

# Extraversion in Games

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**Abstract.** The behavior of a human player in a game expresses the personality of that player. Personality is an important characteristic for modeling the player's profile. In our research we use the five factor model of personality, in which extraversion is a notable factor. Extraversion is the human tendency of being sensitive to rewards. This often results in humans seeking socially rewarding situations. Extraversion plays a prominent part in the in-game behavior of a player. The in-game behavior can be decomposed in 20 different in-game elements.

In this paper, we investigate which in-game elements influence the in-game behavior when looking at extraversion only. To answer this question we performed two experiments. The outcome is rather clear. Variation in behavior, caused by extraversion can be seen in 12 of the 20 elements that spanned the 20-dimensional space. Future research will focus on: (1) in-game behavior correlated to the other factors and (2) whether more elements can be added to the characterisation of extraversion.

## 1 Introduction

Personality is the notion used to describe patterns of human preference and behavior. These patterns are assumed to be stable over long periods of time and across many situations. Personality can be found in nearly all aspects of human life, from education to gaming. Typical examples of a personality spectrum are: introvert versus extravert, social versus egoistical, and fearful versus stable. Personality descriptions are used by almost everyone to characterize a person or even themselves.

Personality profiling focuses on finding models that accurately describe personality characteristics in a human under investigation. Deciding what constitutes a good model of personality has long been a matter of debate [18]. Over the years, many models have been proposed. From all proposals, the five factor model has emerged as the best established and most validated model of personality [12]. Nowadays, the five factors of this model are generally considered to constitute the main structure of human personality [6]. Based on their research, Costa and McCrae [9] even suggest that the five factor model is the universal structure of personality.

A widely accepted instrument for assessing the five factor model is the NEO-PI-R personality questionnaire (see section 2.2) [6], which is also used in the

present research. The five factors are: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, usually abbreviated to OCEAN (though some use CANOE). The NEO-PI-R measures an individual's "characteristic and enduring emotional, interpersonal, experiential, attitudinal, and motivational styles" and is therefore suitable for measuring individual differences in various situations [11].

Personality theory has demonstrated its use in a variety of areas. For instance, it has shown that there is a consistent relationship between conscientiousness and academic success [22], that drinking motives are related to extraversion [24], and that low agreeableness combined with low conscientiousness predicts juvenile delinquency [19]. Personality profiling is used in practice to profile offenders and aid law-enforcement agencies in understanding their motives [3].

### 1.1 Methods of Personality Profiling

Current methods of personality profiling encompass (1) written tests, (2) verbal tests, and (3) observational studies. (Ad 1) Written tests are usually lists of statements describing personal preference and behavior. In such a test, subjects are invited to rate to what degree the statements describe them correctly. Based on these ratings, a personality profile is computed. (Ad 2) Verbal tests are interviews in which a psychologist asks a subject questions about his<sup>1</sup> preferences. Then he composes a personality profile based on the subject's answers. (Ad 3) In observational studies a trained observer analyses a subject directly or scans videos of a subject, and composes a personality profile based on the observed behavior. The three methods together are called personality tests. They suffer from several drawbacks, of which five are discussed below (indicated by A to E).

Written tests and verbal tests are based on the assumption that a subject's reports are (A) truthful and (B) comprehensive. Obviously, the reports are vulnerable to inaccurate or untruthful self-reporting. It has been shown that subjects are unable to report accurately on their own habits. Gross and Niman [17] have pointed out that self-report data have little correlation to actual behavior frequencies.

Observational studies are considered to be more reliable and more objective than self-reports [1]. They do not suffer from inaccurate subject reports. However, these studies suffer from (C) high cost and (D) high effort in data collection. Gathering sufficient data through observational studies to form an adequate model of personality may take years of work and may involve numerous observations on numerous subjects [10].

Personality tests in which a subject knows that his personality is tested are called explicit tests. All explicit tests are vulnerable to (E) socially desirable behavior. People tend to act more socially favorable when they feel they are being evaluated or assessed. They do so by presenting themselves in a more accepted fashion. An example is: people pretending to be more conscientious than they really are [15].

<sup>1</sup> For the sake of brevity, we use 'he' and 'his' whenever 'he or she' and 'his or her' are meant.

## 1.2 Motivation

To alleviate the drawbacks of the personality tests in use today, our research aims to create an *automatic* observational test that is contained in a game. Such a test is then implicit. In an implicit test, it is not immediately apparent to the test subject what is being measured. The function of the test is to measure personality, silently reducing the need for human effort. In the recent past, this was considered to be virtually impossible [10].

As stated above, the goal of the present research is to model a subject's personality automatically, based on his actions and choices in a game. The drawback of using a game is that players can act unlike their 'real-life personality' and more like the role of the character that they wish to play. However, we assume that, even if players are acting according to their character's role, there will still be a substantial number of characteristic behavioral patterns that result from their personality.

Game environments have the advantage that they provide the opportunity to incorporate many measurement types of personality. Three possibilities are: player responses during in-game conversation, behavior, and choices made in the game. The in-game tests can be conducted in implicit and explicit ways as well as in observational and self-report fashions.

## 1.3 Problem Statement

Our research investigates the possibilities of using behavior in games to profile personality. We investigate the correlations between behavior in a game and written test scores. The problem statement that guides our research reads: *To what extent is it possible to build a psychological profile of a person by monitoring his actions in a game?*

We attempt to answer this problem statement by comparing game data to responses on the NEO-PI-R personality test. To the best of our knowledge, no previous research on this topic exists. In the present paper we restrict our research to just one personality factor, namely extraversion.

## 1.4 Outline

This first section provided a short introduction to the field of psychological profiling and the reasons why we believe a new way of testing would be a welcome addition to the currently available tests. Section 2 gives an overview of the theoretical framework, the history of the five factor model, and its most important tests and practical uses. A further insight into the extraversion factor is also given. Section 3 describes our experimental setup used for conducting the experiment. In section 4 we present our results. In section 5 conclusions are derived and recommendations for future research are given.

## 2 Background

In this section we present a theoretical framework for our research (2.1), and the history of the five factor model (2.2). Moreover, we describe the extraversion personality factor in relation to player modeling and profiling (2.3).

### 2.1 The Five Factor Model

Comparisons between people are commonly based on factors [18]. The earliest known personality descriptions were suggested by philosophers. They first explored personality through observation and reasoning. They tried to understand illness, emotional suffering, and behavior [20]. Usually, thinking about personality follows a logical rather than empirical line of thought.

In the 19th century psychiatry explored personality in an attempt to cure mental illness. Freud and Jung were among the first to examine properties of the mind in order to diagnose dysfunctional behavior [16]. Freud's ideas were based on personal philosophies, while Jung required empirical evidence and facts to support his theories [23]. Jung's ideas are at the basis of modern psychology.

If a psychological theory is empirically validated and the model is standardised it can be used to compare individuals to groups of people. Wundt was the first to perform empirical validations of personality by using experimentation. He laid the basis for modern experimental research methodology, and investigated various domains of psychology including consciousness, perceptions, sensations, and feelings [20]. His accomplishments are directly transferable to the domain of psychological profiling.

At the start of the 20th century personality theory was seen as a chaotic and unstructured field. Personality was being examined in different levels of abstraction and from different perspectives [19]. Each perspective contributed in its own way to the field. However, the diversity of scales measuring the different perspectives on personality made it impossible to compare the scales and choose an appropriate one. In order to give structure to the field of personality research, a descriptive model (taxonomy) was needed. Such a taxonomy would allow for comparison and structure between scales and perspectives. After several proposals, Thurstone [26] was the first to suggest a taxonomy of five factors: *the five factor model of personality* [18, 19].

The five factor model is based on the terms that people use to describe each other's stable attributes. The model describes personality by the five OCEAN factors. The model was designed by analysing the natural language terms which people use to describe one another [19]. Several other researchers independently found evidence for a system of five factors. This marked the start of the five factor model [27].

The five factor model was thus independently confirmed in several studies, but soon received near fatal criticism. Mischel [21] criticised the factor approach in general and disputed the reliability of five factor research up to that time (1968). Costa and McCrae [11] also provided criticism but simultaneously they

suggested a more reliable instrument as the solution to the criticisms: the NEO-PI-R questionnaire.

## 2.2 The NEO-PI-R

In 1992, Costa and McCrae [7] developed the first robust tool for measuring the five factor model: the NEO-PI (which is an abbreviation for Neuroticism, Extraversion and Openness to experience Personality Inventory). The NEO-PI was meant to replace earlier, suboptimal tests measuring the five factor model [11]. The earliest versions of the NEO-PI measure only three personality factors, in the following years two others were added.

The NEO-PI divides every factor into six facets. The facets provide a detailed specification of the contents of each factor [8]. The facets' design was supported by existing literature. The 30 facets were meant to be similar in breadth and should represent "maximally distinct" aspects of each factor.

The current, modern test is called the NEO-PI-R (the 'R' standing for 'revised'). It is considered to be a reliable and valid test for personality. It contains 240 statements (see 1.1) measuring the five factors and their facets. It has been thoroughly tested [11], and it set the five factor model (the OCEAN factors) as the standard model of personality structure.

## 2.3 Extraversion

In this research we focus on the personality factor called extraversion. The factor was first proposed by Jung, who described it as the inward or outward focus of libido. According to Jung, low extraversion people tend to turn their energy, focus, and orientation towards themselves, while high extraversion people focus outside themselves. In contrast, Costa and McCrae [7] describe people with high extraversion as sociable, meaning they prefer to be in the company of others and in social situations. They introduced the following six facets of extraversion.

- *Activity*: Active, energetic people have high pace and powerful movement. They need to be busy and radiate a feeling of energy. They have a busy and hasty life.
- *Assertiveness*: Assertive people are dominant, self-confident, and controlling. They talk without hesitation and often lead groups.
- *Excitement-seeking*: Excitement seekers desire adventure, stimulation, and action. They like bright colors, noisy environments, and aculeated sensations.
- *Gregariousness*: Gregarious people prefer the company of others. They seek out others and like crowds and group activities.
- *Positive emotion*: People with positive emotion have fun, and feel happy and joyful. They laugh easily and are often cheerful and optimistic.
- *Warmth*: Warm people desire to form emotional bonds with others by showing warmth and affection. They are friendly and show that they genuinely like others.

These facets can provide interesting information on their own but should always be considered in relation to the other facets and the factor as a whole [8]. Low scores on a facet do not indicate the opposite of the facet, just the absence of the tendencies of that facet. For instance, low positive emotion does not mean unhappiness, just an absence of positive emotion.

## 2.4 Player Modeling versus Player Profiling

Player modeling is a technique used to learn a player’s tendencies through automatic observation in games [25]. The technique can be used to improve gameplay by, for example, adjusting a difficulty or a storyline to the player’s preferences.

The origin of player modeling is found in the domain of classic board games under the name of opponent modeling. It has been simultaneously discovered in Israel and the Netherlands [13]. The goal of opponent modeling is to model the opponent’s decision-making process in order to make the best counter moves.

Opponent modeling spread to modern computer games as a means of devising the an effective way to defeat opponents. As in classic games, opponent modeling tried to model the opponent’s decision-making strategies in order to play the best moves. Recently this goal has shifted. The emphasis is no longer on playing the strongest moves, but rather it is on increasing entertainment [2]. A good example of player modeling attempting to enhance the entertainment of games is the research by Thue [25] and by El-Nasr [14], in which player models are used to adapt the story and action in the game in order to fit the player’s preferences.

Player profiling is the automated approach to personality profiling as described in this paper. In player profiling we look for correlations between the player’s in-game behavior and his scores on a personality test. This can be seen as a form of classification in which the classes consist of combinations of scores in the five personality factors.

The major differences between player modeling and player profiling lie in the features modeled. Player modeling attempts to model the player’s playing style, while player profiling attempts to model the player’s personality. The models produced by player profiling are readily applicable in any situation where conventional personality models can be used. Player profiling is also supported by a large body of psychological knowledge.

## 3 Experimental Setup

Our claim is that a player profile can be constructed by automatically observing player behavior in a game. To test our claim we developed a game using the Neverwinter Nights environment. Neverwinter Nights is particularly suitable for this purpose, as it comes with a powerful, easy-to-use tool set that allows for the creation of large virtual worlds with social interaction and conversation. It also allows for the logging of player behavior and player choices.

We created a short story for the Neverwinter Nights module. Playing through the story takes about half an hour. The story starts with a little girl asking the

player to deliver a message to the king. The road to the king is filled with several obstacles and encounters such as a beggar, several guards, a cleric, and several townspeople. In the end, the player will meet the king, and the game ends upon delivery of the message. While the player works through this story he unknowingly provides behavioral data on 20 different in-game elements.

Neverwinter Nights is a top-down roleplaying game. The player can see himself from an eagle-eye perspective. The player choose a spot to move to by clicking somewhere on the ground. He can also interact with objects by clicking on them or he can start communication with game characters by clicking on them.

### 3.1 In-Game Elements

The main challenge of our research is to relate written tests to behavioral observation. Directly converting items of the existing personality questionnaire into in-game elements has proved challenging. The NEO-PI-R asks introspective questions *about* behavior. However, we need to construct in-game situations in which the player has the opportunity to display *actual* behavior. As source of inspiration to overcome the challenge we studied the written test statement guidelines by Costa and McCrae [7]. As a result, we defined our in-game elements to be based on NEO-PI-R statements as well as on real life situations that were expected to elicit extravert and introvert behavior. Our items were designed to give the players a broad range of possible behaviors to facilitate them in acting in a personal and natural way.

We divided our in-game elements into three categories: choice and **A**ction, implicit **B**ehaviour, and **C**onversation. These categories served as guidelines for creating in-game elements for different types of behavior. We attempted to create at least one in-game elements for every facet of extraversion in each of the categories. The total number of in-game elements we arrived at was 20.

- *Choice and Action* (A) encapsulates explicit and rational behavior. The player faces a number of choices by in-game elements that range from choices which a high extraversion person would make to choices which a low extraversion person would make.
- *Implicit behavior* (B) covers unconscious behavior that is performed as an automatic preference. In in-game elements belonging to this category no conscious choice is involved. The in-game elements often involve (1) measuring the time a player takes to make a decision or (2) the distance that is travelled within a certain amount of time.
- *Conversational items* (C) represent conversational preferences. Differences in in-game elements can be found in context information, presentation, and style.

All in-game elements are sorted by facet of extraversion. As listed earlier (see section 2.3), the facets are Activity (Act), Assertiveness (Ass), Excitement seeking (Exc), Gregariousness (Gre), Positive emotion (Pos), and Warmth (War). The items are coded as a combination of (I) the facet measured and (II) the

category used. For example: GreB is an in-game element measuring gregariousness (Gre) by implicit behavior (B). A small list of four in-game elements follows below. As an example of in-game elements we describe one facet: activity. For this facet we have implicit behavioral and conversational in-game elements. The in-game elements for all six facets can be found at the website [www.gielvanlankveld.nl/gameitems.html](http://www.gielvanlankveld.nl/gameitems.html).

**Activity (Act)** ActB.1: The time it takes the player to complete the entire experiment. Active people are expected to finish the game faster.

ActB.2: In the game, the player is forced to wait in a big, empty room for one minute. Active people are expected to walk around more then less active players (i.e., this means to cover more in-game distance during this period).

ActC.1: The player is requested to wait. Active people are expected to respond less positively to this request.

ActC.2: The player is asked to confirm his response on ActC.1. Active people are expected to keep their choice.

### 3.2 Experiment

The experiment is based on a modudule made in Neverwinter Nights. For details of the module see the second paragraph of section 3.

Subjects were invited either to rate the statements of the NEO-PI-R on extraversion or requested to play the game. In order to control for any possible order effects, the test subjects were divided into two groups that had a different order of the statements or playing the game. After performing the two tasks, subjects were asked to answers questions about topics that might influence the outcome of the experiment. These topics included age, sex, and experience with computers and games.

Rating the statements took 10 minutes. Playing the game took between 30 and 40 minutes. For each subject we had one hour.

For playing an instruction booklet was provided, asking participants to respond if possible as they would do in real life. Instructions on playing the game were included in the booklet. After reading the instructions the participant

A pool of 39 participants, containing 20 males and 19 females, was tested. Ages ranged from 18 to 43 with a mean age of 24. Most participants were either students or former students. All subject data was processed anonymously.

Below, we briefly describe the aim of our experiment. We claim that our in-game elements have a correlation with the facet and extraversion scores of the NEO-PI-R. Therefore, they should function as predictors for extraversion and its facets. This is what our experiments is meant to investigate.

The results (see section 4) were analysed by SPSS using a multiple linear regression analysis. The NEO-PI-R returns results on a one to nine scale. Correlations were calculated using extraversion and the facet scores as dependent variables and the 20 in-game elements as independent variables. Furthermore, regression analysis was conducted to inspect the relationships between the control variables and the extraversion scores.



## 4 Results

The results of this experiment have been summarised in Table 1. On the horizontal axis, the table contains the factor extraversion and its facets. On the vertical axis the table contains 12 of the 20 in-game elements, namely those that showed some correlation with one or more of the facets or extraversion itself. We denoted the effect size by  $r$  and the significance by  $p$ . An effect size is accepted when it has a significance of 0.05 or smaller (the generally accepted significance level in psychology). For the variance of human behavior,  $r = .30$  is considered as a medium effect, while  $r = .50$  and higher is considered a large effect [4, 5]. In the table there is a distinction between positive correlations and negative correlations. A negative correlation indicates an inverse relationship between a factor or facet and an in-game element. If the in-game element increases in value its related facet decreases.

Table 1 contains the correlations between in-game elements and the NEO-PI-R scores. It should be noted that the in-game element named “skipped” is added to the table. This was done because some of the subjects broke off the conversation with the beggar (a character in the game). After some investigation it became apparent that the players skipped the beggar by accident. Skipping the beggar was significantly related to a low control skill in the game ( $p < .05$ ).

### 4.1 Extraversion

The NEO-PI-R results (not reproduced here but are available at [www.gielvanlankveld.nl](http://www.gielvanlankveld.nl)) show that our test subjects scored above average on extraversion. Scores range from 1 to 9 with 4 as the lowest measured score in the group of participants. Table 1 shows the significant correlations between five of the in-game elements and extraversion. Three of the correlations are positive and two are negative. All correlations are significant on a level of  $p < 0.05$  or lower. Items ActC\_1 and ActC\_2 were conversation elements involving the willingness to wait, and item GreA\_1 represents the choice between preference of going into the library or into the bar. Item ExcB\_1 is the choice of colorful clothing which was scored from low being black to high being quite colorful. PosA\_1 is a conversation element displaying the amount of optimism when asked whether the player believes that the game mission will be a success. Three of the five in-game elements showing correlation are conversation elements, one is an implicit and one is an explicit choice. None of the other 21 in-game elements showed any correlation sufficiently high to be significant with extraversion but 12 elements showed correlation with the facets.

Of our in-game elements, 12 of the 20 in-game elements demonstrated correlation with extraversion or with its facets. This result at least shows that it is possible to measure extraversion by observing player behavior in a game. Our expectation was that each of the in-game elements would correlate with their given facet. However, we found that this is not the case.

	Extraversion	War	Gre	Ass	Act	Exc	Pos
ActB.1 r	-	.279	-	.327	-	-	-
p	-	.043	-	.021	-	-	-
ActB.2 r	-	-	-	-	-.279	-	-
p	-	-	-	-	.043	-	-
ActC.1 r	.321	-	-	.303	.339	-	.269
p	.023	-	-	.030	.017	-	.049
ActC.2 r	.271	-	.451	.351	-	-	.293
p	.047	-	.002	.024	-	-	.035
AssA.1 r	-	-	-	-	-	-	.302
p	-	-	-	-	-	-	.031
AssB.1 r	-	-	-	-	-	.353	-
p	-	-	-	-	-	.014	-
ExcB.1 r	-.318	-	-.349	-	-	-.325	-.302
p	.024	-	.015	-	-	.022	.031
GreA.2 r	-.321	-	-	-	-	-.605	-
p	.023	-	-	-	-	.000	-
GreB.1 r	-	-	-	-	-	.432	-
p	-	-	-	-	-	.003	-
PosA.1 r	.307	-	-	.294	-	-	-
p	.029	-	-	.034	-	-	-
WarC.1 r	-	-	-	-	-	-	.278
p	-	-	-	-	-	-	.043
Skip r	-	-	-	-	-	-.277	-
p	-	-	-	-	-	.044	-

Table 1. Correlations between NEO-PI-R scores and game items

## 4.2 Control Questions

The experimental results for the control questions can be found on the webpage: [www.gielvanlankveld.nl/extraversionresults.html](http://www.gielvanlankveld.nl/extraversionresults.html).

## 5 Conclusions

The research goal was to make a test that measures extraversion and its facets in a game. In order to answer the problem statement we created of in-game element set in the game *Neverwinter Nights*. The in-game elements were based on the statements of the NEO-PI-R and were divided into three categories: choices and actions, implicit behavior, and conversation.

In order to answer the question of correlation between in-game behavior and personality scores on the NEO-PI-R, the test was administered to a pool of 39 participants and yielded results in 20 in-game elements. Results were analysed for correlations using regression analysis. From the results we may provisionally conclude that it is possible to measure extraversion and its facets using behavior in a virtual world. Six of our in-game elements had significant correlation directly

to extraversion scores on the NEO-PI-R. While five in-game elements had correlation to one or more of the facets of extraversion rather than to extraversion directly. The latter observations confirm our conclusion above.

### 5.1 Future Work

We currently lack evidence indicating whether a virtual world measurement or NEO-PI-R measurements reflect real life more accurately. Therefore, in future work we will expand our research to include the other four factors of personality. There is also a need to compare the predictiveness of player profiling to written personality tests and to expand the number of elements measuring the factors and their facets.

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