



Published in final edited form as:

J Abnorm Psychol. 2014 November ; 123(4): 771–782. doi:10.1037/abn0000005.

Do People with Schizophrenia Have Difficulty Anticipating Pleasure, Engaging in Effortful Behavior, or Both?

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Abstract

Motivation deficits are common in schizophrenia, but little is known about underlying mechanisms, or the specific goals that people with schizophrenia set in daily life. Using neurobiological heuristics of pleasure anticipation and effort assessment, we examined the quality of activities and goals of 47 people with and 41 people without schizophrenia, utilizing Ecological Momentary Assessment. Participants were provided cell phones and called four times a day for seven days, and were asked about their current activities and anticipation of upcoming goals. Activities and goals were later coded by independent raters on pleasure and effort. In line with recent laboratory findings on effort computation deficits in schizophrenia, relative to healthy participants, people with schizophrenia reported engaging in less effortful activities and setting less effortful goals, which were related to patient functioning. In addition, patients showed some inaccuracy in estimating how difficult an effortful goal would be, which in turn was associated

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Portions of this research were presented at the Society for Research in Psychopathology in Oakland, California in September, 2013.

with lower neurocognition. In contrast to previous research, people with schizophrenia engaged in activities and set goals that were *more* pleasure-based, and anticipated goals as being *more* pleasurable than controls. Thus, this study provided evidence for difficulty with effortful behavior and not anticipation of pleasure. These findings may have psychosocial treatment implications, focusing on effort assessment/effort expenditure. For example, in order to help people with schizophrenia engage in more meaningful goal pursuits, treatment providers may leverage low-effort pleasurable goals by helping patients to break down larger, more complex goals into smaller, lower-effort steps that are associated with specific pleasurable rewards.

Keywords

Experience sampling method; amotivation; avolition; anhedonia; goal directed behavior

Motivational impairment in schizophrenia, a key negative symptom, is an emerging area of research with important ramifications for both outcome and treatment (Barch & Dowd, 2010; Barch, 2005; Fervaha, Foussias, Agid, & Remington, 2013a; Medalia & Saperstein, 2011). In addition, motivation has been shown to mediate the relationship between neurocognition and functional outcome in schizophrenia (Gard, Fisher, Garrett, Genevsky, & Vinogradov, 2009; Nakagami, Xie, Hoe, & Brekke, 2008), and changes in motivation over time have been shown to be related to changes in psychosocial functioning (Nakagami, Hoe, & Brekke, 2010). However, motivation is a complex construct with multiple component processes (Barch & Dowd, 2010). Two such processes relevant to schizophrenia which have emerged from basic behavioral neuroscience involve incentive salience (Berridge & Robinson, 1998), sometimes referred to in the schizophrenia literature as ‘anticipatory pleasure’ (Gard, Kring, Germans Gard, Horan, & Green, 2007; Kring & Barch, 2014), and effort assessment/effort expenditure (Salamone, Correa, Farrar, & Mingote, 2007).

Over the past two decades behavioral neuroscientists have distinguished between different temporal components of reward or pleasure. In particular, researchers using animal models have found a clear difference between ‘*wanting*’, which is thought to involve dopaminergic (DA) projections along the mesolimbic pathway, and is in contrast to in-the-moment pleasure or reward, also termed ‘*liking*’, which involves serotonergic and opioid systems (e.g., Schultz, 2002; Wise, 2002). This distinction seems particularly important in schizophrenia, where patients consistently report the symptom of anhedonia (e.g., Herbener & Harrow, 2002), and yet do not report a decrease in pleasure or positive emotion to pleasant stimuli (Cohen & Minor, 2010). We previously hypothesized that the discrepancy in reported anhedonia may be an anticipatory pleasure deficit (i.e., ‘*wanting*’) and not an in-the-moment, or ‘*consummatory pleasure*’ deficit (i.e., ‘*liking*’). In an Ecological Momentary Assessment (EMA) study, we found this: people with schizophrenia reported similar levels of pleasure in their daily activities (‘*consummatory pleasure*’), but a deficit in anticipated pleasure for future goal-directed activities (Gard et al., 2007). Additional findings of an anticipatory but not consummatory pleasure deficit have been observed using a self-report measure as well (Chan et al., 2010; Gard et al., 2007; but see Strauss, Wilbur, Warren, August, & Gold, 2011). Some related, although distinct, research has focused on reward

processing in schizophrenia (for a review see Strauss, Waltz, & Gold, 2013). This research has focused less on the self-reported anticipation of pleasure or reward, or the experience of reward, and more on how people with schizophrenia respond to reward (especially monetary reward). In these studies, people with schizophrenia have shown deficits in learning from rewarded trials in a range of tasks (Gold et al., 2012; Gold, Waltz, Prentice, Morris, & Heerey, 2008; Heerey, Bell-Warren, & Gold, 2008), with decreased ventral striatal activation during the anticipation of reward (Juckel et al., 2006), which correlates with the symptom of anhedonia (Dowd & Barch, 2012). Taken together, these data indicate that individuals with schizophrenia appear to have difficulty anticipating rewarding outcomes, which may impact motivated behavior. Importantly, reward anticipation in schizophrenia has been found to be related to some elements of functioning (Buck & Lysaker, 2013; Gard et al., 2007), although its relationship to neurocognition is unknown.

Another element of DA modulation in motivated behavior involves the assessment of *effort* involved in pursuing and obtaining an upcoming reward. For example, Salamone and colleagues studied rats in a T-maze with one arm that involves low effort and a low reward, and another arm that involves high effort and high reward (their usual preference). Dopaminergic lesions and blockade of D2 receptors led the rats to prefer the low effort/low reward option (Assadi, Yücel, & Pantelis, 2009; Salamone et al., 2007). In several controls, Salamone and others have shown that DA depleted rats still prefer high reward over low reward, and that DA depletion appears to impact high effort choices. For example, when the low reward option is removed (and the only choice is to do nothing, or exert effort for reward), DA depleted rats do not differ from controls in their exertion of effort (Denk et al., 2005; Salamone, 1996). In schizophrenia, Gold and colleagues have shown that individuals high in negative symptoms have difficulty computing the effort needed on a simple button press task in order to obtain a higher reward (Gold et al., 2013). In a similar study Fervaha et al. extended these results by finding that people with schizophrenia did not have deficits in the valuation of reward (shown in a separate task), but only in the assessment of the effort involved to receive a reward (Fervaha, Graff-Guerrero, et al., 2013). These data indicate that schizophrenia may be characterized by a difficulty assessing (and expending) the effort needed to achieve a rewarding goal. In terms of the relationship of effort-assessment/ expenditure with neurocognition and functioning, both studies in schizophrenia found that difficulty with effort assessment was associated with lower neurocognition, however there are no data to date on the relationship between effort assessment and functioning, nor are there data to our knowledge on the assessment of effort in daily life in schizophrenia.

A more detailed understanding of the role of these two processes in schizophrenia has important implications for understanding real-world behavior and designing meaningful treatment interventions. For example, if impaired anticipatory pleasure is the crucial factor leading to reduced motivation, then people with schizophrenia will engage in fewer activities, will set fewer goals, and will set (and engage in) less rewarding or pleasure-based goals, because they do not “look forward” to pleasurable outcomes. Useful treatments could focus on helping patients learn to hold rewards in mind and to set and achieve pleasurable goals (Favrod, Giuliani, Ernst, & Bonsack, 2010). However, if impaired effort assessment/ effort expenditure plays the critical role in reduced motivation, then people with

schizophrenia will not have difficulty setting and engaging in pleasurable goals – indeed pleasurable activities/goals (e.g., watching a movie, eating something enjoyable) often require little effort. In this case, useful treatments would focus on helping patients break down more complicated and effortful goals into manageable and enjoyable components, and to find satisfaction in goal-directed effortful behaviors that lead to adaptive distal outcomes.

In order to contrast the ecological validity of these models of motivated behavior emerging from the basic sciences, we performed an Ecological Momentary Assessment (EMA) study to elucidate the specific activities and goals of patients in their daily lives. Specifically we were interested in participants' experience of pleasure during their daily activities and goals, while also systematically evaluating the qualitative aspects of the activities and goals. Most EMA studies sample behavior utilizing either pagers or wrist watches as alarms, along with paper and pencil forms, to have participants respond to specific questions about their environment and experience, with recent studies utilizing smartphones and text messages to acquire these data. We adapted this traditional EMA format by using cell phones, with a trained research assistant caller who contacted participants with semi-structured questions throughout the day. This methodology shifts the cognitive or motivational burden of recording and tracking of daily life to study personnel, making it easier for participants to respond to open-ended questions without needing to type or write long responses. This method has also been used successfully with a number of complicated populations (e.g., Galloway, Didier, Garrison, & Mendelson, 2008; Lanzi et al., 2007). In the present study the use of cell phone calls allowed participants to respond to open-ended questions about their activities and goals, and for those activities and goals to be later coded on the pleasure and effort involved. Given that we were interested in motivated behavior, we were careful to select our comparison (healthy control) group to be as similar to our participants with schizophrenia as possible, since factors unrelated to diagnosis could directly influence the findings. In addition to confirming that demographic variables were similar (including participant education and parental education level), we included analyses on participant employment, and also assessed the level of reward/stimulation of the home environment of participants. Research has shown that the level of stimulation in the environment can influence motivation (e.g., Gottfried & Fleming, 1998), although this work has primarily focused on children. In the present study this assessment was completed by trained study personnel who visited the homes of our participants, and rated the environment on the degree to which the home environment was stimulating/rewarding.

We investigated the following questions:

1. Compared to a socio-demographically matched group of healthy participants, do participants with schizophrenia demonstrate fewer daily activities and goals, decreased anticipatory pleasure for their upcoming goals, decreased pleasure-based goals, but intact in-the-moment pleasure? Such findings would be consistent with impaired pleasure anticipation (i.e., deficits in *anticipatory pleasure*).
2. Do participants with schizophrenia pursue goals and activities that are less effortful than healthy comparison participants, and do they have difficulty assessing the effort of an upcoming goal? Such findings would be consistent with impaired effort assessment/effort expenditure. It is important to note that these two mechanisms

(anticipatory pleasure vs. effort impairment) are not mutually exclusive, and that people with schizophrenia could show either or both types of impairment.

3. Do people with schizophrenia have difficulty completing their goals, and is this related to anticipation or experience of pleasure, or to how effortful the goal is?
4. In people with schizophrenia, what is the relationship of anticipatory pleasure and effort exertion/assessment to: cognitive dysfunction, symptoms, and functioning?
5. To what degree could group differences found in questions 1–4 be explained by any other non-diagnostic group differences (e.g., demographic differences, employment differences, or how stimulating/rewarding the home environment was)?

Method

Participants

All patient participants were recruited from outpatient clinics and day treatment centers in the San Francisco Bay Area. Healthy comparison participants were recruited through online postings and flyers distributed in the Bay Area. Exclusion criteria for all participants included a history of head trauma/loss of consciousness, substance abuse in the last six months, neurological or debilitating medical disorders, or non-fluency in English. Patients were excluded if there were any significant changes in medication or dosage in the previous 30-days, or if there was a hospitalization in the previous three months. Forty-seven stable outpatients with schizophrenia (n=31) or schizoaffective disorder (n=16) and 41 healthy comparison participants completed the study and were included in all analyses. Diagnoses were confirmed for all participants using the SCID, DSM-IV-Clinician Version (First, Spitzer, Gibbon, & Williams, 1997). People with schizophrenia were also administered the Positive and Negative Syndrome Scale (PANSS: Kay, Fiszbein, & Opler, 1987). There were no differences in any demographic measure between groups, except employment, where people without schizophrenia were more likely to be employed (see Table 1).

Measures

Ecological Momentary Assessment—Each call consisted of a brief semi-structured interview with questions about current participant experiences, the environmental context, and the participant’s goals for the next few hours (e.g., ‘Who are you with?’, ‘What are you doing?’, and ‘What goals do you have, or what are the most important things you would like to do, in the next few hours?’). The decision to use the question “What goals do you have, or what are the most important things you would like to do, in the next few hours?” was based on careful piloting of both people with and without schizophrenia in which we described in lay terms that we wanted to gather data on ‘important things that they wanted to do in the next few hours.’ For both groups, the term ‘goals’ was understood clearly, and participants described their behaviors and plans in this way. In addition, we were careful in the study orientation to work with each participant to be clear that they understood that ‘goals’ was meant to refer to important things they wanted to do, planned for the coming few hours, and we made sure that the test call examples with all participants reflected that that they understood all questions. Research assistants during the orientation and calls were careful to

not direct participants to respond in any particular way, but instead to allow participants to answer in whatever way they desired. Participants could offer up to 4 responses to the activities and goals questions. *Consummatory pleasure* was assessed by asking each participant ‘How much are you enjoying what you are doing?’; *anticipatory pleasure* was assessed for each goal with the question ‘How much enjoyment do you think you will get out of (this goal)?’; both questions used a Likert scale (0=not at all, to 5=extremely). On subsequent calls, research assistants asked these same questions, and whether they completed the goals mentioned on previous calls. Thus, if a participant mentioned a goal of ‘cleaning their room’ on call 5, on call 6 they were asked if they completed this specific goal. For a subset of participants (people with schizophrenia N=25, without N=21) we assessed how difficult the participant thought each goal would be, using the same 0–5 Likert scale. There were no demographic differences between these participants nor between the overall subject samples.

Home Assessment—After the EMA week, two independent research assistants travelled to the homes of 40 participants with schizophrenia and 32 participants without schizophrenia to complete the home assessment. Seven people with schizophrenia and nine people without schizophrenia decided not to complete the home assessment. The reasons for not completing the assessment included scheduling problems (unavailable in the several weeks after the EMA period), not feeling comfortable with the assessment, and a roommate or parent not feeling comfortable with the home assessment. There were no demographic differences between participants who completed the home assessment and those who did not, nor were there differences within group, on measured dependent variables. Once in the home of the participant, research assistants completed a modified version of the Environmental Assessment Scale (EASy; Velligan & Bow-Thomas, 2000; Velligan et al., 2000). This scale measures several aspects to the home environment and has been used primarily in Cognitive Adaptive Training in schizophrenia. In order to derive a stimulating/rewarding environment score we added items to the EASy from the Home Observation for the Measurement of the Environment (HOME; Elardo & Bradley, 1981). The two raters coded how stimulating/rewarding the environment was on three factors 1) how aesthetically stimulating/rewarding the home was (e.g., pictures on the walls, whether the environment was not cluttered, dark or monotonous), availability of media (e.g., books, magazines, cable TV, internet, phone access), and social stimulation (e.g., presence of other people in their living environment and how often participants reported interacting with these people). We computed an average rating of all three domains (for an ‘overall stimulation’ score) and individual averages of the three separate subdomains. Inter-rater reliability on the home assessment was computed using intra-class correlations (ICC), which indicates the degree of agreement/disagreement between coders and can range from –1.0 to 1.0. All ICCs for this study were calculated using a two-way mixed, consistency, average-measures ICC as described and suggested by McGraw & Wong (1996). ICC’s for the home assessment were all > .80, indicating excellent agreement.

Neurocognition—During a separate laboratory session, 40 participants with schizophrenia completed the MATRICS Consensus Cognitive Battery (Nuechterlein et al., 2008). There were no differences between the 7 patients who did not return for the MATRICS testing and

the 40 that did. We used an overall average of these measures for all analyses reported here. Analyses were also completed using the subdomains of the MATRICS, with nearly identical findings for working memory and processing speed. We report on the overall average here for brevity.

Clinician ratings of functioning—Participants with schizophrenia were rated on an abbreviated version of the Quality of Life Scale (Bilker et al., 2003). To assess overall functioning we averaged the ‘acquaintances’, ‘social initiative’, ‘extent of occupational role functioning’, ‘common place objects’ and ‘capacity for empathy’ items (alpha was very good at 0.82). We did not include the items ‘motivation’ and ‘anhedonia’ so that we would not conflate our functioning measure with our EMA dependent variables that emphasize motivated behavior and enjoyment/pleasure¹.

Procedures

Study process and payment—Participants were fully oriented to the EMA procedure in the laboratory (which included test calls to explain the procedure and to answer any questions), and each participant provided written informed consent. In order to maintain call consistency all participants used provided study phones regardless of whether they owned a cell phone. Participants were called four times a day for seven days between the hours of 9am and 9pm at pseudorandom times, in line with previous EMA procedures (Csikszentmihalyi & Larson, 1987; Granholm, Loh, & Swendsen, 2008). Participants were paid both for returning the phone (\$44) and \$2 per phone call responded to (up to an additional \$56) (Galloway et al., 2008), plus \$10 per hour for completing the other measures. The home assessment was completed at the end of the EMA call period. All phone calls and home assessments were audio recorded for later quality checks.

Qualitative Coding of Activities and Goals—All participants’ activities (‘Who are you with?’, ‘What are you doing?’) and goals (“‘What goals do you have, or what are the most important things you would like to do, in the next few hours.’?”) were type-written verbatim by the research callers and were later randomly ordered for independent coding. All participants’ responses were mixed together such that responses from people with and without schizophrenia were coded together. Four independent coders then rated each individual activity and goal on a Likert scale (0=not at all, to 3=extremely) on specific attributes of the activity or goal, based on the above research questions. ‘*Pleasure-based*’ activities and goals were defined as: “typically not involving enjoyment or pleasure” (e.g., washing dishes, filling out forms, running an errand) to “typically very pleasurable” (e.g., eating something for pleasure, watching TV, playing games). ‘*Effortful*’ activities and goals were defined as “simple perfunctory activity or goal” (e.g., eating a readymade meal, walking a dog, watching TV) to “major forethought and planning” (e.g., creating a meal for several people, repairing a bike, engaging in a multi-task chore). ‘*Long-term benefit*’ activities and goals were defined as “typically no long-term potential benefit to health, occupation or social functioning” (e.g., eating something not especially healthy, doing a

¹Analyses completed with the full abbreviated QLS scale resulted in similar findings to those reported here, with stronger relationships between effortful behavior when the ‘motivation’ item was included in the analysis. Inclusion of the ‘anhedonia’ item did not change the relationship between the QLS and anticipatory or consummatory pleasure ratings by participants.

daily chore, passing the time) to “large potential” (e.g., exercise, learning a new skill, making friends). ‘Social’ activities and goals were defined as “not involving other people” (e.g., doing an activity at home alone, or only incidentally involving others, such as riding on public transportation) to “the primary reason for the activity/goal was to interact with other people” (e.g., going to a friend’s house to spend time with them). See Table 2 for a summary of the ratings. All coders were extensively trained in several meetings on a subset of the data to reach good reliability before they coded the larger data set.

Intra-class correlations for the final coded data set for all ratings were $> .65$, ranging from good to excellent. Coding discrepancies were handled such that differences in 1 point between raters (e.g., one rater rated a goal as a 1, and another a 2) were averaged (1.5). When raters differed by more than 1 point, consensus ratings were completed (by DEG and AHS). Less than 6% of the activities and goals in any one category differed by more than one rating point.

Data Analytic Strategy

All EMA analyses were conducted using Hierarchical Linear Modeling (Bryk, Raudenbush, & Raudenbush, 1992). HLM is recommended for EMA studies as it allows for missing data and is ideal for nested data. HLM treats multiple observations from each participant as ‘Level 1’ data and the between-group differences as ‘Level 2’ data (Schwartz & Stone, 1998). Separate models were computed for each analysis reported; significance levels as well as effect sizes (pseudo- r^2 for EMA variables and Cohen’s d for all others) are also reported here. For the relationship between EMA dependent variables and clinical variables in the participant group with schizophrenia, the Level 2 factor was symptoms, neurocognition, or functioning as listed. For the home assessment domains, independent samples t -tests were computed for the overall stimulation of the environment as well as the three specific subdomains.

Results

Feasibility of this EMA Method

Fifty people with schizophrenia were approached and signed informed consent; two people found the study method was too involved prior to the first call, and one person stopped after two calls. Forty-three participants without schizophrenia provided informed consent, but one dropped out after the first day due to finding the study too burdensome, and one responded to less than 1/3 of the prompts (deVries, 1992). The remaining 47 participants with schizophrenia and 41 participants without schizophrenia provided the data presented below. All cell phones were returned in working order, except for one lost phone and one phone that was water damaged. The call response rates did not differ between the two groups: people with schizophrenia responded to 80.61% (SD = 17.02) of the calls, compared to 81.31% (SD = 14.43) for people without $t(86) = -0.91, p = .85$, and these response rates are well within suggested guidelines (deVries, 1992).

Question 1: Anticipatory/consummatory pleasure assessment

People with and without schizophrenia did not differ in the quantity of the activities $t(86) = 1.09, p = .92$ or goals they reported $t(86) = 1.33, p = .21$. In contrast to previous findings, relative to the healthy comparison group, people with schizophrenia reported *higher* levels of *anticipatory pleasure* for goals, $t(86) = 2.46, p = .02, pseudo-r^2 = 0.06$, but similar levels of *consummatory pleasure* for activities, $t(86) = 1.04, p = .30$. See Figure 1. In addition, independent coders rated the activities of people with schizophrenia as *more* pleasure-based $t(86) = 4.22, p < .001, pseudo-r^2 = 0.19$ than people without schizophrenia, and similarly, the goals that participants with schizophrenia set were rated as more pleasure-based $t(86) = -3.38, p = .001, pseudo-r^2 = 0.19$. Anticipatory and consummatory pleasure was unrelated to the quantity of activities and goals. Overall, these findings suggest that impaired reward anticipation/anticipatory pleasure may *not* play a key role in motivated behavior in daily life in schizophrenia, in terms of quantity of activities or the number of goals set, or in the pleasurable quality of the activities and goals.

Question 2: Effort expenditure and effort assessment

Independent coders rated the *activities* of people with schizophrenia as less effortful $t(86) = -7.41, p < .001, pseudo-r^2 = 0.45$, and as having less long-term benefit $t(86) = -7.08, p < .001, pseudo-r^2 = 0.49$, but similar in how social they were $t(86) = -1.48, p = .14$. Coders also rated the *goals* of people with schizophrenia as less effortful, $t(86) = -7.65, p < .001, pseudo-r^2 = 0.45$, as having less long-term benefit, $t(86) = -4.70, p < .001, pseudo-r^2 = 0.25$, and as less social, $t(86) = -2.32, p = .02, pseudo-r^2 = 0.05$. See Figure 2.

Even though the goals of the schizophrenia participant group were independently rated as less effortful than those of the matched comparison participants, the difficulty ratings of participants (i.e., how difficult the participant thought an upcoming goal would be) did not differ between the groups $t(86) = 0.86, p = .91$. We next examined whether the relationship between (study personnel) coded effort and participant self-report of goal difficulty was significantly different between patients and controls (with the assumption that more effortful goals should be rated by participants as more difficult). We detected a significant cross level interaction, such that there was a stronger relationship between coder's long-term ratings and the participant's self-reported difficulty ratings for our healthy participant group compared to our group with schizophrenia. In other words, for our group with schizophrenia there was a significantly weaker relationship between difficulty ratings and independent coders' long-term ratings as compared to this relationship in the healthy comparison group, $t(49) = -2.52, p = .015$. There was also a trend for coders' ratings of the effort of goals as they related to participants' difficulty ratings, $t(49) = -1.76, p = .086$. Taken together, our findings indicate that people with schizophrenia set less effortful goals, and engage in less effortful activities, but also have a more idiosyncratic assessment of the difficulty and effort involved in accomplishing their upcoming goals.

Given the significantly fewer social goals reported by people with schizophrenia, and at the suggestion of a reviewer, we also completed a post hoc analysis investigating the relationship of the social qualities of activities and goals as they related to participant reported enjoyment levels. Specifically, we investigated whether there were group

differences in participant reported activity enjoyment as the activity was independently rated as more social, and whether there were group differences in anticipated enjoyment as the goal was rated as more social. We found that for people with schizophrenia, there was a trend that anticipatory pleasure was more weakly related to the social nature of their goals $t(86) = -1.92, p = .058$. The group differences for consummatory pleasure and social activities did not reach significance $t(86) = -1.37, p = .173$, however. In other words there was a trend such that people with schizophrenia did not appear to differentiate their enjoyment in anticipation by how social the goal was. People without schizophrenia, on the other hand, tended to rate activities and goals as more enjoyable as the activity was coded as more social.

Question 3: Goal completion

There were no group differences in reported goal completion $t(86) = 1.33, p = .21$, and goal completion was unrelated to anticipatory pleasure, or the coded quality of the goals. The similar rates of goal completion may be due to the differences in the quality of the goals set. Post hoc analyses indicated that 92% of goals for our group with schizophrenia were rated as having either no effort or very little effort (not one goal in more than 2000 schizophrenia-participant goals was rated as a 3, and only 28 were rated as a '2') compared to 69% of our healthy comparison goals rated as no or very little effort. In other words, people with schizophrenia set less effortful goals, but were able to complete them at the same rate as participants without schizophrenia².

Question 4: Relationship of dependent variables to neurocognition, symptoms, and functioning within the patient participant group

Neurocognition—Dependent variables of activities and goals (anticipatory pleasure ratings, as well as coder ratings of pleasure, effort, long-term benefit, and social) were all unrelated to the overall neurocognitive abilities of patients (all p 's $> .15$). However, the relationship between patient ratings of the difficulty of a goal and the independent coder's ratings of effort of the goals were explained by neurocognition $t(18) = 2.12, p < .05$. In other words, patients with schizophrenia who had lower neurocognitive functioning appeared to have more trouble assessing how difficult an upcoming goal would be.

Positive, negative and overall symptoms were unrelated to measured dependent variables with the exception that individuals with more negative symptoms set goals with less long-term positive potential $t(41) = -2.63, p = .01, pseudo-r^2 = 0.14$.

In terms of *functioning* as measured by the QLS, people with schizophrenia with lower functioning showed lower effortful goals $t(40) = 2.86, p = .007, pseudo-r^2 = 0.17$, lower social activities $t(40) = 3.93, p < .001, pseudo-r^2 = 0.27$, and goals $t(40) = 3.49, p = .001$,

²In addition to asking participants if they completed the previously mentioned goal, we also completed a post hoc analysis of activities and goals to see if there were group differences in whether participants happened to be engaging in activities they previously mentioned as a goal. Unfortunately, this analysis was unsuccessful as less than 5% of the activities in both groups were mentioned as a previous goal. The primary reason for this was likely due to the fact that the question about the specifics of the activities ('What are you doing') was not clear enough to directly tie it directly to previous goals. A follow-up question, "is this activity the goal you previously mentioned" would have more precisely tested this question.

$pseudo-r^2 = 0.25$ and lower long-term positive activities $t(40) = 3.17, p = .003, pseudo-r^2 = 0.28$.

Question 5: Relationship of dependent variables to other factors, including between group differences in employment or the stimulation of the home environment

Employment—Given that people with schizophrenia were less likely to be employed, and that employment could have an impact on the significant differences seen in Questions # 1 and 2 above (*anticipatory pleasure*, and the types of activities and goals that participants engaged in: *effort, long-term, pleasure-based, and social*), we assessed the effect of employment on our dependent variables in three ways: 1) Does employment predict our dependent variables listed above when we combine participant groups into one larger sample? 2) Do patient versus control differences on the dependent variables above remain significant when employment is added into the model? 3) Given the much higher variability in employment in our healthy control group, what is the relationship of employment to our dependent variables in the healthy group only? Q1: We found that anticipatory pleasure was unrelated to employment, but that employment did predict the quality of *activities* (effort, $t(82) = 2.83, p = .006, pseudo-r^2 = 0.11$, long-term implications $t(82) = 2.75, p = .007, pseudo-r^2 = 0.10$, and pleasure-based activities, $t(82) = -2.69, p = .009, pseudo-r^2 = 0.10$ (although not social activities $t(82) = 1.27, p = .18$)), but was not related to any goals. Q2: When employment was added to our dependent variable model, group remained a significant predictor for all variables, except pleasure-based activities, which fell to non-significance $t(82) = 1.67, p = .15$. Q3: Within our control group only, we found that employment was unrelated to anticipatory pleasure, predicted the quality of some activities (effort $t(39) = 2.87, p = .007, pseudo-r^2 = 0.17$, and long-term $t(39) = 2.46, p = .007, pseudo-r^2 = 0.15$) but not others (pleasure-based activities $t(39) = -0.81, p = .43$, or social activities $t(39) = -1.30, p = .20$). There were no significant relationships between control participant goals and employment. Thus, as one would expect, employment appears to impact the quality of some activities that participants are engaging in over the course of the week. However, employment does not impact the goals that participants set for themselves. Most importantly, for the present study, participant group differences continued to explain nearly all differences in activities and goals over and above employment differences.

Home Assessment—People with schizophrenia were rated as having less of an overall stimulating environment than people without schizophrenia $t(68) = 2.35, p < .05, d = 0.57$, and this was driven by less media stimulation $t(68) = 2.23, p < .05, d = 0.54$ and less social stimulation in the environment $t(68) = 4.09, p < .001, d = 0.99$, but not by how aesthetically stimulating the environment was $t(68) = 0.24, p = .81$. Given these group differences in the stimulation of the environment, we included our significant home assessment variables (overall, media stimulation, and social stimulation) into our HLM models as a Level 2 variable to check if home environment stimulation explained any of the group differences seen in Questions 1–3. With the addition of the home assessment variables into the HLM model all significant differences remained. In other words, the stimulation of the environment, as measured by the amount of media or social stimulation (or overall average), did not explain the group differences found in the EMA task³.

Discussion

There is a surprising dearth of information on the actual activities and goals of people with schizophrenia (Foussias, Mann, Zakzanis, van Reekum, & Remington, 2009). To our knowledge, this is the first study to use EMA to systematically assess these daily real-world activities and goals; our most significant finding was that individuals with persistent schizophrenia and socio-demographically matched comparison participants differ mainly in the *quality* rather than the quantity of the activities engaged in and the goals set. Our finding of a similar number of activities and goals is in line with a recent study using the Day Reconstruction Method (DRM; a structured self-report that asks participants to reconstruct their previous day), that showed that people with schizophrenia reported doing a similar number of activities to people without schizophrenia (Agid et al., 2012). Our data expand on this and appear to align with problems in effort exertion and effort assessment in people with schizophrenia, who chose activities and set goals that were less effortful, had fewer long-term positive benefits, and were more pleasure-based than participants without schizophrenia.

In terms of our first question, an unexpected finding was that people with schizophrenia reported *higher* levels of anticipated pleasure of goals than participants without schizophrenia. This contradicts our previous EMA study, where we found people with schizophrenia reported *lower* levels of anticipatory pleasure (Gard et al., 2007). The largest methodological difference here was the use of a live research assistant caller. Indeed, given that people with schizophrenia set significantly fewer social goals, the interactions with the research assistant may have been an important social contact for them. Perhaps the boost of social engagement with the caller activated more anticipatory pleasure through the known interaction effects of social cognitive and pleasure/motivation circuits (Ochsner, 2008; Zaki & Ochsner, 2009). It is also possible that the research assistant caller activated social desirability (to ‘look better’) when the participant with schizophrenia was asked about anticipated pleasure of goals, thus making future goals more salient in a manner not typically part of their daily lives. It should be noted, however, that consummatory pleasure did not differ between groups, and it is unclear why social desirability or social contact would be higher for anticipatory pleasure only.

An alternative explanation is that the anticipation of pleasure is not impaired in schizophrenia, or that patient self-reports of anticipated pleasure are not reliably measured. To our knowledge this is just the second of two studies of anticipated pleasure in daily life in schizophrenia, with the present study utilizing a slightly different question about goals (“How much enjoyment do you think you will get out of (this goal)”) as opposed to our previous study, which assessed the anticipation of future events (“What are you looking forward to...” and “How much do you think you will enjoy that...”) (Gard et al., 2007). Both of these assessments of anticipated pleasure involve a predicted element of pleasure experience, which is in contrast to studies that have used the Temporal Experience of

³We also investigated whether the home assessment variables were related to any of the dependent variables in the EMA task. There were no significant associations of the home assessment to EMA dependent variables in people with schizophrenia. In the healthy participant group, overall stimulation of the environment was significantly related to the effort level of goals $t(28) = 2.18, p = .04$.

Pleasure Scale, which measures pleasure experienced in anticipation, and has indicated lower anticipated pleasure in people with schizophrenia (Chan et al., 2010; Gard et al., 2007; but see Strauss et al., 2011). Thus, one possibility is that people with schizophrenia struggle with pleasure experience in anticipation, and not the future *prediction* of pleasure. It is unclear whether the anticipatory pleasure findings of the present study are due to these measurement differences, social desirability, unreliability of the measure of anticipation of pleasure, or some combination of these factors. Regardless, the present findings of higher anticipatory pleasure in people with schizophrenia do not necessarily contradict deficits seen in patients in reward learning or, alternatively, ‘wanting.’ Instead research in this area has relied less on the self-report of experience and more on behavior and physiology. Indeed, researchers focusing on neurobehavioral models of reward in depression have emphasized deficits in the role of effortful behavior over deficits in pleasure experience (e.g., Treadway & Zald, 2011).

Although the finding of higher anticipated pleasure in schizophrenia may be due to using research assistant callers, social desirability, or self-report of future pleasure experience, this is not likely a factor in the coded ratings of the actual activities and goals, which were rated *post hoc* by research assistants blind to participant group. In these coded ratings, a pure deficit in anticipated pleasure was also not supported; instead, people with schizophrenia set goals that were *more* pleasure-based. Therefore, our data indicate that people with schizophrenia do not struggle with the pursuit of future high reward goals when the goal does not require much effort. Interestingly, while anticipatory pleasure was higher, and pleasure-based goals and activities were higher in people with schizophrenia, consummatory pleasure was not. One would expect that the higher number of pleasure-based activities would lead to higher consummatory pleasure. One interpretation of this finding could be a deficit in consummatory pleasure for our patient group. However, it should be noted that while consummatory pleasure was not significantly different between the groups, patients did in fact report a higher mean of enjoyment over the week. This is the first to our knowledge of such a finding, and again may be due to the specific methodology used.

An additional interesting finding regarding anticipated enjoyment was a trend that people with schizophrenia appeared to anticipate social activities as being less enjoyable than people without schizophrenia. One interpretation of this is that social anhedonia in schizophrenia may be understood in part as a lack of hedonic differentiation between social and non-social contexts, as opposed to a simple lack of enjoyment in social interactions. It is also possible (and perhaps likely) that patients have a more complicated relationship with the individuals they interact with, resulting in a less linear relationship between social contact and enjoyment. This needs further replication, but is in line with research finding that people with schizophrenia, and individuals high in social anhedonia may find social interactions as less pleasant than healthy individuals (Gard & Kring, 2009; Kwapil et al., 2009).

In the present study our findings of higher anticipatory pleasure may also be related to the answers to our second question. Perhaps activities and goals were more frequently pleasure-based in part because they require low effort (e.g., watching TV, eating something enjoyable). Specifically, we found that people with schizophrenia engaged in activities and

set goals that were less effortful overall and involved less long-term positive benefit, and both of these processes were related to patient functioning. This finding is also in line with the recent study using DRM that found that people with recent-onset schizophrenia were engaging in fewer goal-directed activities (Agid et al., 2012). Thus, effort expenditure appears to be an important part of the deficit in motivated behavior for people with schizophrenia. In addition, relative to healthy participants, for people with schizophrenia, the assessment of the difficulty of a goal was less correlated with the actual effort of the goal. This finding appears to be consistent with recent laboratory based work where people with schizophrenia have shown difficulty calculating the amount of effort that is needed to receive a reward, especially in high reward situations (Gold et al., 2013). In that study, people with schizophrenia with high negative symptoms showed the most difficulty assessing effort, which is also consistent with our finding that people with high negative symptoms set goals that have less positive long term benefit. This difficulty assessing effort may be related to reward representation problems (Gold et al., 2008); people with schizophrenia may have particular difficulty representing a goal's positive/rewarding value when the concomitant assessment of effort is also required. It is also important to note that reward representation and effort computation may be inherently linked processes (Barch & Dowd, 2010; Fervaha, Foussias, Agid, & Remington, 2013b).

Interestingly, neurocognition was unrelated to the quality of goals. Although we expected that higher cognitive functioning would relate to more effortful tasks (since these behaviors should require more planning and execution), the null results here may be due to the limited range of activities and goals that were set by our group with schizophrenia. Nevertheless, in line with recent laboratory studies of effort assessment in schizophrenia (Fervaha, Graff-Guerrero, et al., 2013; Gold et al., 2013), neurocognition did explain the less accurate relationship we observed between patients' ratings of goal difficulty and how effortful the goal appeared to be. This lends further evidence that people with schizophrenia are struggling to compute the cost or difficulty in completing a goal – especially when cognition is impaired. Surprisingly, negative symptoms were only related to the long-term implications of goals, and were unrelated to other qualities of activities and goals of participants. Given the centrality of amotivation to negative symptoms in schizophrenia, we expected there to be more substantive relationships with these variables to negative symptoms overall. One possibility is our use of the PANSS as a negative symptom measure. This measure focuses less on the constructs of amotivation or anhedonia (emphasizing instead 'passive apathetic social withdrawal' and 'disturbance of volition', which is defined as "willful initiation, sustenance and control of ones thoughts, behavior, movements and speech" and less about motivated behavior per se). Thus, our choice of a negative symptom measure may have not been ideal. Future research may wish to utilize a measure more closely tied to specifics of motivated behavior such as the CAINS (Blanchard, Kring, Horan, & Gur, 2011).

In terms of study limitations, first, as previously mentioned, our findings regarding higher anticipatory pleasure ratings may be due the social interactions with the research caller (cell phone calls, for example, are known to increase participant involvement in treatment) (e.g., Depp et al., 2010; Ehrenreich, Righter, Rocke, Dixon, & Himelhoch, 2011). If this mechanism is contributing to enhanced anticipatory pleasure in people with schizophrenia, it

may represent an important therapeutic tool that can be explicitly harnessed. A second limitation was our focus on short-term, rather than long-term goals. However, we examined this indirectly by determining whether people with schizophrenia engaged in goals with long-term positive implications, and found they did not set such goals at the same rate as our healthy comparison group. Third, to our knowledge this is the first study that has involved an assessment of the home environment as it relates to motivation in schizophrenia; however, the mostly null findings related to motivation here are certainly preliminary. Indeed, the differences seen between participant groups regarding overall stimulation of the environment highlights this as a possible avenue for future exploration. Fourth, our finding that participants' assessment of goal difficulty and researchers' ratings of goal effort was less strongly related in people with schizophrenia, was based on a smaller sample than the overall analyses and should therefore be interpreted with caution. Finally, although employment differences did not explain much of the key findings reported here (i.e., the quality of the activities and goals of participants remained significant by group when controlling for employment), the employment differences between our groups makes this factor difficult to completely rule out. Ideally, our healthy participant group would have been equivalent in terms of employment. However, it should be noted that sampling a healthy participant group high in unemployment poses its own set of problems, including the possibility of having a healthy participant group with higher motivation difficulties. Indeed, nearly one-third of our healthy control participants were unemployed (much higher than the general population unemployment rate), which may imply that our healthy control group differs in some ways to the general community population. Future research may also benefit from a longitudinal focus where participant changes in employment may be tied to changes in motivated behavior. In addition, the meaning of being employed or unemployed may be different for our participant groups. For example, being unemployed with a severe mental illness versus being unemployed but seeking work may have large differences in how participants structure their activities and goals. Thus, researchers may wish to assess what it means to participants to be unemployed in order to fully understand the impact of this factor.

Our study elucidates the nature of motivated behavior in the daily lives of people with schizophrenia, and emphasizes that effortful activities and goals, and the assessment of the difficulty of these goals, are crucial areas of impairment that are in turn related to neurocognitive dysfunction. In addition, our novel approach to the assessment of daily life in schizophrenia allowed for the assessment of important qualitative data, and is consistent with an increase in the use of mobile technology in both research and treatment of schizophrenia (e.g., Johnson et al., 2009; Palmier-claus et al., 2012). Treatment implications from this study are three-fold. First, it appears that a vigorous focus on cognitive improvement, particularly early in the course of illness, will be an important aspect of helping people with schizophrenia retain the ability to accurately assess goal difficulty, and to set and achieve effortful goals with long-term benefit. Second, the intact ability to set and enjoy low-effort pleasurable goals may be used as a leverage for helping people with schizophrenia break down larger, more complex goals into smaller, lower-effort steps that are associated with specific pleasurable rewards, including extrinsic as well as intrinsic rewarding factors (Medalia & Brekke, 2010; Silverstein, 2010). Third, our unexpected finding of a possible role for social engagement in specifically enhancing anticipatory

pleasure requires replication and follow-up. A greater understanding of all of these processes will be critical for developing maximally effective interventions for individuals with schizophrenia.

Acknowledgments

This work was supported by Award Number R21MH086801 from the National Institute of Mental Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Mental Health or the National Institutes of Health.

We would like to thank Dawn Velligan, Ph.D. for her input on the adaptation of the Environmental Assessment Scale for use in this study. We would also like to thank the following research assistants for their hard work on this project: Vallena Bircheff, Elma Caplin, Yasmin Campos, Jennifer Chou, Devyn Difilippo, Jennifer DiJoseph, Yvette Fama, Meredith Frank, Claudia Gara, Heidi Iseman, Lindsey Lavaysse, Samantha Mitchell, Sunny Pence, Jessica Starr, Wallace Smith, and Courtney Stich.

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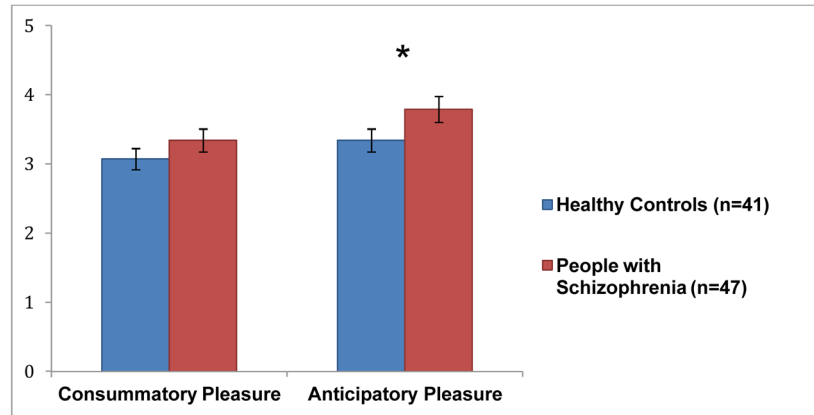


Figure 1.

In contrast to previous research, people with schizophrenia reported *higher* levels of anticipation of enjoyment of goals – ‘anticipatory pleasure’-- relative to comparison participants. * $p < .05$.

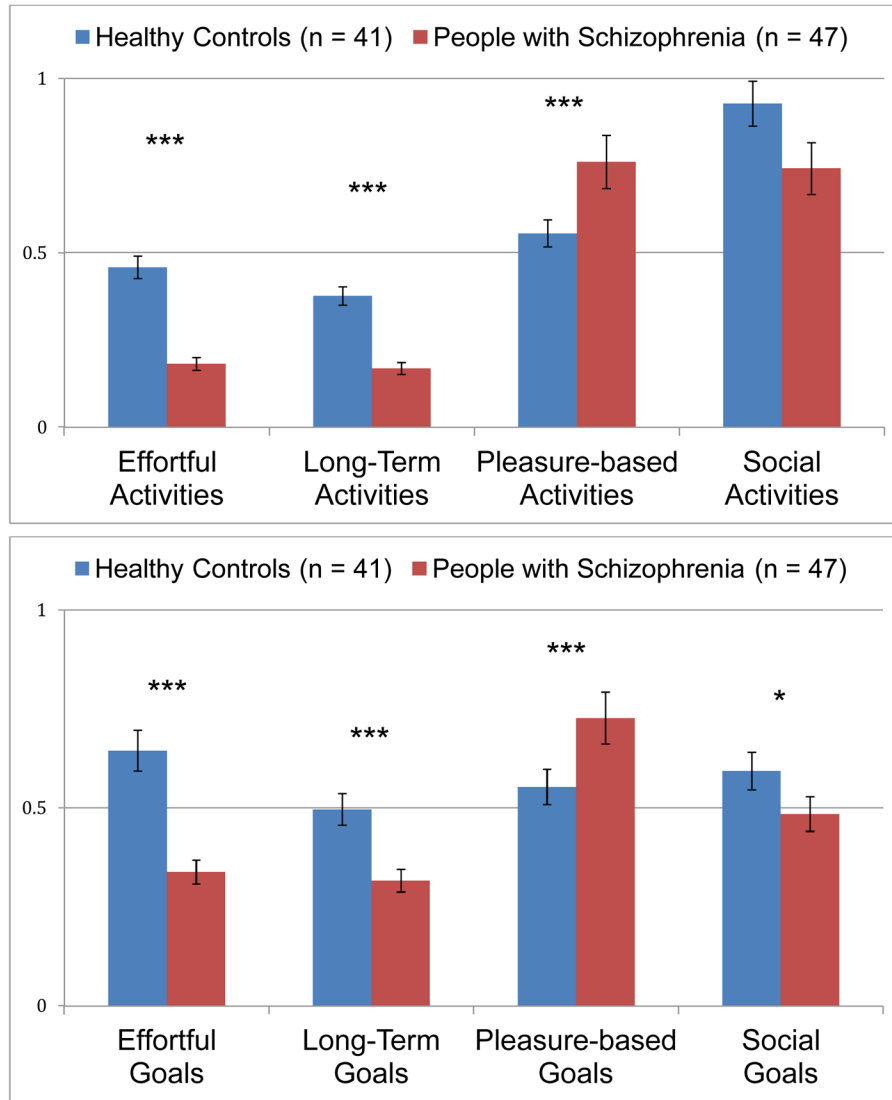


Figure 2.

Relative to comparison participants, people with schizophrenia differed on the quality of the activities that they participated in and the types of short-term goals they set for themselves. Quality of activities and goals were rated by independent coders on how much effort was involved, how much long-term positive benefit could result, how pleasurable, and how social they were. $*p < .05$, $**p < .01$, $***p < .001$.

Table 1

Participant characteristics

Characteristic	Schizophrenia N=47	Healthy Comparison N=41	p-value
Age	39.55 (13.95)	36.83 (14.89)	.38
Education – years (SD)	13.9 (2.55)	14.55 (2.05)	.21
Parental Education – years (SD)	13.95 (2.75)	14.25 (3.46)	.68
Gender, n, %			.20
Male	35, 74%	26, 63%	
Female	12, 26%	15, 37%	
Ethnicity, n, %			.39
African American	6, 13%	5, 12%	
Caucasian/ White	18, 38%	21, 51%	
Asian American	9, 19%	8, 19%	
Latino	8, 17%	6, 15%	
Other	6, 13%	1, 2%	
Employment, n, %			<.001
Full Time	2, 4%	10, 24%	
Part Time	6, 13%	18, 44%	
Unemployed	39, 83%	13, 32%	
Diagnosis – n:			
Schizophrenia	31	NA	
Schizoaffective	16	NA	
Chlorpromazine Eq. (SD)	418.14 (555.67)	NA	
PANSS-Total, Sum Average (SD)	64.42 (13.11)	NA	
PANSS – Positive, Average (SD)	15.27 (4.97)	NA	
PANSS – Negative, Average (SD)	16.69 (5.27)	NA	
MATRICES MCCB, Average z (SD)	–0.99 (0.88)		

Note: There were no demographic differences between groups on any variable except employment.

Table 2

Means (and standard deviations) of dependent variables, and descriptions of the questions and coded variables.

	Schizophrenia (N=47)	Healthy Comparison (N=41)	t-value
Q1: ANTICIPATORY ENJOYMENT			
Quantity of activities reported (SD)	32.89 (11.98)	31.81 (10.24)	1.09
Quantity of goals reported (SD)	44.49 (5.50)	40.76 (12.33)	1.33
Participant consummatory rating of activities (0–5 scale): “How much are you enjoying this activity?”	3.34 (1.56)	3.19 (1.50)	1.04
Participant anticipatory rating of goals (0–5 scale): “How much do you think you will enjoy this goal?”	3.79 (1.32) *	3.40 (1.40)	2.46
Coder-rated pleasure-based activities (0–3 scale)	0.76 (0.73) ***	0.56 (0.68)	4.22
Coder-rated pleasure-based goals (0–3 scale) ‘Pleasure-based’ defined as: “not involving enjoyment or pleasure” to “very pleasurable” (e.g., eating something for pleasure, watching TV, playing games).	0.72 (0.72) ***	0.56 (0.71)	3.88
Q2: EFFORT-BASED BEHAVIOR			
Coder-rated effort of activities (0–3 scale)	0.18 (0.40) ***	0.45 (.65)	-7.41
Coder-rated effort of goals (0–3 scale) ‘Effort’ defined as “simple perfunctory activity” (e.g., eating/reading/watching TV) to “major forethought and planning” (e.g., creating a meal for several people, repairing a bike, multi-task chore).	0.34 (0.49) ***	0.64 (0.66)	-7.65
Coder-rated long term benefit of activities (0–3 scale)	0.17 (0.41) ***	0.37 (0.58)	-7.08
Coder-rated long term benefit of goals (0–3 scale) Long term benefit defined as “no potential to benefit health, occupation or social functioning” to “large potential” (e.g., exercise, learning a skill, making friends).	0.32 (0.62) ***	0.49 (0.73)	-4.07
Coder-rated social activities (0–3 scale)	0.74 (0.85)	0.93 (0.85)	-1.48
Coder-rated social goals (0–3 scale) ‘Social’ defined as “not involving other people” to “the primary reason for the activity/goal is to interact with other people”	0.48 (0.75) *	0.60 (0.74)	-2.32
Participant rating of difficulty of goals (0–5 scale): “How difficult do you think this goal will be to complete?”	0.89 (1.29)	1.26 (1.30)	0.86
Q3: GOAL COMPLETION			
Percentage of goals reported completed, %, (SD)	74.66% (14.9)	71.66% (8.9%)	1.33
Q5: HOME ASSESSMENT DOMAINS			
Rater average of Overall ‘Stimulation’ of the home environment (percentage average of three domains: home aesthetics, media stimulation, and social stimulation)	62.49% (27.05) *	73.74% (20.26)	-2.35
Rater average of ‘Home Aesthetic Stimulation’ (Percent average of eight items (coded ‘yes’) related to physical environment of the home e.g., having pictures on the walls, non-cluttered environment, room decorations, not dark or monotonous environment)	64.77% (26.65)	63.11% (29.85)	0.24
Rater average of ‘Media Stimulation’ (Percent average of eighteen items (coded ‘yes’) related to access to media items: e.g., access to cable, internet, cell phone, computer, books, magazines, etc.)	71.13% (28.00) *	83.97% (14.80)	-2.23
Rater average of ‘Social Stimulation’ (Percent average of fourteen items (coded ‘yes’) related to presence of roommates, activities with others, interactions with others in home environment)	52.58% (26.50) ***	74.13% (16.12)	-4.09

Note: Significant differences between groups are **bolded**

*
p < .05,

**
p < .01,

p < .001.