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What You Hear is Where You Are is What I Hear:

Optimising Immersive Experiences for Interindividual Differences

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Aiming at providing data points for a framework of adaptive audio implementations, this paper draws on previous results obtained from an ongoing series of experiments in ludomusicology. From discussing findings on enhanced user interaction in video games through the use of adaptive music, further insights are offered into optimising immersive experience by means of adjusted temporal-structural and expressive attributes according to interindividual differences in the cognitive-emotional processing of music. In addition to outlining those implications for the design of a user-aware audio engine, the presented study takes into account situational percepts and context effects as opposed to treating situation as a mere external stimulus. Not only the cognitive-emotional processing of music, but also situation awareness and tendency for immersive experience, has been shown to vary along different manifestations of personality traits. Accordingly, self-report measures of spatial presence and emotional response showcased correlations with trait empathising-systemising and trait absorption. Differential effects on those dimensions appeared depending on the use of situation-adaptive implementations of low and high arousing music stimuli in an action-adventure 3D video game. These findings suggest interindividual differences in the sub-attentional processing of music found in genre video games and are discussed with regards to the potential of psychologically informed sound design to affect a users' mental model of situational context and experience of agency.

User-aware audio. Music, Personality. Situation. Immersive experience. Empathising. Involvement.

1. INTRODUCTION

Does sound and music affect the experience of situations that we encounter in the physical as much as in the virtual? Do these effects depend on the motivational and attentional affordances encountered in a situation? In addition, do we all agree upon what type of auditory stimuli fit to performing a task, not to speak of what sounds or music we would like to hear in a given situation?

If you have ever found yourself turning off that nerve-wrecking beep tone in a user interface or muting an annoying music track that distracted you from beating a video game, you probably see the significance of the above questions in the ongoing discussion on the use of sound and music in human-computer interaction. While some auditory stimuli may suit a given task better than some others, making them work for all parties turns out problematic under many circumstances. One way to work against this is the use of cultural conventions as demonstrated by the use of "temp tracks" in film music or standardised sound libraries for "foley" (cf. Cohen 2001). Another approach involving user-aware audio implementations promises to enhance the fitting of an audio sources' content and temporal placement to the user agents' current state of mind and actions within interactive media. However, in order to feed this framework with data one may first need to acquire an understanding of the processes that make humans affected differently by sound and music. There is good reason to believe that these processes not only vary along stable personality traits but also situations (cf. Saus *et al*. 2012, Datcu *et al*. 2013). Situational trait paradigms try to account for the tendency to respond in a particular manner to one type of situation, while another type may evoke a different response (cf. Murtha *et al*. 1996). Here,

situation type refers to a class of situations that contain objects with a specified property of relation (Greeno 1994). Given that the affordances encountered in one situation require different attunements to constraints than in another situation, one may expect varying attentional resources spent on different acoustic stimuli. Some evidence for this may be seen in studies identifying supportive as well as interfering effects of music on task performance in work-related contexts as much as during leisure activities, such as playing video games (see Yang *et al*. 2015, Richards *et al*. 2008). Moreover, research on music and personality has revealed listening preferences as well as emotional contagion of music to be situation dependent (e.g. Liljeström *et al*. 2012). While previous studies have examined situation-dependent music preferences and listening styles by confronting subjects with a selection of tasks in real-life and virtual scenarios, data collection has traditionally focused on outcome variables such as emotion/appraisal while leaving out situational percepts that had prompted these reports. But also the process of perceiving a situation appears to be relative. Accordingly, if situation is considered to entail an internal and external component of appraisal, it is subject to a listener's perception. The latter consolidates endogen-voluntary and exogen-reflexive (sub)-attentional processes. Thus, when determining the impact on the appraisal of a particular sound or music stimulus, the notion of situation implies the product of subjective percepts, such as current motivational and attentional focus or the sense of environment and task that poses varying demands for adaptation to the organism. While it is possible to examine each of the above's parameters in isolation, one would run in danger to neglect the holistic phenomenological quality of situation as well as following up its prerequisites, such as mental models.

In order to account for these potential shortcomings, the present paper makes use of the construct 'situational context', which directly relates to the meaning structures and outcome prediction components derived from situation awareness (cf. Draper *et al*. 1998, Riley *et al*. 2003, Gasselseder 2012). In a wider context, both constructs have been associated with immersive experiences, such as presence. While presence may be considered as the placing of the self into an environment, situation awareness may represent the placing of the environment in relation to the self. Riley and co-workers (2003) asserted empirically a relationship between presence and situation awareness, where the first refers to the holistic situation of the self, while the latter recognises the cognitive simulation of the situation. Adding to the complexity of measuring these constructs, recent work has also shown interindividual differences in the appraisal of situational settings along personality constructs as found in the big five-factor model (cf. Jacobucci 1998). Similar results are obtained with trait absorption and sensation seeking for immersive experiences arising while watching films or using video games (cf. Weibel *et al*. 2010, Gasselseder 2012). Considering the wide span of situations encountered within interactive media, it appears that an investigation of the interindividual effects of sound and music requires to account for situation as much as situation would have to account for the notion of interindividual variance of perceptual processes.

Aiming to enrich this framework with further data, the following sections investigate the perceptual processes that are believed to be at play while using a current generation video game as means of providing varying situational affordances to the user. An empirical examination of the role of personality traits in the experience of immersive content adds to this framework by its inclusion of adaptive music accompaniment that aims to reflect low and high arousing situation types. Finally, the paper proposes design recommendations for user-aware audio applications by taking the findings on music as an example of optimising immersive experience in video games.

2. MUSIC IN SITUATIONAL CONTEXT

Research on non-mediation has seen many descriptions of experiencing situation awareness within a virtual scenario. Terms such as 'immersion', 'presence', 'involvement', 'absorption', 'suspension of disbelief' as well as 'self-location' and 'flow' form examples of overlapping constructs that sometimes are used interchangeably and merely denote a specific application, such as virtual reality or challenge-based video games. However divergently defined, it may be argued that common ground is found in the notion of specific motivational states and altered cognitive representations of situational factors. Here, imaginary aspects found in constructs such as absorption and suspension of disbelief are discerned from embodied, sensory-spatial aspects found in flow, self-location, and perceived possible actions. The multi-construct 'immersive presence' (Gasselseder 2012) aims to consolidate these imaginary and sensory-spatial aspects of non-mediation within a unified framework that incorporates the notion of relational differentials during agency detection. In this view, immersive experiences arise from perceptual processes that juxtapose expected and incoming sensory data as a function of situational demands (cf. Popper & Fay 1997, Bruner & Postman 1949).

Here, relational differentials operationalise an agent's current and future state as well as realm of interaction in the environment with regards to

expected outcomes for the user (cf. Gasselseder 2012). Ascribing purpose and relevance to surrounding events in relation to our own beliefs and desires appears to be a ubiquitous process of perception (cf. Zwaan 1999). Research on theory of mind supports this view in that activity of the mirror neuron system is only observed when actions are attributed to agents but not to non-agents (see Decety & Grèzes 2006). In order to assess a situation, these relational differentials are subsumed to a syntax or reference frame that determines the situational context, which is further projected to subsequent cue juxtapositions and awareness of the range of possible actions. Relational differentials may then be seen in connection to intrinsic motivation, which in turn is believed to support the experience of flow and the exploration of the environment (cf. Csikszentmihalyi 1991, Gasselseder 2012).

It is hypothesised that music achieves immersive experiences by altering relational differentials as a result of directing selective attention and retrieving schemata in function to varying levels of expression-congruency. In doing so, connotations based on prior experiences and cultural codes drive expectations and evaluative functions of music (cf. Gaver & Mandler 1987, Cohen 2001). Applying this information to relational differentials enhances the validity and predictive value of individual cues. The attribution of a reference frame and its associated situation model then emerges from sensations caused by corresponding audio-visual accent structures (cf. Boltz et al. 2009, Cohen 2001, Petrini et al. 2011).

The first step of achieving immersive experiences through music in interactive media may be seen in the primal urge of humans to synchronize incoming stimuli (Maasø 2000). When initialising selective attention and searching for salient cues in the environment, other senses are taken over by the superior temporal resolution of sonic dimensions (Spence & Driver 1997, Maasø 2000). At this, a first set of filters directs subsequent hypotheses testing towards congruent percepts (Bruner & Postman 1949).

Synchronisation ensures the assessing of audio-visual accent structures at contact with visual and other stimuli. If music and the remaining modalities are found to follow similar structural features causing analogue sensations, multisensory expectations on emotional congruency towards the situation at focus are formed. If matching combinations of stimuli are found to be congruent to a hypothesis of perception, attention allocation to the media content is intensified. While at this point, connotations of music are processed on an extramedial level, that is a conscious integration into relational differentials within the situational context of media reception (i.e. sitting in front of a PC and knowing that speakers placed in the room play music back). The emerging reference frame (i.e. defining challenge-based motives) is attributed towards the situational context implied by the media content. This process of ‘situational context localisation‘ sets the stage for experiencing imaginary immersion by giving access to portrayed intentions and motivations (cf. Erma & Mäyrä 2005, Wirth *et al*. 2007, Gasselseder 2012).

At this point only expressive features reach the processing of relational differentials. Previous work by the author suggests that expressive features related to emotional valence may play a dominant role during extramedial processing (cf. Gasselseder 2012). This may be due to a basal matching process of synchronisation that yet does not fully account for momentary changes. Accordingly, valence is less likely to change spontaneously, suggesting that the potential of music in modulating emotional valence, as for example by the means of minor keys and dissonance, may provide an efficient way of establishing mood and situation. The associated connotations are integrated consciously, meaning that the perceiving subject is still able to discern the presence of music as well as its surface features from the remaining modalities of the media content. This is of relevance for the attribution process of agency, which is negotiated between a subpersonal automatic level for action identification and a more conscious level for sensing agency related representations about intentions, plans and desires (cf. Decety & Grézes 2006).

While this hierarchy is asserted for real-life social interactions, it is the contention of the presented model that this sequence may be reversed in media reception. Hence, the conscious sense of agency pre-exists and is followed by covert automatic processing that couples pre-motor action with a virtual avatar. Compared to automatic bottom-up, the conscious top-down path processes information slower, making it more susceptible to information that is carried by the valence potential of music. For the faster bottom-up path, however, a more efficient source of information may be seen in the changing levels of arousal potential in music.

Having reached extramedial localisation, the basal matching process of synchronisation may be extended by momentary changes. The gained relevance of the latter allows for lower latency in action identification so that varying levels of music-expressed arousal take a dominant role in driving multisensory expectations on emotional congruency. If proportional to the arousal potential of the remaining modalities, an increase of arousal in music leads to an intramedial localisation of schemata recall. Arising connotations are now

unconsciously integrated into relational differentials attributed to the situational context implied within the media content. However, the transition to intramedial localisation is gradual insofar that the latency it takes for music to follow the remainder of the accent-structure determines the degree of attribution for a particular event or action to an agent, such as the user itself. Note that due to constraints in terms of syntactic structure and scoring conventions, music expression rarely mimics on-screen action directly (see Cohen 2001).

Within pre-motor activation, however, music may affect expectations directed towards action readiness or 'forward models' at a higher level that encodes global specifications of the action with the controlling and adapting to their goals and underlying motivations (Decety & Grézes 2006, Jeannerod 1997). This synchronisation of pre-motor activity marks the point when intramedial localisation has been reached and the self has become aware of its physical extension towards the possible realm of action and its location. Since an action may become an intrinsic motivator in its own right, it is more likely to be attributed to the self. Within the context of the flow model (Csikszentmihalyi 1991) the additional information provided by music affects the assessment of task demands, while also modulating self-perception of skills (Gasselseder 2012).

For presence, previous studies have found a correlation between varying levels of induced arousal and self-location (Robillard *et al*. 2003). Moreover, forward models may also contribute to discern one's own thoughts and emotions apart from others, providing the foundation of cognitive empathy (Decety & Grèzes 2006). This discrimination may allow relational differentials to become emotionally contagious. Finally, schemata recall and emerging relational differentials are contextualised beyond the motivational ties that were ascribed to the usage situation (i.e., playing for fun in the living room). The situational context model thus operationalises immersive presence as a mediated perspectivation of situational characteristics that are represented by the media content and its expressed meaning structures (Bruner 1986).

3. DIFFERENTIAL PROCESSING OF SITUATION

Davis' (1980) multi-dimensional definition of empathy as a cognitive and emotional process of perspective adoption includes interindividual differences in the capability to project one's thoughts and actions into fictional settings. While representing fictional settings may seem more apparent in the visual domain, Slater (2003) notes the possibility of varying interindividual perceptual sensitivity and weighting of modalities in presence experience. Whereas Slater's statement relates to form, such as auditory fidelity, rather than content, the above reference to mental models may justify the use of a construct of empathy that pays justice to the representational syntax and the expressive fidelity of music within the intersection of the physical and the virtual. Such a relationship may be found in the empathising-systemising distinction (Baron-Cohen 2003, Kreutz et al. 2008) where the former could be seen as a decoding capacity of the sonorous quality of expression, as found in orchestration or movement/counterpoint, while the later refers to conceptual aspects in musical syntax. Not surprisingly, empathising has been associated with correlations between preference of music style and decoding accuracy of emotions and thus may be of relevance to the sense of drama and situation in music (cf. Garrido & Schubert 2011, Sandstrom & Russo 2011).

Thus, just like there is reason to consider a decoding structure of perspectivation in the likes of Davis' (1980) 'fantasy-empathy' construct, it may be necessary to control for a user's sensitivity towards the expressive qualities of music that are assumed to play a role in forming hypotheses of perception. Apart from decoding incoming stimuli as a result of cognitive empathy, another processing structure may be active with affective empathy determining the actual emotional response (cf. Shamay-Tsoory *et al*. 2009). In the situational context model, this process of emotional contagion is reflected in that the shifting of schemata recall from extra- towards intramedial localisation depends on a user's tendency to synthesize unanimously decoded expressive cues from multi-sensory stimuli as well as concurring associations.

4. EXAMINING THE ROLE OF PERSONALITY IN MUSICALLY SUPPORTED IMMERSIVE EXPERIENCES

In order to investigate above claims empirically, the following sections present some of the results from a series of experiments investigating the relevance of personality in the immersive experience of sound and music in video games. Offering a variety of different situational settings, video games allow the study of differential effects of music accompaniment within a controlled environment and thus seem to provide an adequate research environment. A total of 60 subjects (23 females, 37 males) aged 18–30 years (M=23.72, SD=3.4) answered self-report questionnaires of experiential states each time after playing a 3rd person action-adventure video game for 10 minutes in one out of three randomised conditions. Experimental manipulation affected emotional arousal and structural-temporal alignment of non-diegetic music independently. This is achieved by contrasting

conditions featuring 1) adaptive music, 2) static music with low arousal and 3) high arousal potential. Besides determining the experience of situation by measuring spatial presence self-location, data collection also included emotional valence and arousal. For the purpose of examining interindividual differences, analysis will focus exclusively on personality traits related to the decoding/appraisal and synthesising of expressive cues in music empathising and immersive tendency/emotional involvement.

4.1 Subjects

Subjects spend on average 2.37 hours (SD=1.68) at 2.81 days per week (SD=1.78) with playing digital games. None of the included subjects had played the presented game or any of its predecessors before. Also, note that no subjects identified the experimental manipulation.

4.2 Materials

Owing to its guided navigation and wide range of interacting with the environment, the challenge map 'Penguin Museum' of the critically acclaimed 3rd person action-adventure 'Batman: Arkham City' (Rocksteady 2011) was set as a stage for investigating immersive experiences. The game's demands set as per instruction allow the player 10 minutes of time (as shown on a countdown) to distract opponents from chasing escaping hostages before challenging them in a final battle. This allows for sufficient time for immersive experiences to manifest. The orchestral score of 'Arkham City', written by Nick Arundel and Ron Fish, makes use of a horizontal mechanism that reflects calm and confrontational situation changes by musical expression of low and high arousal potential. In addition, the score utilises a vertical mechanism that reflects dramaturgic aspects ranging from danger to task progress by adding and removing four orchestral stems to the mix relative to the actions and performance of the player.

4.3 Instruments

4.3.1 Self-Location (state)
The dimension 'self-location', taken from the 'MEC Spatial Presence Questionnaire' (Borderer *et al*. 2004), refers to a sense of physical projection when interacting with the game. The scale contains four items and is rated on a Likert-type scale scored from 0–4. Studies undertaken by the instruments' authors show good internal consistencies between α=.80 to α=.92 as well as construct validity of about k>.70.

4.3.2 Emotion (state)
The emotion software measurement instrument 'EMuJoy' (Nagel *et al*. 2007) operationalises the circumplex model of emotion in an intuitive visual interface. The emotion space is represented as a coordinate system between degree of valence (pleasure-displeasure, X-axis) and arousal (Y-axis). Ratings are given by moving a cursor and pressing a button. Previous applications have found high re-test and construct correlations of about r>0.8 as well as high consistency between continuous and distinct measures. The present study makes use of distinct measures before and after game presentation as to prevent interference with immersive experience.

4.3.3 Music Empathising (trait)
The dimension 'music empathising' taken from the 'Music Empathising-Music Systemising Inventory' (Kreutz et al. 2008) was used to assess the ability to identify and respond to expressive content in music. The ME-MS presents music empathising with nine items in randomised order on a Likert-type scale ranging from 0–3. The here used German translation is characterised by an internal consistency of α=.71, which compares well to the α=.69 of the original English version.

4.3.4 Emotional Involvement (trait)
The dimension 'emotional involvement', taken from Weibel and co-workers' (2010) German adaptation of the 'Immersion Tendency Questionnaire' (ITQ), refers to the tendency for experiencing emotional reactions during media usage and (day-)dreaming. The subscale consists of five items presented in randomised order and rated on a Likert type scale scored from 0–4. Results of the present study show acceptable internal consistency of α=.71.

4.4 Procedure

The game was displayed on a 15.6" notebook running at 1366x768 pixels, 32-bit, 60Hz, and second highest graphic settings. Sound was provided on closed stereo headphones (AKG K270 Studio) at 30% volume as set on an audio interface (MOTU 828 mkl). Sound-fx were fed to the monitoring input of a DAW (Apple Logic Pro set at 128 samples buffer). For static conditions, they were mixed with the pre-recorded original music tracks (A-weighted volume matched). Prior testing, subjects went through a 30-minute training session involving game mechanics and EMuJoy. Before starting the game, EMuJoy ratings on current emotional state were recorded.

Next, the game excerpt is presented in three sessions of 10 minutes length, each reflecting one out of three music modalities contrasting adaptive/static mechanisms and arousal potential characteristics in randomised order. At the end of each game excerpt an animation of 5 seconds length signalled successful completion, which marked the point when sound was faded out gradually. Following this, subjects were asked to

provide ratings on EMuJoy and measures of immersive experience. After having passed all sessions, subjects completed the experiment by filling out the personality trait questionnaires 'ME-MS' and 'ITQ'.

4.5 Results

For the following correlations, attention is drawn to prior studies in music and social psychology where mean effect sizes range between r=.21 and r=.40 (see Sandstrom & Russo 2011). Investigating the relationship of trait empathy and emotional experience with Spearman ranks, music empathising and pre-post arousal measures were correlated only in the static low arousal potential condition, r=.26, p=.04, while no correlations manifested in conditions presenting adaptive, r=.01, p=.96, and static music with high arousal potential, r=.06, p=.63. Comparable results are found for emotional involvement for which a moderate correlation with pre-post arousal appeared only in static music with low arousal potential, r=.33, p=.01, whereas non-significant results were obtained from the high arousal potential counterpart, r=.22, p=.09, and adaptive music conditions, r=.10, p=.46. When changing over to MEC-SPQ measures of self-location, music empathising correlates roughly moderately after playing in the adaptive music, r=.28, p=.03, and static low arousal potential conditions, r=.26, p=.04, albeit results from the high arousal potential variant remain non-significant, r=.21, p=.10. Interestingly, emotional involvement and self-location showed relatively strong correlations only in static music with high arousal potential conditions, r=.39, p=<.01, despite non-significant results for adaptive, r=.13, p=.33, and static low arousal potential, r=.13, p=.34.

4.6 Discussion

Compared to the tendency for general emotional involvement, the capacity of decoding expression in music was expected to correlate higher with pre-post arousal measures in the adaptive music condition. While this hypothesis wasn't supported with regards to music empathising and emotion measures, the expected pattern of results appeared for music empathising and reported self-location during adaptive music and static low arousal potential conditions, albeit without observable difference between either condition.

The lack of same correlation reaching significance in the high arousal potential condition may suggest an inferior role of musical decoding structures in the experience of spatial presence when being exposed to a higher volume/intensity of sensory stimulation. This view agrees with the finding that trait emotional involvement, a construct closer to emotional contagion, and self-location correlated only in the high arousal potential condition, indicating the presumed role of the former in synthesising decoded expressive cues from multiple channels and turning them into a holistic experience.

When inspecting the expressive parameters of music for each condition separately, the above given interpretation finds support in the limited dynamic range of high arousal potential material compared to the more complex sweeping dynamics and ambivalent expression that characterises the low arousal potential material. This complexity may also constitute the reason for low arousal potential music marking the only condition in which trait music empathising as well as trait emotional involvement correlate with pre-post arousal measures. On top of its reported predictive validity for enjoying sad music (see Garrido & Schubert 2011) music empathising's correlation with pre-post arousal may be due to higher decoding demands set by low arousal potential music.

For emotional involvement, the pattern of results suggests the participation of a distinct structure, which may be responsible for the vicariousness of decoded expressive stimuli, presumably also indicating a link to perceptual realism as witnessed in environmental feedback such as the higher prominence of sound-fx relative to the lower volume of music during the low arousal potential condition.

5. IMPLICATIONS FOR SOUND DESIGN

Contrary to research on presence, prior studies on music perception have suggested either a weak correlation if not dissociation between trait (music) absorption and pre-post measures of reported arousal, initially making the personality trait appear a less-than-ideal choice in studying interindividual differences of reported intensity changes in music dramaturgy (cf. Sandstrom & Russo 2011).

However, the present study demonstrates the lifting of this disconnection when considering experiential measures involving cognitive components, such as spatial presence. This finding goes in line with discussing trait music empathising closer to decoding capacities as implied by the construct of cognitive empathy. Conversely, future studies aiming to capture the construct of trait emotional involvement may benefit from a division of expression synthesis and emotional contagion where the first marks primarily a cognitive effort, and the second, the extent of decoded expression being promoted to the emotion system. While the above discussion provides initial insights regarding cognitive styles in experiencing music within

interactive media, further evaluations and adaptation of the scales in use will be necessary in order to determine their ties to the immersive presence multi construct more thoroughly. Nevertheless, the current data suggests that related constructs to situation awareness, such as spatial presence, indeed correlate with domain-specific decoding structures depending on the music in use.

The extent of experienced self-location as realised through adaptive and low arousal music conditions depends on a players' ability to decode and project the expressive dynamics onto the situational setting posed by the game. Presuming a player showcases lower than average decoding capabilities, game designers are advised to offer arousing stimuli at context-sensitive volume levels, as may be realised by adding/removing instrumental layers through vertical techniques. This ensures a high stimulation of general cue synthesising while retaining audibility of sound-fx for the purpose of achieving perceptual realism. Similarly, music indicating specific situation types may evoke differential weighting of decoding and involvement structures, resulting in a shift of attentional focus. This may be realised by adjusting horizontal changes of music accompaniment; that is the fading from one sequence to another following events, which require a (re-)evaluation of the portrayed situation. Here, in-sequence variation, as found in vertical layering, may be less desirable due to the increased relevance of stable cues, such as valence-potential in music, for establishing extramedial localisation and top-down paths concerning meaning inference and outcome prediction of situational settings.

These aspects of decoding and immersive tendency form examples of how situational dispositions may affect immersive experiences, raising the rationale for user-aware adaptive soundtracks in the future. By examining and designing audio content for specific decoding abilities and behavioural tendencies, it is hoped that the situational context model will help to enhance the predictive validity of immersive experience measures.

6. CONCLUSION AND FUTURE WORK

Situational characteristics, such as features of rooms, characters, as well as their logical ties within a virtual ecology are believed to propose a mental model that is contrasted with the user's personal framing based on prior experiences and personality traits. This mediated perspectivation may rely on a modal-specific decoding capacity of empathic understanding that is further processed by a general synthesising capacity resulting in intensified emotional experiences. Following this line of thinking, the present paper outlined an experiment demonstrating that the experience of situation, as in spatial-location, varies with trait music empathising and trait tendency for emotional involvement depending on playing a video game with adaptive or static music stimuli, thus, proposing different situational affordances via altered musical connotations. The obtained findings not only suggest interindividual differences in the subattentional processing of music and situation, but give reason to assume the potential of music to alter situation awareness, the sense of agency and emotional experience. Future work will place focus on implementing user-aware audio solutions for directing attentional resources towards specific constellations of relational differentials that may promote desired cognitive and behavioural outcomes for situation types spanning from tutorials to performance tasks supporting flow experience.

Initial trials within the experimental paradigm presented here may support this reasoning in that subjects rated items containing relational attributes of game characters differently depending on the music accompaniment used in the game (cf. Gasselseder 2012).

Character interactions on the interrelational level (all characters excluding the avatar) were described as being more 'multifaceted' when playing the game in the adaptive music versus static music conditions, while the impression of perceiving characters through the lenses of the avatar (intrarelational) was linked to items referring to credibility and suspension of disbelief. Presenting sound-fx at a higher volume relative to music resulted in more frequent positive attributions of competency in avatar-user interaction (introrelational), which could potentially be put to use for manipulating an antecedent factor of flow experience in the perceived fit of skills and task demands (cf. Csikszentmihalyi 1991).

Considering the illustrated connections between immersive tendency, situation awareness and sense of agency, it is expected that future applications of context and personality-aware audio engines will allow us to control how a (fictional) setting is perceived and experienced while using interactive media content to its full potential.

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