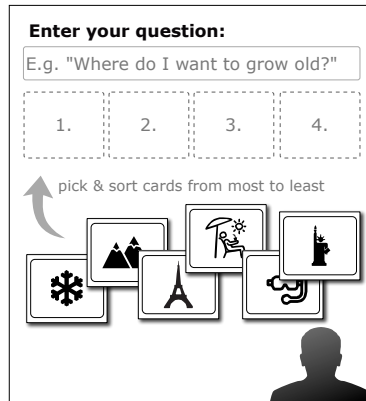
Supplementary Material 3:
Design Project List

| Type	Brief	Participants*	#
Project	Financial self-management (desktop/mobile)	3 game designers, 2 subject matter experts, 2 software developers, 1 marketer	8
Project	Writing online classified advertisements (desktop/web)	3 product managers, 2 UX designers, 5 software developers	9
Training	Ad campaign for social music sharing (desktop/web)	27 digital advertising creatives	27
Training	Ad campaign for consumer cloud storage (desktop/mobile/web)	21 digital advertising creatives	21
Training	Smoking cessation (mobile)	24 advertising creatives	24
Project	Social engagement around watching live soccer games (mobile)	2 UX designers	2
Training	Adding contacts on business social network (desktop/web)	16 UX designers	16
Project	Adding contacts on business social network (desktop/web)	2 UX designers	2
Project	Discovery and informal learning in online video archives (desktop/web)	2 game designers, 1 UX designer, 2 business consultants, 1 subject matter expert	6
Project	Self-learning of big data analytics software (desktop/web)	1 CEO, 1 CTO, 1 CMO, 2 marketers	5
Training	Facilitating social connections for new employees (any platform)	12 product managers, UX designers, marketers	12
Project	Contacting others on online dating platform (desktop/web)	1 UX designer, 4 product managers	5
Project	Online question and answer platform (desktop/web)	1 UX designer, 1 marketer, 1 project manager	3
Project	Online learning for travel sales agents (desktop/web)	2 digital advertising creatives	2
Training	Writing more online classified advertisements (desktop/web)	23 product managers	23
Training	Financial self-management (desktop/web)	120 UX designers	120
Training	Financial self-management (desktop/web)	30 UX designers	30
Training	Car assembly training (analog/physical)	5 product managers, 2 marketers, 2 innovation managers, 4 subject matter experts	13
Project	Car assembly training (analog/physical)	1 product manager, 2 game designers, 4 subject matter experts	7
* Participant count excludes lead gameful designer			

Supplementary Material 4:

Picture Match Storyboard

Skill Atom Storyboard

Enter your question:

E.g. "Where do I want to grow old?"

| 1. | 2. | 3. | 4. |

pick & sort cards from most to least
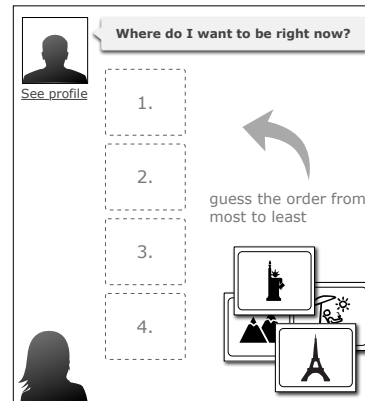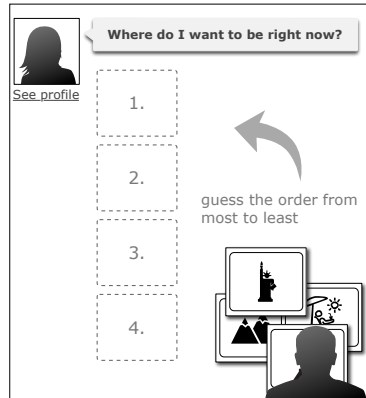
Action & object: User A writes question, picks and sorts images according to his personal order of preference. **Rules:** He has to pick from a random predefined set of images.
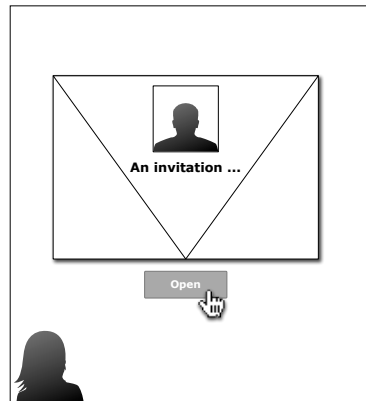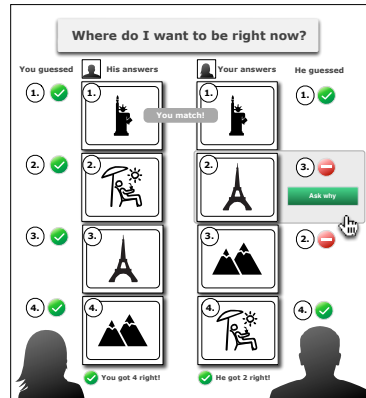
An invitation ...

Open

Action & object: User B receives and opens an invitation to the picture match started by user A.

Where do I want to be right now?

See profile

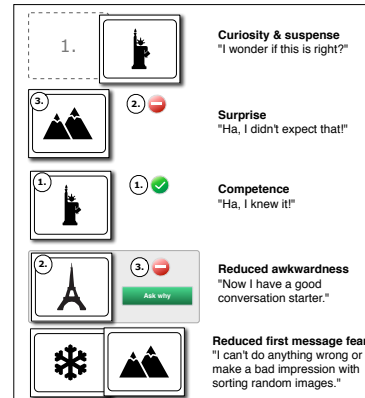| 1. |
| 2. |
| 3. |
| 4. |

guess the order from most to least

Challenge: Infer the other user's preferences based on viewing his or her profile. **Goal**: Bring the images in the order the other user put them.

Where do I want to be right now?

See profile

| 1. |
| 2. |
| 3. |
| 4. |

guess the order from most to least

Action & object: User B likewise puts the images in her order of preference. User A receives a notification that user B has answered and now has to guess her ranking.

Where do I want to be right now?

You guessed   His answers   Your answers   He guessed

You match!

Ask why

Ask why

✅ You got 4 right!   ✅ He got 2 right!

Feedback: User A and B see how many guesses each one got right and where they match. They can send a message on each answer and match to start a conversation.

1.

3.   2.

1.   1.

2.   3.

Ask why

Curiosity & suspense
"I wonder if this is right?"

Surprise
"Ha, I didn't expect that!"

Competence
"Ha, I knew it!"

Reduced awkwardness
"Now I have a good conversation starter."

Reduced first message fear
"I can't do anything wrong or make a bad impression with sorting random images."

Motivation: Sorting and guessing image orders reduces the fear of writing an awkward first message and gives conversation starters. It also generates curiosity, surprise, and competence.

Title
Picture Match

Core idea
Users send each other image post cards and a question like "my favourite holiday". Users rank post cards according to the question and have to guess the ranking of each other.

Elements

Motivation What motivation fuels the user? How is that motivation satisfied?

**Goal** What goals does the user pursue? How are they suggested to the user?

Action & object What does the user do with what to achieve that goal?

Challenge What's the learnable challenge inherent in the activity?

Rules What are rules & constraints?

Feedback *Immediate*: How does the user learn about the success of her action? *Progress*: How does the user learn about her progress toward her motive over time?

Supplementary Material 5:
Case Study 2 Sidebar Prototype
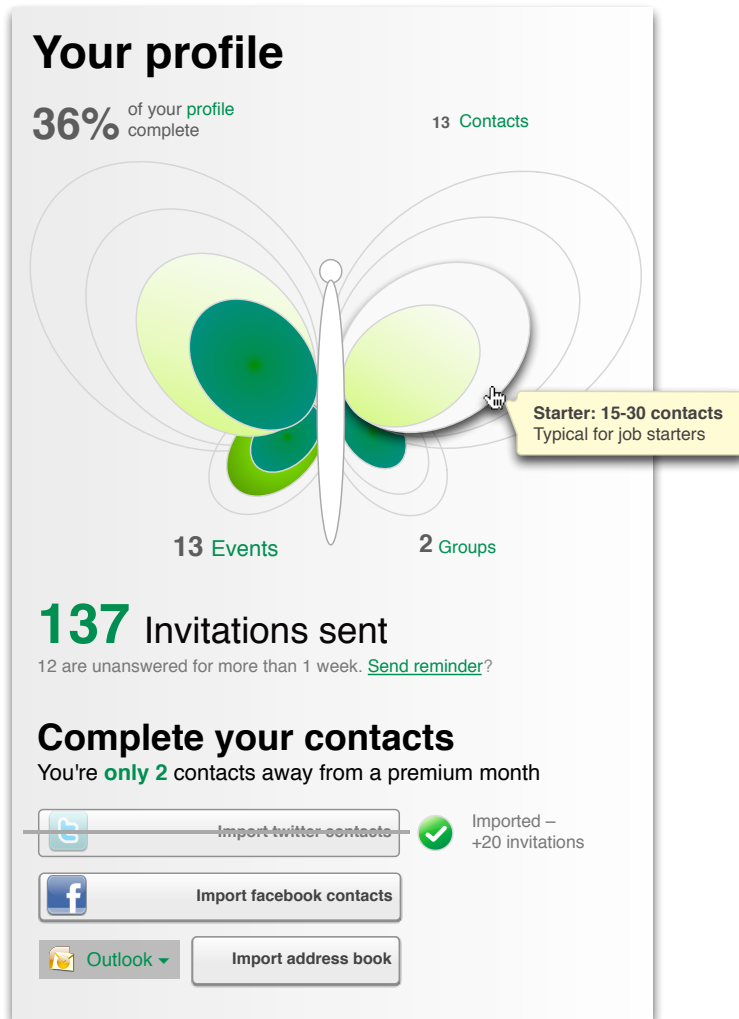
The figure shows a persistent sidebar we suggested to add to the interface. The design introduces a butterfly as a visual representation (*sensual objects*) of the dimensions a "well-rounded" business network shows: membership in groups, attending events, a completed profile, and a certain number of contacts. As the user progresses in each dimension, additional portions of the respective wing are filled out, with tooltips explaining the numbers and relevance of the different "levels", presenting *interim goals* and *graspable progress*. Underneath the butterfly and a reminder of unanswered invitations comes a checklist whose content changes as the user progresses in "levels". Not only does it hold a direct appeal to motivations ("You're only 2 contacts away from a premium month"): the checklist again provides *graspable progress,* suggests *next best actions*, and functions as a form of *onboarding*.