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# Towards Designing Assistants for Well-being: Clarifying the Relationship between Users' Intrinsic Motivation and Expectations from Assistants

*Completed Research Paper*

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## Abstract

Although considerable research effort has been devoted to understanding the adoption and use of commercially available intelligent assistants, the relationship between user expectations from assistants and users' endogenous intrinsic motivation to perform an activity has not been explored. Doing so is important to meet user expectations, prevent adoption failures, and design for well-being. In this paper, we investigate whether a person's intrinsic motivation to perform an activity impacts (a) their expectations from an assistant, and, (b) the assistant feature set chosen to meet these expectations. Via a survey based study with N=296 participants, we provide empirical evidence showing that, after controlling for demographic factors, users' prior, endogenous intrinsic motivation influences their intrinsic expectations for competence, stimulation and influence, but not extrinsic and hedonic expectations. Users with low prior motivation prefer an assistant in a supervisor role. Implications for research and practice are discussed.

**Keywords:** intrinsic motivation, intelligent assistants, user expectations, assistant design

## Introduction

Intelligent assistants or agents have enjoyed widespread adoption in recent years in everyday life, and are also expected to play a major role in professional settings in the coming years (Maedche et al., 2019). Conventionally, assistants have been designed to improve user productivity and efficiency (Brandtzaeg & Følstad, 2017; McLean & Osei-Frimpong, 2019; Dhiman et al., 2022) but, in recent years, researchers have called for a shift beyond these utilitarian design objectives towards other aspects of human experience such as meaning, happiness and flourishing, collectively grouped under the term *well-being* (Peters et al., 2018).

Intelligent systems exhibit abilities that are much different from previously studied systems in the Information Systems (IS) domain, and researchers have argued that existing IS theories be updated to adequately explain users' perceptions, acceptance and continued use of intelligent systems (Burton-Jones et al., 2021). For instance, Moussawi et al. (2022) assert that information technology continuance needs to be updated to include characteristics of intelligent agents. Moreover, Knote et al. (2021) contend that existing IS theories should be revised to reflect the ability of intelligent services to "proactively and dynamically shape affordances offered to users". Similarly, Baird & Maruping (2021) propose viewing interaction with 'agentic' IS artifacts as through the lens of 'delegation'.

Likewise, we are still in the process of understanding the role of intelligent IS artifacts in fostering users' cognitive and affective sense of well-being. Prior literature shows that fostering human well-being depends on the fulfillment of certain psychological needs (Vansteenkiste et al., 2020). Moreover, it rests on an understanding of the nature of users' motivation to perform an activity (Ryan & Deci, 2000). Hence, systems that are able to leverage "users' inherent behavioral capacities" would perform well even in the absence of external stimuli, or exogenous motivations (Malhotra & Galletta, 2004). The relationship between endogenous motivation and technology acceptance has been studied previously (Malhotra, Galletta, & Kirsch, 2008) in the context of technology adoption, but in the context of assistant design, we lack an understanding of whether users' endogenous motivation has an effect on - (a) *which* well-being objectives users expect to achieve through assistance, and - (b) *how* an assistant can help users achieve them.

The first aforementioned gap points to a lack of understanding of user expectations in the context of assistant use. Although a body of literature has accumulated around the study of factors influencing assistant adoption (Ling et al., 2021), user characteristics have been ignored (Diedrich et al., 2022), and the relationship of endogenous motivations to users' expectations has not been addressed. We argue that closing this gap is important when it comes to designing assistants. For one, system use depends on meeting user expectations (Lowry et al., 2015), and motivations are direct antecedent of expectations (Vallerand, 1997). Moreover, assistance finds its meaning in existing, established activities shaped by individual/socio-demographic factors and values (Dhiman et al., 2022). Therefore, the design of assistants should be based on an understanding of user motivation to perform an activity. For instance, a user who is highly self-determined and experiences a high degree of interest and enjoyment in an activity may have different expectations from an assistant than a user who is externally motivated to perform the same activity (e.g. out of necessity).

The second gap points towards a lack of understanding regarding agent characteristics that are suited to users with a particular disposition. Research shows that the design space for assistant design is vast and consists of several options (Knote et al., 2019; Dhiman et al., 2022) and that users indeed have differing preferences (Schiaffino & Amandi, 2004); as such it may not be feasible to try and test every potential configuration of features. Rather, we need a nuanced understanding of what different types of users may expect from assistants in certain contexts (Maedche et al., 2019). By doing so, it is easier to factor in some of the use-complexity in the design phase itself, save time and effort during the design-test-evaluate cycle, and adapt assistant features over time. Taking the example above, someone who is highly self-determined and experiences a high degree of interest and enjoyment in an activity will most likely expect a higher degree of autonomy than an externally motivated user. The design strategy for the latter user could, for instance, realize a different path towards well-being than for the former user.

The present study explores the relationship between users' prior intrinsic motivation to perform a task and their expectations from assistants in this particular task context. For the purposes of this study, we view the user's prior motivation through the lens of Self-Determination Theory (SDT) (Ryan & Deci, 2017), more specifically, the perceived interest and enjoyment scale that indicates endogenous intrinsic motivation (McAuley et al., 1989). We conducted a questionnaire based study consisting of N=296 participants and contribute to existing research by answering two questions:

(1) since motivations are antecedents of expectations, how does users' intrinsic motivation to perform an activity influence their expectations from an assistant?
(2) given users' motivation in an activity, which design dimensions of assistants do users prefer to best meet their expectations?

We first provide a theoretical account of intrinsic motivation and its relationship to well-being in the context of psychology and technology use. We then provide empirical evidence that, after controlling for user demographics (i.e. age and gender), user motivation does indeed play a differentiated role in their expectations and design options regarding assistants. Further, we show that users with varying dispositions may choose different assistant characteristics. Finally, we discuss implications for assistant design and experimental evaluation.

# Related Work

## *Users' Endogenous Intrinsic Motivation and its Link to Expectations*

Although motivations have always played an important role in expanding our understanding of user acceptance of technologies, the original model proposed by Davis et al. (1992) which continues to influence technology acceptance research relies on the exogenous dichotomy of intrinsic/extrinsic motivations. That is, they are external to the user, brought about by external stimuli such as system features. However, as Malhotra et al., (2008) state, this view is rather mechanistic and offers us a limited view of user motivation. Looking at the endogenous counterpart of user motivation can improve our understanding of user needs and expectations, especially when it comes to fostering user well-being.

Theories such as SDT (Ryan & Deci, 2017) take the endogenous perspective towards user motivation, and give priority to a person's experiences and their subjective psychological meaning. In SDT, the intrinsic motivation to perform an activity, measured by perceived interest or enjoyment signifies the "pursuit of optimal challenges that enhance self-learning, self-development and self-growth" viewed independently of external stimuli. Intrinsically motivated activities are "done for their inherent satisfactions" (Ryan & Deci, 2017), and not for the pursuit of pleasure and enjoyment per se. Perceived interest, in this sense, is a direct indicator of users' need fulfillment (for competence, autonomy, and relatedness) and perceived locus of control (PLOC) (Ryan & Deci, 2017). People who are intrinsically motivated choose challenging tasks (Abuhamdeh & Csikszentmihalyi, 2012) and are curious explorers (Silvia, 2012). Therefore, people who are intrinsically motivated lay emphasis on personal growth and enrichment rather than doing activities for instrumental objectives (Fishbach & Woolley, 2022). Hence, users vary in their propensity to find tasks interesting, which are influenced by situational, contextual and cultural factors (Ryan & Deci, 2017), and so, the expectations that a user has from an assistant may also vary. A similar effect is seen in the domain of decision support systems, where user motivation to perform a task moderates the outcomes of its use (Chan, 2009).

Expectations are beliefs about how a user supposes a system ought to perform (Bhattacherjee, 2001). And, research in psychology shows that motivations drive expectations (Vallerand, 1997). Hence, one would expect that, when it comes to being assisted in an activity, a user's prior, endogenous intrinsic motivation should have some role to play in what users expect from an assistant after taking into account the socio-demographic factors of culture, age and gender. Importantly, since intrinsic motivations are related to behaviors carried out for seeking accomplishment, growth and learning (Bock et al., 2005; Son, 2011) this effect should be positive when it comes to intrinsic expectations. Whether hedonic expectations, characterized by a pursuit of pleasure and arousal, are predicted by intrinsic motivation is unclear, since the pursuit of intrinsic goals is usually accompanied by positive effects of pleasure and joy (Waterman et al., 2008). Moreover, research shows that the relationship between intrinsic motivation and extrinsic outcomes such as productivity is questionable (Cerasoli et al., 2014), hence it is not known if intrinsic motivation will have any impact on extrinsic expectations (instrumental expectations directed at productivity and efficiency) (Sheldon et al. 2001, Hassenzahl et al. 2010).

The aforementioned constructs of intrinsic, extrinsic, and hedonic expectations are well-established in existing information systems research (Lowry et al., 2015), however, they do not adequately capture the entire spectrum of human needs. In investigating user experience with technology, research indicates that users' long-term well-being experiences are related to the fulfillment of specific needs, among them the need for competence (attaining or exceeding a standard in one's performance), stimulation (to have new activities and sources of growth), relatedness (to have a sense of contact with people one cares for), popularity/influence (to be a person whose advice others seek or follow), security (to have structured and predictable routines), and self-actualization (deeper understanding of one's purpose) (Hassenzahl et al., 2010). At first glance, some of these needs seem to be covered under the construct of intrinsic expectations;

at the same time, using this set of needs may offer us a more nuanced look at user expectations - something that has not been considered before.

Based on the foregoing discussion, we postulate that, after controlling for users' age and gender:

- H1: users' intrinsic motivation to do a task is positively associated with users' intrinsic expectations from an assistant.
- H2: users' intrinsic motivation to do a task is positively associated with users' hedonic expectations from an assistant.
- H3: users' intrinsic motivation to do a task is not associated with users' extrinsic expectations from an assistant.

In addition, to expand our understanding of user expectations, we add this exploratory question to our analysis:

- E1: users' intrinsic motivation to do a task is associated with which of these expectations from an assistant: competence, stimulation, relatedness, influence, security and self-actualization?

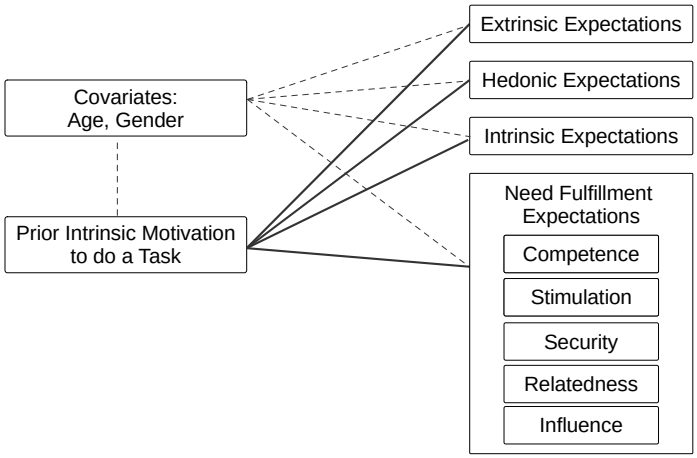


**Figure 1. Research Model, Hypotheses 1-3 and Exploratory Question 1**

## *Users' Endogenous Intrinsic Motivation and its Link to Assistant Features*

While the most commonly used intelligent assistants tend to be voice controlled assistants, a review of intelligent assistant design reveals that intelligent assistants have been designed for a variety of tasks incorporating a myriad of features concerning assistant outcomes, task environment and assistant characteristics (for instance, anthropomorphism, adaptability, modality etc.) (Dhiman et al., 2022). As examples from other domains show, user motivation can be linked to technology feature set use (Wu & Lu, 2013; James et al., 2019). Each of these design characteristics can have an influence on assistant adoption (Ling et al., 2021). However, the potential design space for assistants is large. Design spaces rarely offer design suggestions, and designers have to rely on prescriptive knowledge to make informed guesses regarding which functionality to provide.

From an assistant design perspective, an important question then, is how to systematically incorporate features in the design phase that fulfill user expectations. For instance, users who are highly intrinsically motivated may prefer to be in charge such that the assistant only offers them minimal feedback, whereas those with low motivation (and hence external PLOC) may place a higher importance on utilitarian performance and expect the assistant to guide them and take over some of the effort. However, the relationship between user motivation and particular design characteristics of assistants has not yet been investigated. In this paper, we selectively consider the following design dimensions, taken from (Dhiman et al., 2022):

- *Assistant autonomy* (the assistant acts on its own) vs *user delegation* (the assistant acts only upon user instruction)). Prior work shows that users prefer to delegate (Lopatovska et al., 2019), and are

only willing to allow the assistant to act autonomously if they are sure about its actions (Milewski & Lewis, 1997; Schiaffino & Amandi, 2004). Which expectations and whether users' own motivation predicts the kind of assistant initiative is unclear.

- Roles the assistant could adopt in participants' activity: as a *supervisor* who provides step-by-step instructions, or as a *teacher* who lets them perform the activity and provides feedback. Past work shows that expert users see assistants in a collaborator or helper role (Schiaffino & Amandi, 2004). However, there is a positive relationship between intrinsic motivation and the need for autonomy (Dickinson, 1995). Whereas users with lower motivation levels may be more receptive to a supervisory style of communication, characteristic of external stimulation and activity tracking, those who are highly self-determined may prefer minimal intervention from the assistant but expect qualitative feedback.
- Adaptability of the assistant (whether the assistant *automatically adapts* to user preferences, whether users *configure* their preferences, or whether they are able to teach or *program* the assistant and extend it over time). Users who are intrinsically motivated and self-determined are more willing to engage with their environment (Ryan & Deci, 2017) and may want to actively participate in shaping their assistant according to their own preferences, rather than have it automatically adapt itself to them (Oulasvirta & Blom, 2008).

Hence, we postulate that, after controlling for users' age and gender:

- H4: motivation will affect users' preference regarding assistant initiative. Highly motivated users will indicate a higher preference for a delegation style of interaction, and users with low motivation will rate assistant initiative higher.
- H5: motivation will affect users' preference regarding assistant roles. Users with low prior motivation will show a higher preference for a more guided form of assistance with external stimulation (supervisor mode), whereas those with higher motivation will show a higher preference for the teacher mode.
- H6: motivation will affect users' preference regarding assistant adaptability. More specifically, highly motivated users will show an inclination towards forms of adaptation that afford them more control (i.e. configuring and programming the assistant rather than have it adapt itself).

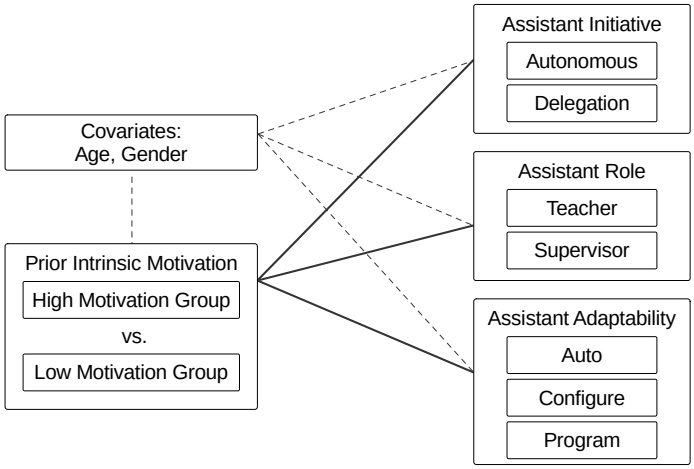


**Figure 2. Research Model, Hypotheses 4-6**

# Method

Figures 1 and 2 illustrate the models tested in this study. First, we wanted to understand the relationship between intrinsic motivation to do a task and assistant expectations. Second, we wished to see if high and low intrinsic motivation groups differ in chosen assistant options. To gather data, we carried out a vignette study consisting of a task scenario in which participants were presented with a hypothetical assistant and administered a questionnaire-based survey.

The survey was conducted in early 2021, a time when COVID-19 pandemic induced lockdowns disrupted everyday public life and services. To set up a task scenario, we specifically chose the activity of home-cooking which was enjoying an increased resurgence. Plus, cooking is multifaceted in nature in that it is a sufficiently complex activity (consists of several different tasks and sub-tasks involving various tools), can be socially significant (one may do it alone or with others, for oneself or for others), can involve discretion and creativity or can be done by the book (in terms of recipes and processes). More importantly, it can be pursued as an intrinsically motivated avocation or as an extrinsically motivated necessity.

We recruited university students as initial participants but encouraged them to share the link to the study with their friends and family members. 318 participants completed the survey. After checking the responses for completeness and removing outliers using Mahalanobis distance, n=296 responses were analyzed. Most of the respondents listed their country of origin as Germany (n=270), with 21 participants distributed among various western nations (United States (n=8), Norway (n=3), Netherlands (n=2), Austria (n=1), Belgium (n=1), Denmark (n=1), France (n=1) Italy (n=1), San Marino (n=1) and Switzerland (n=1)). The remaining 5 participants stated their country of origin as Russia (n=4) and Serbia (n=1). Participants were between 20 and 70 years old (Mean age group 30-35y, 136 females, 160 males).

## *Procedure*

Participants were asked to enter their demographic information, followed by questions regarding whether they are using an intelligent assistant and how frequently. Following this, we motivated the scenario by describing how the ongoing pandemic situation has spurred an interest in home-cooking, and asked users to rate their intrinsic motivation to cook based on their own experience. Next, we introduced a hypothetical cooking assistant designed to help them in their cooking tasks. To prevent priming the participants we refrained from explaining exactly how the assistant could help them, but showed the participants an illustration of what the assistant consists of (an interactive display, sensors, smart utensils and devices with which the assistant can communicate) (see Figure 3).

Following this, we asked participants' how they would want the assistant to help them by rating their intrinsic, extrinsic, hedonic expectations (taken from IS literature), followed by competence, relatedness, stimulation, security and popularity expectations (taken from well-being and Human-Computer Interaction (HCI) literature). Subsequent questions asked users on how they would rate the desirability of specific features of the assistant.

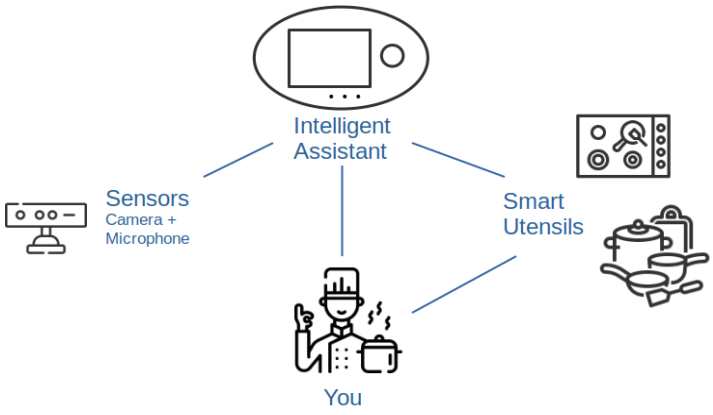


**Figure 3. Vignette Illustration**

## *Measures*

To measure participants' intrinsic motivation to perform the task we used the interest/enjoyment scale from the intrinsic-motivation inventory (Deci et al., 1994). Intrinsic expectation was measured using the scale provided by Lowry et al. (Lowry et al., 2015). Extrinsic expectation was measured using the usefulness scale (Bhattacherjee & Premkumar, 2004), whereas hedonic expectations were measured based on the enjoyment scale (van der Heijden 2004). User expectations concerning competence, stimulation, security, influence (popularity), relatedness and self-actualization were taken from Sheldon et al. (Sheldon et al., 2001). To test the scale's structural validity, we conducted a principal component analysis which

reproduced similar factor loadings. Reliability analysis indicated sufficient internal consistencies except for one subscale (self-actualization, alpha = 0.53) which was not used for this study. All items were scored using a 7 point likert scale. All items were translated for German-speaking participants. Table 1 shows the scales used, the variable used to represent the calculated value of each instrument, and the scale reliability.

Regarding assistant features, each option was phrased to describe its functionality in a single line (for instance, assistant delegation was phrased as 'The assistant should only do something, when I tell it to') and participants were asked to rate the desirability of this feature (Likert scale, 1 = "very undesirable", 7 = "very desirable"). Doing so allowed us to compare between group preferences and to check if two options were equally preferred, something which is not possible in nominal or rank order questions. The complete questionnaire used in this study is included in Appendix A.

| Instrument | Variable | Items | Cronbach's α | Source |
|---|---|---|---|---|
| Motivation to perform a task | | | | |
| Intrinsic Motivation | p_interest | 7 | 0.91 | Intrinsic Motivation Inventory (McAuley et al., 1989) |
| Expectations | | | | |
| Intrinsic Expectations | exp_intrinsic | 3 | 0.82 | (Lowry et al., 2015) |
| Extrinsic Expectations | exp_extrinsic | 3 | 0.86 | (Bhattacherjee & Premkumar, 2004) |
| Hedonic Expectations | exp_hedonic | 5 | 0.88 | (Van der Heijden, 2004) |
| Competence | exp_competence | 2 | 0.78 | (Sheldon et. al., 2001; Hassenzahl et al., 2010) |
| Stimulation | exp_stimulation | 2 | 0.81 | |
| Relatedness | exp_relatedness | 2 | 0.87 | |
| Influence | exp_influence | 2 | 0.83 | |
| Security | exp_security | 2 | 0.73 | |
| Assistant Features | | | | |
| Initiative (autonomous) | invoke_auto | 1 | -- | Created by authors |
| Initiative (delegate) | invoke_delegate | 1 | | |
| Role (supervisor) | role_supervisor | 1 | | |
| Role (teacher) | role_teacher | 1 | | |
| Adaptability (auto) | adapt_auto | 1 | | |
| Adaptability (configure) | adapt_configure | 1 | | |
| Adaptability (program) | adapt_program | 1 | | |

**Table 1. Instruments Overview (Complete Questionnaire in Appendix A)**

# Results and Analysis

## *Descriptive Statistics*

Means, standard deviations and zero order correlations are available in Appendix B. Due to space limitations, we only discuss the most relevant aspects here.

Overall, as Figure 4 shows, both intrinsic (M=5.68, SD=1.05) and extrinsic (M=5.53, SD=1.24) expectations were rated the highest, followed by hedonic expectations. Viewed individually, the expectations for stimulation (M=5.82, SD=1.05) and competence (M=5.46, SD=1.28) were rated most important, followed by security (M=4.88, SD=1.32). Social expectations such as influence (M=3.37, SD=1.71) and relatedness (M=2.85, SD=1.78) were rated the lowest. This suggests that overall, participants expect the assistant to help them fulfill personal (i.e. instrumental and/or informational goals) rather than social goals. In

addition, user response regarding social expectations exhibits a higher standard deviation, perhaps indicating an ambivalence in user preference owing to the fact that the data combines several age groups.

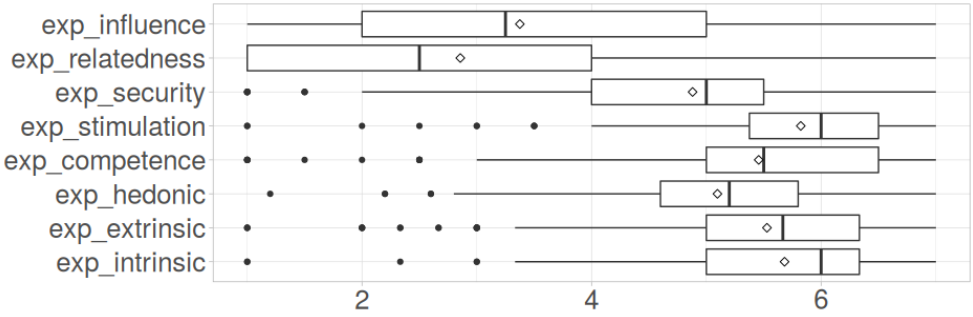


**Figure 4. Participants' Expectations**

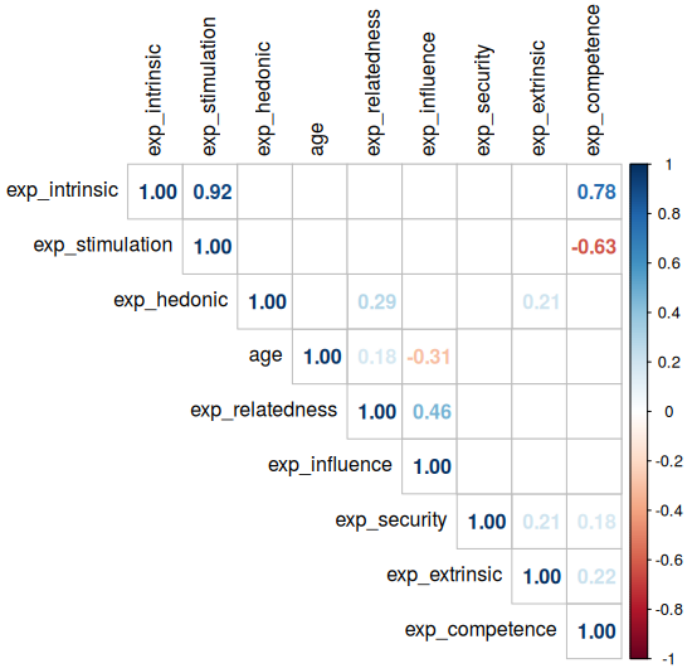


**Figure 5. Pairwise Partial Correlations ($p < 0.05$)**

As expected, the construct for intrinsic expectation correlates highly with the construct for competence and stimulation (Figure 5). Surprisingly, competence and stimulation expectations are negatively associated, indicating that, when holding other variables constant, the expectation that the assistant helps one to master challenging tasks is negatively associated with the expectation that the assistant suggests new tasks. More importantly, it is apparent that social expectations fall in a different group than task related expectations, whereby extrinsic expectations, competence, security and hedonic expectations are moderately correlated with each other. Hedonic expectation is correlated with both extrinsic and social expectations, an interesting finding which reaffirms prior research as it being a distinct form of expectation. Taken together, there are four distinct clusters of user expectations: extrinsic, intrinsic, hedonic, and social.

As Figure 6 illustrates, participants expressed an overwhelming preference for a delegative interaction style (M=5.60, SD=1.58) in comparison to assistant initiative (M=2.48, SD=1.66). The response regarding assistant adaptation was mixed; both configuring the assistant (M=5.54, SD=1.55) and having it automatically adapt to the user (M=5.12, SD=1.82) was favored to the users programming the assistant (M=4.49, SD=1.98). Regarding assistant roles, the supervisor role was rated significantly lower (M=3.63, SD=1.90) than the teacher role (M=5.18, SD=1.59). Regarding assistance outcome, participants lean towards compensatory assistance (compensate (M=5.22, SD=1.72)), that is, they prefer assistance in

situations where they need help, rather than needing it when they are confident of their progress at the activity (M=5.01, SD=1.62). Overall, the responses indicate that functionally, respondents envision technological assistants as subordinate helpers who respond when required, adapt to users' preferences, respect user autonomy and enhance users' competence and enjoyment at an activity.

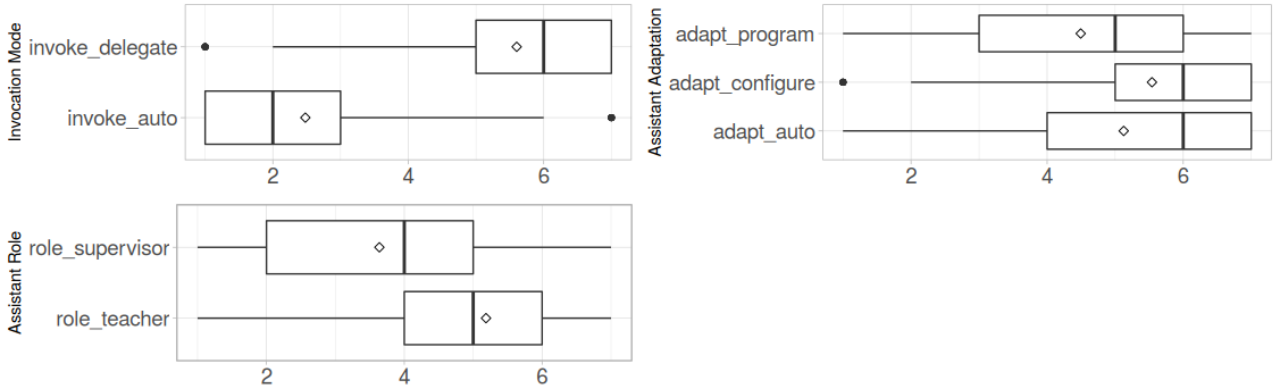


**Figure 6. Assistant Feature Preference**

### *Effect of Users' Endogenous Intrinsic Motivation to perform a Task on Expectations*

We used hierarchical linear regression to estimate the effect of users' self-reported intrinsic motivation on their expectations from the assistant after controlling for the effects of age and gender. Complete results can be seen in Appendix C. Table 2 only summarizes the coefficients of intrinsic motivation and their significance values after accounting for effects of age and gender. Collinearity diagnostics confirmed that the VIF values were below 2 (Appendix C).

| **Dependent Variable** | ***β*** | ***t*** | ***R²*** |
|---|---|---|---|
| | | | |
| exp_extrinsic | 0.068 | 1.163 | 0.027 |
| exp_intrinisic | 0.205 | 3.626*** | 0.097 |
| exp_hedonic | 0.098 | 1.667 | 0.016 |
| exp_competence | 0.220 | 3.906*** | 0.103 |
| exp_stimulation | 0.143 | 2.485* | 0.064 |
| exp_security | -0.015 | -0.246 | 0.015 |
| exp_relatedness | 0.103 | 1.753 | 0.020 |
| exp_influence | 0.128 | 2.263* | 0.091 |

**Table 2. Regression Coefficients**

The regression models for the following dependent variables were statistically significant: exp_intrinsic ($F(3, 292) = 10.414$, $p<0.001$), exp_competence ($F(3, 292) = 11.139$, $p < 0.001$) , exp_stimulation ($F(3, 292) = 6.653$, $p < 0.001$) and exp_influence ($F(3, 292) = 9.748$ , $p < 0.001$).

Hypothesis 1 is supported: intrinsic motivation to perform a task positively affects users' intrinsic expectations from an assistant ($\beta = 0.205$, $p<0.001$).

Hypothesis 2 is not supported. The combined regression model for hedonic expectations was non-significant, indicating that hedonic expectations are most likely independent of users' demographics and motivation to perform the task.

Hypothesis 3 is supported: the combined model for extrinsic expectations was non-significant, suggesting that extrinsic expectations from an assistant are not influenced by users' own motivation to perform a task.

Regarding our exploratory question (E1), we find that the expectations for competence ($\beta=0.220$, $p<0.001$) and stimulation ($\beta=0.143$, $p<0.001$) are positively related to users' intrinsic motivation. This is hardly

surprising, given that these instruments are highly correlated to the instrument for intrinsic expectations. Interestingly, participants' expectation to be popular/influence others is positively related to their own intrinsic motivation to perform the task (β=0.128, p=0.024). The effect of intrinsic motivation on relatedness and security expectations is non-significant.

### *Comparison of High vs. Low Intrinsic Motivation Groups regarding Assistant Features*

| | Motivation Group | | | | | |
|---|---|---|---|---|---|---|
| | Low | | High | | | |
| **Measure** | **M** | **SD** | **M** | **SD** | **F** | **$\eta^2$** |
| invoke_delegate | 5.47 | 1.60 | 5.72 | 1.55 | 1.572 | 0.005 |
| invoke_auto | 2.55 | 1.77 | 2.40 | 1.55 | 0.406 | 0.003 |
| adapt_auto | 4.89 | 1.88 | 5.35 | 1.73 | 4.867* | 0.016 |
| adapt_configure | 5.47 | 1.55 | 5.60 | 1.55 | 0.384 | 0.001 |
| adapt_program | 4.47 | 1.93 | 4.51 | 2.02 | 0.076 | 0.000 |
| role_supervisor | 4.15 | 1.85 | 3.12 | 1.81 | 21.670*** | 0.064 |
| role_teacher | 5.18 | 1.57 | 5.18 | 1.6 | 0.067 | 0.000 |

**Table 3. Analysis of Covariance (ANCOVA)**

Since the dependent variables (assistant features) were measured using non-standard constructs, we used group comparison to compare whether the means between the two groups differed significantly. We used a median split to create two groups of participants (low motivation group (n = 148, M=3.38, SD=0.95) and high motivation group (n=148, M=5.76, SD=0.63)). Whether the preferences of these two users regarding assistance features differ significantly was analyzed using ANCOVA, while factoring in the covariates of age and gender (see Table 3). Appendix D shows the complete results of the analysis. Levene's test for equality of variance was non-significant for all the variables.

Hypothesis 4 is not supported. Although there are differences between user preferences regarding assistant delegation and initiative which fall in line with our hypothesis (the high motivation group rated their preference for delegation higher and assistant initiative lower than low motivation group), these differences are not significant.

Hypothesis 5 is partly supported. There was a statistically significant difference in preference for a 'supervisor' assistance style between the two groups (F=21.67, p<0.001). However, the difference between the preference for a 'teacher' or 'helper' assistant role was non-significant between the two groups.

Hypothesis 6 is partly supported, albeit in a counter-intuitive manner. There was a statistically significant difference in preference for assistant auto adaptation (F=4.867, p=0.028). Users in the high motivation group rated this feature higher than those in the lower motivation group. There are no significant differences in preferences regarding the other two forms of assistant adaptation (configure and program).

## Discussion

### *Summary of Results*

Figure 5 indicates that intrinsic and extrinsic expectations are distinct, whereas there is some correlation between hedonic and extrinsic expectations. This also confirms the internal/external or endogenous/exogenous dichotomy between user motivations and expectations - whereas both extrinsic and hedonic scales used in this study reflect the ability of the assistant to influence the activity and its external outcomes, the intrinsic expectations construct focuses on the user. Moreover, the additional constructs of competence, stimulation, security, relatedness and influence also reveal a more nuanced picture (Figure 4). Competence (mastering challenging tasks and completing difficult projects) and security expectations (making an activity structured and predictable) correlate with each other as well as with extrinsic

expectations, pointing to the possibility that being assisted to complete tasks in a structured manner contributes towards users' sense of productivity and efficiency. While social expectations (influence and relatedness) are correlated, only relatedness correlates with hedonic expectations, reiterating SDT's assertion that fulfilling the need for relatedness contributes to fun/enjoyment in an activity (Reis et al., 2000).

By combining the construct of users' prior endogenous motivation to do the task into regression models, we are also able to distinguish between which expectations users have, and why they value these (Table 2). The regression analysis (Table 2) used to test H1 (and explore E1) confirms that users with high intrinsic motivation expect that the assistant helps them master their skills, expand their knowledge, and be recognized as guides and role models. The regression model for relatedness was non-significant, implying that, regardless of intrinsic motivation, users do not expect assistants to take over social roles (understood as whether users expect assistant to mediate relatedness with others). This outcome is interesting in light of the fact that the need for relatedness is one of the fundamental psychological needs proposed by SDT. The regression model used to test H3 is also non-significant (Table 2 and Appendix C), indicating that externally oriented expectations such as productivity and efficiency, although highly rated (Figure 4), are not explained by prior intrinsic motivation, a fact echoed in prior studies (Cerasoli et al., 2014). We think that reflects the nature of tasks that have tangible, measurable outcomes. In activities such as cooking, producing such an outcome may be inherently important regardless of motivation. Moreover, for users with low motivation, assistance might simply imply a means to offload cognitive effort to achieve instrumental outcomes (low effort-expectancy), whereas intrinsically motivated users may view being productive and/or efficiency as a sign of their skill and competence, which implies that although both types of users may rate extrinsic outcomes highly, the paths they take may nonetheless differ (Figure 6 and Table 3). The rejection of H2 can be alternatively explained as follows. From a psychological perspective, hedonia is a core component of human well-being, and can be attained as a goal in itself or be perceived as an accompanying outcome of psychological need satisfaction. Even if one does not find an activity enjoyable, as long as one values the utility of the activity, it does not exclude the possibility that one indeed desires that the activity become enjoyable. Therefore, those who are intrinsically motivated would expect that the assistant supports those mechanisms that contribute to intrinsic motivation, whereas others might see hedonic outcomes as desirable in themselves. However, studies show that hedonia only has short-term effect on well-being (Huta & Ryan, 2010), and recent studies concerning the importance of intelligent agent characteristics also point to the short-term importance of hedonic characteristics (Moussawi et al., 2022). Researchers have instead suggested focusing on fostering psychological needs via interaction (Peters et al., 2018), an area yet to be explored in the domain of IS.

Concerning hypotheses 4 to 6, both motivation groups show a similar preference concerning assistant autonomy (H4), indicating that it is not linked to prior intrinsic motivation in the activity. Alternative explanations could be that this choice reflects users' need to maintain agency (and autonomy), as asserted by SDT and reflected in other studies (Mieczkowski & Hancock, 2022), and may reflect the default reaction of users in the absence of information to appraise the capability of the agent, since findings show that initially, users prefer control out of a fear of losing autonomy or privacy as long as they not possess requisite information and experience to place their trust in the system's abilities (Zierau et al. 2020).

Concerning H5, we see different preferences for granularity of support – those in the low motivation group expect support both during and after the activity, while those in the high motivation group expect feedback only after the activity, indicating a behavioral difference between how the two groups imagine interacting with the assistant. H6 again reflects a nuanced view of user agency – when capable of adaptation, highly motivated users rate the ability of the assistant to model itself after them higher, whereas the groups show no differences in their preference for other ways to enforce their preferences with use.

On the whole, we find that from a well-being perspective, the results signify a distinction between the core activity (concerning user goals and qualitative aspects of information/feedback) from the agentic aspects, and further, from the adaptability/configurability of the intelligent artifact. The first aspect points towards the change users wish the assistant should support in themselves and their surroundings as well as the granularity of information needed to effect this change. Here, the role of intrinsic motivation is more pronounced. In the latter two aspects, the underlying corroborating sense of autonomy in actively shaping the course of one's activity and relationship with the assistant is prominent.

## *Contribution to Research and Practice*

Our study makes several contributions to research and practice. First, by including prior user motivation in the analysis, we add to existing theory emphasizing the importance of user disposition on design, since these affect user expectations and hence possible confirmation/disconfirmation (Lu et al., 2019). User expectations tend to be indicative of internalized values and beliefs (Ryan & Deci, 2017), whereas users' intrinsic motivation is indicative of their present need-fulfillment in an activity. As our data shows, in some aspects, users low in intrinsic motivation may still have the same aspirations as highly motivated users, a finding that contradicts previous claims (Wu & Lu, 2013). But, as SDT postulates, the reason why users have these aspirations differ and can have consequences on users' subsequent well-being, a point to be explored in future studies.

Second, in including the broader construct of user psychological needs, our research expands the components of user's expectations, especially in terms of how users expect themselves to develop while using an assistant. For instance, the social dimension of assistant use has until now only been studied as the relationship between the agent's social characteristics and its effect on use or the symbolic benefits it brings to a user (McLean & Osei-Frimpong, 2019). We instead show that the expectation of users' own ability to inspire others (popularity or influence) might be an additional reason to use an assistant in a particular activity context. At the same time, we notice that users, regardless of their motivation, do not expect an assistant to mediate social connections on their behalf. Given that relatedness is an important psychological need, this finding raises questions regarding the social role of an assistant, another aspect which can be explored further.

Third, by comparing user preferences for individual features based on users' prior intrinsic motivation, we have also endeavored to show whether user self-determination may be a factor influencing feature selection and hence personalization. It seems that autonomy is desired regardless of one's prior intrinsic motivation, but how users exercise this autonomy may be affected by it. Moreover, whereas previous results have expressed general design suggestions (Lopatovska et al., 2020), by relating specific features to user disposition, we provide a more practical approach towards design and personalization, an approach already used in the context of fitness technologies (James et al., 2019).

From a practical perspective, we contend that working with an assistant has to be seen as a combination of two activities: the first is the core activity itself (i.e. cooking in our case). The second concerns the interaction with, and adaptation of the assistant over time. Although users may differ in their choice of outcomes of being assisted, the high preference for interacting with, and configuring the assistant over time is an indication that when it comes to assistant adaptability and autonomy, users' need for autonomy ought to take precedence (Peters et al., 2018). Therefore, we would argue that, first, users be given a choice concerning *how* the assistant is to work with them. Then, the level of intrinsic motivation of users could be used as a heuristic to tailor the content, outcome and granularity of support to suit a particular user. For instance, highly motivated users may like suggestions for exploration, challenging activities and complex tasks, and ways to share their results with others, but, may require feedback that is higher in the level of construal, and is delivered at the end of a task. Conversely, users with lower motivation may require more guidance and granular feedback regarding their performance at a low level of construal during relatively risk-free tasks, however, this should not come at the expense of losing their sense of autonomy. In addition, specific strategies or interventions (Wiese et al., 2020) could be necessary to nudge the low motivation groups towards higher interest and enjoyment in the activity, while making sure that the design does not thwart autonomy and competence for high motivation groups.

## *Limitations and Future Research*

To our knowledge, our study is the first to investigate the link between users prior (endogenous) motivation and expectations. In doing so, we only looked at intrinsic motivation, which means that our analysis does not exactly represent groups that are on the opposite ends of the motivation spectrum. Using the self-regulation scale (Ryan & Connell, 1989) can help us to capture this other side, that is, extrinsic motivation and its discernable components, providing a more nuanced perspective of user motivation and its relation to user expectations. Moreover, there may be other psychological factors involved in the formation of user expectations from assistants (e.g. propensity to trust the assistant, technology expertise, fear of losing privacy and autonomy etc.) which can give us a more complete picture of user characteristics.

Regarding the structure of the study, the use of a text-based scenario allowed us to choose a specific, familiar task for all participants and gather user preferences regarding several aspects of the assistant. Doing so in an experimental setting would be a challenge, however, the insights gathered in this study could inform the design of actual prototypes which could be evaluated in an experimental setting, where users' disconfirmation and possible experiences resulting from their interaction with the assistant can be evaluated. We also think that, following the approach of James et al. (2019), more effort needs to be devoted to developing a generalized validated construct that measures the attractiveness of the assistant features, for example, delegation. In our case, since the questions were brief, users may have not fully understood for instance, how these features would be implemented and what would be required of them to achieve this functionality. Some theoretical work has already been done in this regard (Baird & Maruping, 2021), and we hope that as the various taxonomies characterizing assistant features converge, opportunities arise to test users' evaluation of the attractiveness of particular features in the design phase itself.

Further, the notion of user needs with regard to technology use has been previously explored as an antecedent of user experience. The reliability and consistency of the scales indicates that they could be used to adapt and validate measures of user expectation in the context of designing technology for well-being. Specifically, the construct of 'intrinsic expectations' as used previously could be expanded to include the social dimensions as well.

Finally, our sample size consisted of mostly German participants, who rank high in terms of individualism and uncertainty avoidance on Hofstede's cultural dimensions. These factors can affect users' propensity to trust autonomous technology (Chien et al., 2016), and it is possible that they played a role in this study. It would be helpful to conduct similar studies in different cultural and activity contexts. For instance, in this study, we chose the example of a sufficiently complex personal activity which could be purely intrinsically motivated. Activities in the context of paid work, at least in theory, always include an external motivator (i.e. financial compensation), and repeating the same study in an occupational setting may reveal a different picture regarding expectations and the role of intrinsic motivation. In a similar manner, the role of varied functional and informational complexity of tasks may also have an effect on user expectations from assistants.

## Conclusion

The facet of well-being consisting of long term growth, meaning and self-actualization is gaining importance in the design of interactive technology and information systems such as intelligent assistants. Given the size and combinatorial complexity of the design space of such assistants, designing them for well-being presents a challenge. In this paper, we have shown that looking at users' level of intrinsic motivation to do a task can be used to gauge their expectations and interactive preferences regarding how they expect to be assisted. Intrinsic motivation predicts a preference for enhancing intrinsic expectations, more specifically, competence, stimulation and influence, but not hedonic or extrinsic expectations. Those with low intrinsic motivation are more likely to expect to be guided step-by-step, and may benefit from behavior change strategies geared towards increasing intrinsic motivation. These insights could be connected to specific characteristics and dimensions of assistants and be used to develop specific prototypes to be tested under laboratory conditions.

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# Appendix A: Questionnaire used in the study.

Dear Participants,

As more and more people are ordered to stay at home due to the ongoing COVID-19 pandemic, they are discovering newer hobbies and ways to spend more time with themselves, their family or friends. Cooking at home, for example, is becoming popular again, both because of necessity and because it can be a fun, relaxing or fulfilling activity.

You have been given the opportunity to design and configure your intelligent cooking assistant that can help you in the kitchen. Note that this assistant is not a robot, nor will it be able to replace you – it is designed to work with you.

You can choose the purpose for which it should work with you. The intelligent assistant is a dedicated device that has a tangible body suitable to your kitchen (see figure below). It can observe your cooking through various sensors installed around the cooking area and you can also buy smart utensils (for example, a smart pan with built-in temperature sensor, spatula with vibration, and stove with digital controls) with which the assistant can communicate.

Now that you have a general idea about how the assistant works, we can go into the specifics. There are many ways in which the assistant could work together with you to help you achieve your goals. The following questions can help us understand how you want to configure your assistant, so that we can design those features.

| **Construct (Source)** | **Items (Likert Scale from 1 to 7)** | **Variable Name** |
|---|---|---|
| Perceived Interest/Enjoyment (McAuley, Duncan, & Tammen, 1989) | Could you tell us more about your interest in cooking?<br>1. I enjoy cooking very much<br>2. Cooking is fun<br>3. I think cooking is boring (reversed)<br>4. Cooking does not hold my attention at all (reversed)<br>5. I would describe cooking as very interesting<br>6. I think cooking is quite enjoyable<br>7. While I cook, I think about how much I enjoy it | p_interest |
| Extrinsic Expectations (Bhattacherjee & Premkumar, 2004) | All things considered, using the cooking assistant could:<br>1. improve my performance (cook more/faster)<br>2. increase my productivity (cook with less effort)<br>3. enhance my effectiveness (help me cook recipes I previously couldn't) | exp_extrinsic |
| Hedonic Expectations (van der Heijden, 2004) | All things considered, using the cooking assistant could make cooking:<br>1. unenjoyable/enjoyable<br>2. unpleasant/pleasant<br>3. tedious/interesting<br>4. boring/challenging<br>5. not fun/fun | exp_hedonic |
| Intrinsic Expectations (adapted from Lowry et al. 2015) | All things considered, the cooking assistant could help me to:<br>1. learn new recipes<br>2. master new and challenging cooking techniques<br>3. acquire healthy cooking ideas | exp_intrinsic |
| Competence Expectations (adapted from Sheldon et al. 2001) | All things considered, the cooking assistant could help me to:<br>1. master new and challenging cooking techniques | exp_competence |

| | | |
|---|---|---|
| | 2. successfully complete difficult cooking projects | |
| Stimulation Expectations (adapted from Sheldon et al. 2001) | All things considered, the cooking assistant could help me to:<br>1. learn new recipes<br>2. acquire healthy cooking ideas | exp_stimulation |
| Influence/Popularity Expectations (adapted from Sheldon et al. 2001) | All things considered, the cooking assistant could help me to:<br>1. be someone whom others look to for guidance while cooking<br>2. be someone whose advice others seek out and follow | exp_influence |
| Security Expectations (adapted from Sheldon et al. 2001) | All things considered, the cooking assistant could help me to:<br>1. make this activity structured and predictable<br>2. make me safe from uncertainties when cooking | exp_security |
| Relatedness Expectations (adapted from Sheldon et al. 2001) | All things considered, the cooking assistant could help me to:<br>1. connect to people who are important to me<br>2. feel a sense of contact with people who care for me, and whom I care for | exp_relatedness |

**Table 4. Expectation Scales**

| **Assistant Feature** | **Items (Likert scale from 1 to 7)** | **Variable Name** |
|---|---|---|
| Invocation | How would you expect the assistant to work with you?<br>1. The assistant should only do something, when I tell it to. *(delegate)*<br>2. The assistant should always act automatically when it thinks appropriate. *(autonomous)*. | <br>invoke_delegate<br>invoke_auto |
| Adaptation | How would you expect your interaction with the assistant to evolve over time?<br>1. The assistant should automatically learn my preferences over time. (adapt)<br>2. I will configure the assistant's settings myself based on my preferences. (configure)<br>3. I would like to teach and program the assistant myself over time. (program) | <br>adapt_auto<br>adapt_configure<br>adapt_program |
| Role | How would you expect the assistant to help you?<br>1. point out my mistakes so that I can improve my cooking skills and help me learn more about food. *(teacher)*<br>2. be the chef and guide me through cooking step by step *(supervisor)* | <br>role_teacher<br>role_supervisor |

**Table 5. Assistant Features Questionnaire**

Appendices B, C, and D are available online by accessing this link: https://1drv.ms/b/s!Ak3BS9Z51GasjRwKYKB6R92_oyn4?e=Bnfpn9