Abstract
The present paper introduces the results of a review of the methods measuring player experience proposed in articles published in human-computer interaction journals. The present review focused more specifically on the cases of combination of two or more methods. The results showed that 11 articles, all published in the last decade, proposed mixed methods to measure player experience. All these articles proposed at least a subjective measure method, always questionnaire, in combination with an objective one, mainly physiological measures. Player’s emotions were the aspects of player experience that were the most studied in the case of mixed methods. A synthesis of these results was proposed and may be discussed at the workshop.

Author Keywords
Subjective measure; Objective measure; Mixed methods

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces.
Introduction
During the last decade, the community of games user researchers has published numerous scientific publications dealing with player-video game interactions, based on an examination of the players' motivations (e.g., search for pleasure, entertainment, challenges, emotions), and their implications for practical application.

We are currently working on a systematic review of empirical evidences of the current intrinsic concepts of player-video game interactions showed in scientific journals. The aim of this review is to show that, in terms of human-computer interactions, video games should be considered above all as complex information systems, with which individuals wish to interact within the framework of a goal-directed activity, mainly in leisure situations. The community may benefit from literature analysis like this one to build a body of best practices that are based in real research findings.

The goal of the present paper is to focus on the methods proposed in this literature to measure player experience, and more specifically on the cases of combination of two or more methods.

Methods overview
To reach the goal of the review as precisely as possible, only main scientific journals that deal with human-computer interactions were used in the search database. These journals were those that were indexed in the journal list of HCI Bibliography\(^1\) database (hosted by ACM SIGCHI) in 2013. This list was completed by the journals indexed in the Science Citation Index Expanded and the Social Sciences Citation Index (Thomson Reuters) categorized in the “Computer Science, Cybernetics” or ”Ergonomics”\(^2\) subject categories in 2013. A total of 63 journals were surveyed. The only search term was "game" in abstract, title or keywords (if available). The search was run in all the journal volumes published from their beginning to 2012. A total of 1,099 articles were found. A first selection was narrowed by focusing on articles that included empirical evidence relating to the player-video game interaction in leisure situations. A total of 57 articles (published from 2000 to 2012) met the criteria. The findings from this selection are being analyzing for future publication. Then, a second selection was focused only on articles that proposed two or more methods to measure player experience, i.e. player (human) aspects of player-video game interaction.

Results and Discussion
The results of the literature review showed that 11 articles proposed to measure player experience with two or more methods. Table 1 summarizes these articles. See also the references list.

The results showed that six specific methods were proposed to measure different aspects of player experience. The first method was questionnaire, that is a subjective method. The five other methods concern objective methods: eye-tracking, post-task...
performance, physiological measures, finger-stroke behaviors and non-verbal cues.

These methods were proposed to measure multiple aspects of player experience. Some of them concerned aspects that also apply to other human-computer interactions such as in virtual environments. These include engagement, immersion and presence, and are closely linked. The others concerned specific characteristics of leisure and entertainment activities: positive and negative emotions, enjoyment and flow, and are also closely linked.

The results showed that in the articles included in the present review, at least one subjective and one objective measure method were used. In these studies, the subjective measure methods was always a questionnaire. The objective one could be physiological measures, eye-tracking, post-task performance, finger-stroke behaviors and non-verbal cues.

The most frequent combination was the use of questionnaire and physiological measures to measure emotions during video game playing (four studies) [4, 6, 8, 11]. For three other studies, physiological measures were used to measure emotions in combination with questionnaire to measure enjoyment or more general play experience [1, 5, 7]. The four other studies used another objective measure in combination with a questionnaire [2, 3, 9, 10].

Seven studies proposed the use of two or three different methods to measure the same part of player experience. Again, 4 articles used questionnaire and physiological measures to measure players' emotions [4, 6, 8, 11]. Gao et al. [2] used questionnaire and finger-stroke behaviors to measure emotions. Jennett et al. [3] used questionnaire, eye-tracking and post-task performance to measure immersion. Von der Pütten et al. [10] used questionnaire and non-verbal cues to measure presence.

### Table 1. Aspects of player experience sorted by method proposed in each article of the literature review. The first seven articles of the table (highlighted rows) proposed two or more methods to measure the same aspect of player experience.

<table>
<thead>
<tr>
<th>Article</th>
<th>Subjective measure</th>
<th>Objective measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wolfson and Case, 2000</td>
<td>Emotions</td>
<td>Emotions</td>
</tr>
<tr>
<td>Ravaja et al., 2006</td>
<td>Emotions / Presence</td>
<td>Emotions</td>
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<tr>
<td>Mandryk and Atkins, 2007</td>
<td>Emotions / Presence</td>
<td>Emotions</td>
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<tr>
<td>Lim and Reeves, 2010</td>
<td>Emotions / Presence</td>
<td>Emotions</td>
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<tr>
<td>Gao et al., 2012</td>
<td>Emotions</td>
<td>Emotions</td>
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<tr>
<td>Jennett et al., 2008</td>
<td>Immersion</td>
<td>Immersion</td>
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<tr>
<td>Von der Pütten et al., 2012</td>
<td>Presence</td>
<td>Emotions</td>
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<td>Liu et al., 2009</td>
<td>Enjoyment</td>
<td>Emotions</td>
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<tr>
<td>Shahid et al., 2012</td>
<td>Engagement</td>
<td>Emotions</td>
</tr>
<tr>
<td>Chanel et al., 2012</td>
<td>General experience</td>
<td>Emotions</td>
</tr>
<tr>
<td>Nacke et al., 2010</td>
<td>General experience</td>
<td>Emotions</td>
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</table>
Conclusion
The database of journal articles on player-video game interaction was built. Articles were analyzed, and methods proposed in combination were introduced and categorized in the present paper. The present results may help researchers for their future research about measuring player experience and also practitioners for the best practices. We look forward to discussion about the present method of sorting best practices in mixed methods at the workshop.

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References
Authors' short biographies

Loïc Caroux is a postdoctoral research fellow at New York University. He received his Ph.D. in cognitive ergonomics in 2012 from the University of Poitiers, France. His main interests are player experience and performance in video games. More precisely, in the Game Innovation Lab (at NYU), the main goals of his research are to understand how the game visual interfaces impact the player experience and to propose solutions for game designers to optimize them.

Katherine Isbister directs the Game Innovation Lab at NYU, and holds a joint appointment between the School of Engineering’s Computer Science Department and the Tisch Game Center. Isbister is a human computer interaction researcher and designer, focused on creating more compelling emotional and social qualities in games.