The Benefits of Considering Psychological Reactance as Users' Personality Trait in HCI Research

Profiling Users with Hong's Psychological Reactance Scale

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Keywords: Psychological Reactance, User Models, Personality Traits, Adaptation.

Abstract: This paper argues for considering psychological reactance as a personality trait as an aspect for user models in the field of human-computer interaction (HCI). It is pointed out that with increasing human-likeness of services, such as intelligent personal assistants, phenomena from human-human interaction are becoming more important in the field of HCI, as well. The concept and means of measuring psychological reactance are explained. Furthermore, methods for adapting to different levels of trait reactance are proposed and discussed.

1 INTRODUCTION

Usability and user experience research has successfully established a set of metrics and requirements for the assessment and design of human-computer interaction for years. For example EN ISO 9241-11 states effectiveness, efficiency and user-satisfaction as the main criteria for usability (ISO 9241-11, 1999). This criteria are perfectly valid and have been so for decades and for most machines, devices and services. Modern services, such as Apples Siri (Apple Inc., 2011) however, have introduced a new aspect to human-machine interaction: human-likeness.

Even though there have been anthropomorphous robots and services that were intended to act human-like before, they have usually lacked the level of artificial intelligence and flexibility that would have been required to be really convincing. Modern intelligent personal assistants (IPAs) have reached a level of complexity and naturalness of interaction that has not been possible before. Several features and aspects of interaction that have been implemented into the most popular IPAs (Siri, Cortana (Microsoft, 2014), Google Now (Google Inc., 2012)) are probably responsible for this. Six of those features are listed below, but do not necessarily represent the complete list.

Natural Language Understanding. The first one, natural language understanding, can greatly improve the naturalness of human-computer interaction because it allows users to interact with the device in the same modality, as they do with other humans in their everyday life [1]. While natural language interaction is not always the most precise or fastest interaction modality, it has become more important with the increased use of small mobile devices, that have the inherent lack of effective input devices, such as (large) keyboard and mouse. Also, natural language understanding provides hands-free interaction for situations in which the user might not be able or willing to use other means of interaction, such as when driving a car.

Personality. Siri and Cortana have a their own personality that is reflected in their behavior and their voice. Both have human-like voices that can easily be assigned to a specific gender. Cortana is often associated with a face that initially appeared in the computer game "Halo" (faturing a holographic, fictional version of cortana). On requests, both IPAs are able to tell nerdy jokes or talk about their private interests. Additionally, they can get bored or annoyed by a conversation and respond with irony or switching the topic.

Adaptivity. Adaptivity is a feature that enables an IPA (or any other service) to adapt to its environment or its user. For example, Google Now can analyze its user's browsing behavior, identify topics of interest and then recommend new web-content that fits

[1] Even though other modalities, such as gestures, gaze etc. take a big part in this, as well, spoken language is the most salient one.

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The Benefits of Considering Psychological Reactance as UsersâĂŹ Personality Trait in HCI Research - Profiling Users with HongâĂŹs Psychological Reactance Scale.
DOI: 10.5220/0006265301580164
In *Proceedings of the 12th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2017)*, pages 158-164
ISBN: 978-989-758-229-5

the assumed interests of the user. Also, IPAs usually take environmental information, such as the location, into account for recommendations of e.g. restaurants. This gives the IPAs a rough awareness of the context of the interaction, at least in the impression of the user.

Proactive Behavior. Proactive behavior is often combined with adaptation to the user or the environment. The IPA can use data of its user in order to actively recommend content or services to the user. Some example of Google's Now are: The service can infer from moving behavior and other information, where its user works and offers navigation for the fastest way home on its dashboard when work is finished (or it inferred, that work should have finished). Also, it can find boarding cards in the user's emails and present it proactively (in the dashboard) on boarding time. Proactive behavior is usually the expression of an agenda or intend and therefore probably a feature that adds strongly to the perceived human-likeness of IPAs. But proactive behavior implies that the initiative for an action comes from the system, thereby taking away some control over the situation from the user. This makes proactive behavior especially critical for highly reactant users, as explained later on.

Complex Feature Set. Sophisticated IPAs are not only recommendation and conversation services, they also feature a wide set of other functions. Thereby, they act as an interface to other apps of the smart phone or even devices of the smart home with which they are connected. E.g. the feature set of Siri includes managing calendar entries, writing emails, writing notes, open calls, control smart home devices and answer all kinds of requests from fact queries to singing songs. The complex set of feature makes it unpractical to thoroughly evaluate such a service in terms of its usability properties, because all functions would have to be evaluated under reliable conditions. Also, it becomes impossible or at least not reasonable for the user to grasp the complete functionality of such a service. This is even amplified by the fact that IPAs usually do not work locally but are web-based services and new functionalities can be implemented, changed or removed without knowledge of the user. The uncertainty about the abilities of a service adds to the human-likeness of interaction because the user is not able to fully understand the limitations of that service. This might imply an intelligent interaction partner to the human.

Hierarchy. Humans are used to be in a supreme position towards the devices that they use. In the traditional interaction paradigm, humans are taking the initiative and control the machines that they interact with. In modern IPAs and some other services and devices, this paradigm is not fully applicable, anymore. Such services or devices sometimes take the initiative themselves, or autonomously adapt to changes in the situation. They express a certain level of autonomy, which might reduce the hierarchy gap between the service or device and the user.

The above stated features of IPAs and some other services and devices are reasons that make a broad, systematic usability evaluation with traditional methods a hard task. The results will be difficult to interpret and reliability will be poor, because users will react very diverse to many of those features. Just as in human-human interaction, factors that are not mere performance indices, such as behavioral patterns of the service or social presence of an IPA might play an increasing role alongside increasing human-likeness. For example, a study with elderly people observed that users' reactions towards persuasive attempts are more positive if the persuasive agent showed social behavior, such as humans do (Looije et al., 2010). On the other hand it was observed that highly conscientiousness people like agents that show social behavior less, compared to other people (Looije et al., 2010). In order to gain a more complete and meaningful overview of such a system for both, sumative and formative evaluation, new metrics are needed that can access affective user states and personality traits and thereby help to build heuristics about a user's preferences. In this paper, it is argued, that such heuristics can lead to more acceptance among users.

There are multiple character traits and affective states that potentially play a role in the interaction between humans and human-like devices and services. Among those, probably the big five personality traits (Goldberg, 1993), that were used by Looije et al. to investigate users' preferences for agent based intelligent assistants (Looije et al., 2010), are the most commonly known. For this work, however, reactance as a personality trait is in focus. This is due to reactance going along with diminished acceptance (Dillard and Shen, 2005; Ehrenbrink et al., 2016a), what probably makes reactance one of the more important and interesting factors for HCI developers. Further, the discussion will mostly include reactance as a personality trait, in contrast to reactance as an affective state. Personality traits can be used to create a personality profile of a user which would need to be created only once and would rarely require actualization. The assessment of users' state reactance would require constant or very frequent measurements and can be considered as impractical for the lack of appropriate me-

asurement techniques. During further discussion, several examples on how to employ reactance measurement in HCI will be given. As the aim of this paper is to explain the concept of reactance and to argue for its benefits and possible applications in HCI research and design, only two simple use-cases will be given. The seat belt alarm of cars and a fitness application utilize basic interfaces and their functionality is not complex. Here, only few factors apart from reactance have to be considered. This makes those use-cases easier to explain, compared to a full-scale IPA.

2 PSYCHOLOGICAL REACTANCE

Psychological reactance is a concept from psychology that was initially introduced by (Brehm, 1966). Brehm described reactance as a motivational state that effects a persons behavior towards a perceived threat to the personal freedom or freedom of choice. Therefore, a person that has received, or thinks to have received, a freedom threat will become reactant. As a consequence, the option that has been eliminated by the freedom thread will appear more attractive to that person as it would have been otherwise (Brehm and Brehm, 1981). On the other hand, the source of the freedom threat, e.g. the person who denied an certain freedom will be downgraded in its judgement and appear more negative (Brehm and Brehm, 1981).

Also, that person will experience a cognitive dissociation because he or she wants to exercise a certain freedom but is forbidden or unable to do so. In order to then solve the cognitive dissociation, the person will try to restore the threatened freedom. This can be done either directly, or indirectly (Brehm and Brehm, 1981). A direct attempt to restore the threatened freedom would be to directly exercise the threatened freedom. For example, if a child is denied a cookie, it might wait until the parents leave the room and then get a cookie even though it is forbidden. Directly restoring a threatened freedom is however often regarded as antisocial and therefore, the cognitive dissonance is often resolved indirectly. This can be done by exercising another freedom that is not threatened but somehow similiar to the threatened one. Even though that other freedom was not threatened, exercising it can restore the freedom that was lost (Brehm and Brehm, 1981). The child whose parents denied it a cookie would then, instead of secretly eating a cookie, secretly eat some grapes and by that recreate its freedom.

Finally, a coping strategy that can be exercised is denial of the freedom threat. This can often be the case if the freedom threat is ambiguous or unclear (Brehm and Brehm, 1981). Denial of the freedom threat has the advantage that a freedom restoration is not necessary. Therefore, simply ignoring or denying the threat, without further acting against the prohibition (because this could invoke unwanted consequences) can be an easy and effective way to handle the cognitive dissonance.

Reactance can be a motivational or affective state that is time-variant and dependent on the situation. But reactance can also be a personality trait. Trait reactance can be regarded as a person's proneness to become reactant. A person, who's personality is very reactant will also be more likely to enter a reactant state and then exercise reactant behavior as it is described above. If for example a service or device induces reactance in its user, it is likely to suffer negative consequences to its acceptance or its persuasive influence over the user. At this point, it is important to note that personality traits, such as trait reactance are relatively stable over time and therefore would not have to be assessed regularly.

3 MEASURING TRAIT REACTANCE

Trait reactance can be measured with questionnaires. Several questionnaires have been developed that measure trait reactance, mostly by a series of self report items. The fist one was the "Fragebogen zur Messung der psychologischen Reaktanz", published by (Merz, 1983). Merz's questionnaire was later translated and adapted by (Hong and Page, 1989; Hong, 1992; Hong and Faedda, 1996). "Hong's Psychological Reactance Scale" has been validated (Hong, 1992) and discussed in therms of its psychometric properties (Jonason and Knowles, 2006; Shen and Dillard, 2010). Findings in literature support the possibility to treat Hong's Psychological Reactance Scale as an unidimensional scale. It has eleven self-report items that are answered on a Likert-type scale (Likert, 1932). The relatively small size of the questionnaire and the simple analysis of its results make it an easy-to-use tool to quickly assess a person's trait reactance.

Assessing users' trait reactance requires them to fill out Hong's Psychological Reactance Scale (or another appropriate one). While this does not take long, there is still the hurdle of handing out sensitive information. The act of asking users to give such information might trigger strong reactance itself, which could result in opting out to give such information or in giving false information. To avoid this, it should be clearly stated, why such information is collected

and how the user will benefit from that. Research has shown that reactance to the use of personal data decreases with justification for the collection of such data and with utility (White et al., 2008). As personality traits usually do not change much, trait reactance would have to be assessed either rarely or even only once and then be stored in the user profile.

Knowledge about a person's level of trait reactance can be usefull because interaction can then be tailored and adapted to fit the persons personality profile. Also, evaluation results can be interpreted with the persons personality traits, here, trait reactance in mind. For example, a recent (not yet published) evaluation of Apple's Siri, using the AttrakDiff Mini (Hassenzahl and Monk, 2010) questionnaire, revealed that highly reactant persons rate Siri's hedonistic and pragmatic quality worse than people who show low levels of trait reactance. The results reached significant levels $t(22)=2.27$, $p=0.03$, $d=0.927$ for hedonistic quality, but failed to do so for pragmatic quality, with $d = 0.496$ ($N=24$).

4 UTILIZING REACTANCE RESEARCH FOR HCI

4.1 Avoiding Reactant Behavior

Multiple techniques exist that are able to decrease reactance effects. While it can be adequate to always use those techniques for many situations, for example for non-adaptive systems or if no user information is known, a user-specific tuning of the trade-off between the users' reactance and frequency and magnitude of system-persuasion could often be used to optimize compliance. To further clarify this, an example on how the seat belt alarm in a car could be improved is given for each technique. The seat belt alarm is a particularly fitting use case, because it is a persuasive mechanism that car manufacturers use to make drivers wear seat belts. Because of the importance of wearing seat belts, the alarm is usually designed to be quite annoying for the driver. The intention behind this is to make the driver fasten the seat belt as soon as possible. The downside of this is that many drivers get reactant and try to bypass the seat belt alarm while refraining from fastening the seat belt.

Magnitude of Threat. The level of reactance that is induced is also dependent on the magnitude of the threat or request. This means that if a freedom threat or a request is affecting a person a lot, this will cause more reactance compared to a freedom threat or request that has little effect on a person (Brehm and Brehm, 1981). With respect to reactance as a personality trait, one can expect that a highly reactant person is also more sensitive to such requests. A seat belt alarm for a highly reactant person could likely be improved if it would involve a message like "Please put the seat belt on, its not a hard thing to do.". In the mobile context, it could be wise for a service or software not to request additional access rights or present lengthy forms to fill out to users that are known to be highly reactant, because the result could be either the discontinuation of usage or diminished acceptance. In the case of forms, a service might also receive intentionally false information because a highly reactant person attempted to restore personal freedom by acting against the freedom threat.

Magnitude of Request. The magnitude of request is moderated by the explicitness of the request. This means that a formulation like "Fasten your seat belt!" is a strong magnitude of request, where emphasizes lies on the request. Whereas "Fastening your seat belt can significantly improve your chances of survival in an accident." might transport the same message, namely that someone should fasten the seat belt, but employs a more indirect persuasion strategy. The use of an objective argument against a command can increase persuasive power by evoking intrinsic motivation and avoiding reactance. There has been a number of studies that show that magnitude of request can moderate compliance to the message (Rains, 2013; Silvia, 2005).

But You Are Free to Accept or Refuse Technique. A rather simple method to reduce reactant behavior and to increase compliance is the so called "But you are free to accept or refuse technique" that was tested by (Guéguen and Pascual, 2005). The technique works by underlining the option to refuse a request. In that specific study, Guéguen and Pascual asked subjects on the streets whether they want to participate in a survey. Those subjects that were asked using the technique, that is by emphasizing the possibility to refuse the request, showed a significantly higher compliance rate, compared to the control group in which the option to refuse was not emphasized (Guéguen and Pascual, 2005). The "But you are free to accept or refuse"-technique is a simple and easy-to-implement way that can bring improvements especially in persuasive dialogue or recommendation situations.

Adding a bulky affix to sentences is surely a rather inelegant way of increasing compliance. The other hand, the principle of emphasizing the option of refusal can also be applied by other means. For example,

in the case of a graphical user interface, by prominently adding an abort or refuse button. For the seat belt alarm, a button to shut down the warning is defying the importance of the message and a successful persuasion. However an option to postpone the alarm for a couple of seconds could have a similar effect on reactance because it gives some control to the driver. Personalities that show a high level of trait reactance should still be treated accordingly and as the study of Guéguen and Pascual showed, affixes to formulations can have a significant effect (Guéguen and Pascual, 2005). In order not to reverse the intended effect by annoying the user, dialogues would have to contain a larger body of phrases that emphasize the freedom of refusal, which would also be needed to be harmoniously inserted into the dialogue.

Commanding Tone. Commanding tone can be adjusted by the use of strong, commanding phrases like "you must to" or "you absolutely have to" versus "you could do" or "why don't you do". Adapting the magnitude of commanding tone in dialogues to trait reactance could be an especially promising approach to adjust to users. In contrast to emphasizing the freedom of choice, a highly commanding tone emphasizes the freedom threat. This is the opposite effect as the "But you are free to accept or refuse technique". Using a commanding tone on the other hand adds a component of authority to a message, therefore, it could be beneficial for dialogue systems to employ commanding tone in dialogues that are meant to persuade users. Again, the use of commanding tone could be adjusted to the level of trait reactance of a user in order to achieve the most effective persuasion. Hereby, users with a low level of trait reactance can be exposed to a higher amount of commanding tone, in order to increase persuasion or motivation, whereas users with a high level of reactance should be exposed to only minor levels of commanding tone in order not to spoil persuasion or motivation by inducing reactant behavior. For the seat belt alarm this would imply, that drivers with low trait reactance could be addressed more strongly whereas drivers with high trait reactance would have to be addressed more politely in order to achieve the most effective persuasion.

4.2 Inducing Reactant Behavior

Just as there are many situations in which reactance is better be avoided, there are some situations in which reactance can be beneficial. This are mostly situations in which the user is meant to be motivated. One sort of applications that would benefit from such effects are fitness applications.

Target-directed Reactance. In fitness applications, reactance could be induced by giving the user the impression that he or she is underestimated by the application. This can be done by presenting goals that the user can accomplish, like running a certain distance in 30 minutes, but also indicate that the user is not yet ready for those goals. The way that this is done would have to be adjusted to the individual user's trait reactance. Highly reactant personalities are probably already sufficiently reactant when the particular goal is indicated as a goal for the future: "Only two training lessons until you can run three miles in 30 minutes.", whereas users with a low level of trait reactance might require stronger stimuli: "According to your schedule, you are not yet allowed to run three miles in 30 minutes." This direct stimulation of reactance is at risk of bearing negative implications for the user's opinion towards the fitness application itself. This is because the fitness application is the direct source of the threat and reactance behavior will be therefore directed towards it. It is also important not to use messages that might have negative effects on the users' self-esteem for inducing reactance, since this can add to depression or neurosis.

Redirecting Reactance. For a fitness application (and any device or service) it should be avoided to become the target of reactant behavior. In order to still be able to induce reactance in its users, the fitness application would have to present another target towards that the reactance behavior can then be directed. One such target that is proposed here, is the average user of that fitness application. Alongside the personal goals and progress, additional information could be presented that shows the average progress of other users. This information is intended to induce reactance towards the average user, therefore the achievements of the average user have to be better, compared to the achievements of the actual user. Since the actual user will often be above average, the application would have to either fake the average achievements, or use only the achievements of the most-performing users, e.g. the 50th percentile. Strength of the threat can be adjusted to the user's level of trait reactance by decreasing the percentile. For a highly reactant user it is probably sufficient to present a large percentile, whereas a user with a low level of trait reactance might require a small percentile. An example would be: "For a three mile run, you take 30 minutes, this is five minutes slower than the average performance of the top 30% of the users."

4.3 Findings in Literature

The concept of reactance has already been addressed to some extend by the HCI community.

For example, Roubroeks et al. found, that persuasive attempts of an online recommendation system induced more reactance when they were accompanied by socially relevant agents (Roubroeks et al., 2009; Roubroeks et al., 2011). They used still images and videos of a virtual robot as a social agent. On the other hand, Choi et al. found evidence that the level of social presence of a virtual agent can positively influence user's trust in the stimulus (Choi et al., 2001), therefore, a socially relevant agent might be beneficial for persuasive systems in some aspects. The findings of Roubroeks et al. and Choi et al. imply that social presence of virtual agents or IPAs could improve trust in services but that this comes with the risk of inducing state reactance. The knowledge of a persons trait reactance could help to determine the optimal level of social presence that a service or an IPA should emit for each user individually and thereby increase acceptance by optimizing the level of trust(Choi et al., 2001) and reactance (Roubroeks et al., 2009; Roubroeks et al., 2011).

The two-sidedness of reactance in persuasive systems was also noted by Lee and Lee (Lee and Lee, 2009) They found that even though adaption of the recommendation system to the user can improve the user's intention to use the service again, this effect can tip over at some point and induce reactant behavior, such as the intention to avoid using the service. Determining the individual trait reactance of users could probably help to determine their individual tipping point with a user model and improve the adaptation strategies of recommendation systems.

5 CONCLUSION AND FUTURE RESEARCH

A user's level of trait reactance is a valuable information to have for developers. Such knowledge can be used for a couple of purposes.

It can be used to optimize a trade-off between persuasive effort and compliance in a situation in which users are meant to be persuaded or receive recommendations. For example, an artificial fitness coach could use such information to adjust its motivation behavior to the user. A user that has a low level of trait reactance could be exposed to stronger motivational cues more frequently. A user who has a high level of trait reactance is annoyed more easily and could then abandon training or switch to another fitness coach. Such a user might receive a smaller number or less intrusive motivational cues.

The concept of psychological reactance has already been recognized by the marketing industry and also received attention in the respective research community (Dillard and Shen, 2005; Tucker, 2014; Edwards et al., 2002). As sophisticated services, such as IPAs are getting more human-like and their perceived social relevance increases, they are getting more prone to induce effects like reactance. This was also shown by Ehrenbrink et al., who showed that an adaptive spoken dialogue system can induce more reactance, compared to a non-adaptive spoken dialogue system (Ehrenbrink et al., 2016b).

To date, utilizing trait reactance is possible and could prove beneficial for human-computer interaction. The utility of trait reactance is also due to the fact that it does not need to be assessed frequently and will still be valid month after the measurement. As a future perspective, also the utilization of state reactance is an option. State reactance would allow for higher adaptation precision, because environmental factors that influence state reactance would also implicitly be adapted for. The continuous or frequent assessment of state reactance is a problem, though. Today, state reactance is often assessed via a combination of a questionnaire and thought listing (Dillard and Shen, 2005). This technique is however unpractical for continuous measurement because users will hardly be willing to undergo such a procedure frequently while interacting with some service. Therefore, in order to be able to utilize state reactance, new assessment techniques need to be developed. Such techniques could for example employ behavioral or physiological data from wearable devices to draw conclusions on state reactance.

ACKNOWLEDGEMENTS

This work was supported by BMBF, Software Campus, grand no. 01IS12056, Sozialpsychologische Aspekte von Smart Homes (SPASH).

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