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Altered states of consciousness are related to higher sexual responsiveness

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ABSTRACT

Altered states of consciousness lead to profound changes in the sense of self, time and space. We assessed how these changes were related to sexual responsiveness during sex. 116 subjects reported (a) intensity of awareness concerning body, space and time, and (b) satisfaction, desire, arousal, and orgasm occurrence. We differentiated vaginal intercourse orgasm from noncoital orgasm. Female vaginal intercourse orgasm was further differentiated as with or without concurrent clitoral masturbation. Overall, sexual responsiveness was related to greater body awareness and lesser time and space awareness. Satisfaction, desire, and arousal were especially associated with less time awareness in women. Female orgasms during vaginal intercourse were related to greater body awareness and lesser time awareness, but noncoital orgasms were unrelated. Our findings provide empirical support for the hypotheses that altered states of consciousness with attentional absorption are strongly related to sexual responsiveness in women, and to a lesser extent in men.

1. Introduction

Altered states of consciousness induced through meditation, in sensory deprivation, in rhythm-induced trance or under the influence of drugs lead to profound changes in the sense of the self, time and space (Block, 1979; Vaitl et al., 2005; Wittmann, 2015). Altered states of consciousness can also occur in varying degrees during sexual activity (Mosher, 1980; Nielsen et al., 2013; Passie, Hartmann, Schneider, & Emrich, 2003; Swartz, 1994). States of 'absorption' are altered mental states characterized by an intense attentional focus on sensory and/or imaginary experiences which leads to changes in the perception of self, space, and time (Tellegen & Atkinson, 1974). Given that sexual arousal is enhanced by focusing attention on sensory and imaginary sexual stimuli (Brody & Weiss, 2010; Smith & Over, 1987), absorption likely plays an important role in sexual responsiveness. This view is strengthened by studies revealing that the capacity for vivid imagination was related to proneness to sexual excitability in both sexes (Harris, Yulis, & Lacoste, 1980), and that hypnotic suggestibility was greater in women who attain orgasm during coitus more easily (Bridges, Critelli, & Loos, 1985). Both vividness of imagination and hypnotic suggestibility are characteristics of persons predisposed to absorption (Tellegen & Atkinson, 1974). Moreover, creative self-forgetfulness, a personality trait reflecting the tendency for experiencing absorbed states was related to higher sexual desire in women (Costa, Oliveira, Pestana, Costa, & Individual Differences, 2016). During sex, absorbed states occur in

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varying degrees and are characterized by an intense focus on physical sexual sensations, and to some extent, as long it is not distractive, in erotic imagination. Such an absorption in bodily sensations comes together with a reduced awareness of surrounding space and alterations in the sense of time, which can take the form of loss of awareness of time (timelessness) (Swartz, 1994). Similar effects of a loss of time and space can be found in meditative states in experienced meditators (Berkovich-Ohana, Dor-Ziderman, Glicksohn, & Goldstein, 2013; Droit-Volet, Fanget, & Dambrun, 2015) suggesting that changes in the senses of space and time are general characteristics of altered states of consciousness, i.e. of states of absorption and flow (Glicksohn, 2001; Wittmann, 2015).

Swartz (1994) proposed that absorbed states are essential for high sexual arousal and orgasm in many, if not all, women. He further proposed that absorbed states may facilitate male sexual arousal and orgasm by enhancing the subjective hedonic quality, but these altered states are not essential for sexual responsiveness in most men (Swartz, 1994). The present retrospective study aims at assessing how the senses of self, time and space during the last sexual encounter were related to sexual responsiveness. Specifically, it is hypothesized that greater satisfaction, desire, arousal, and orgasm occurrence during the last sexual encounter are related to greater awareness of the body and to lesser awareness of space and time. It is further hypothesized that these associations are stronger for women than for men.

Consistency of female orgasm during coitus was previously related to a greater capacity to enter altered states of consciousness, such as hypnotic suggestibility, enjoying the feeling of being "carried away" by alcohol, and lack of control of movements and thoughts near the end of the coitus (Bridges et al., 1985). In addition, greater likelihood of orgasm from vaginal intercourse without clitoral masturbation (vaginal orgasm) has been more consistently related to higher sexual desire and satisfaction than other orgasm triggers (Brody, 2007; Brody & Weiss, 2011; Nutter & Condron, 1983; Tao & Brody, 2011); hence, in our study we assessed whether occurrence of vaginal orgasm is more strongly related to greater awareness of the body and lesser awareness of space and time.

2. Material and methods

2.1. Participants and procedure

After giving informed consent, 68 women and 48 men participated in the study. All participants were Portuguese recruited in the Lisbon area. Subjects were on average 24.89 years of age (*SD* = 6.98). For more detailed characteristics of the participants, see Table 1. Exclusion criteria were defined as taking prescribed psychotropic medication, i.e. for treating psychiatric conditions, or having been under the influence of recreational psychoactive substances during the last sexual activity (including alcohol, but with exception of nicotine). In order to have a homogeneous sample, individuals reporting homosexual and bisexual inclinations were excluded in this analysis. However, these participants form a subgroup of a laboratory study (not described here) and also provided information on the variables of interest of the present study. The study had the approval of the local Ethics Committee and complied with the principles of the declaration of Helsinki. All participants received a ten-euro voucher or course credits.

2.2. Measures

Two visual analog scales (VAS) with scores from 1 to 7 were used to measure intensity of awareness of body and space during the last sexual activity. The questions in Portuguese were "How intensively did you perceive yourself?" and "How

Table 1
Descriptive statistics.

	Women (*N* = 68)	Men (*N* = 48)
Age (years) Mean (*SD*)	24.84 (7.11)	24.96 (8.12)
Education		
High school %	4.4	8.3
Current university attendance %	45.6	45.9
University degree %	36.8	35.4
Masters degree or more %	13.3	10.5
Occupation		
University student %	63.2	66.7
Employed %	35.3	29.1
Unemployed %	1.5	4.2
Relationship characteristics		
With regular sexual partner %	73.5	77.1
Relationship duration (months) Mean (*SD*)	42.24 (32.61)	38.58 (40.75)
Cohabitating (total sample %)	27.9	21.1
Smoking tobacco before last sex %	8.8	4.2

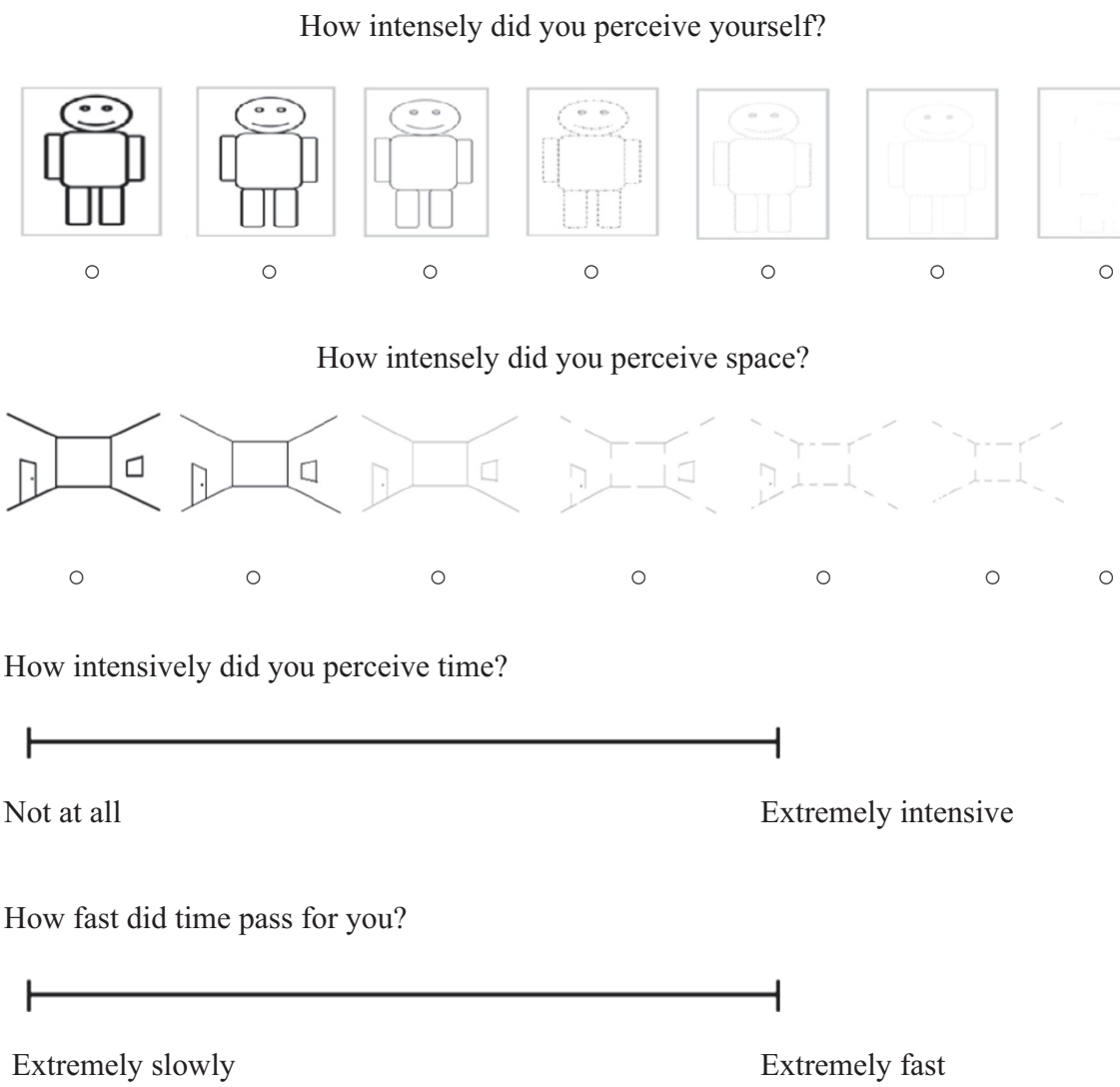

Fig. 1. Visual analog scales to measure the intensity of the awareness of body and space; visual analog scales to measure intensity of awareness of time and the speed of the passage of time.

intensively did you perceive space" (see Fig. 1); higher scores indicate greater awareness of body and space during last sexual activity.

Two visual analog scales (VAS) with a length of 100 mm were used on which respondents had to mark the point which reflected their impression of time during the last sexual activity. The questions were "How intensively did you perceive time?" and "How fast did time pass for you?". The time awareness scale was anchored from 0 mm (not at all) to 100 mm (extremely intensive). The time speed scale was anchored from 0 mm (extremely slow) to 100 mm (extremely fast). See Fig. 1.

Pertaining to the last sexual encounter, women were asked to report if they had an orgasm from (1) penile-vaginal intercourse (henceforth, intercourse) without clitoral masturbation, (2) intercourse with clitoral masturbation, (3) partnered noncoital sex (scores: 0 = orgasm did not occur, 1 = orgasm did occur). In addition, a composite measure was created for assessing orgasm occurrence regardless of triggering activity (scores 0 = no orgasm during last sexual activity, 1 = orgasm during last sexual activity).

Men were asked if during the last sexual encounter they had an orgasm from (1) intercourse, (2) partnered noncoital sex (scores: 0 = orgasm did not occur, 1 = orgasm did occur). Like for women, a composite measure of orgasm occurrence regardless of triggering activity was created (scores: 0 = no orgasm during last sexual activity, 1 = orgasm during last sexual activity).

Sexual satisfaction, desire and arousal during last sexual encounter were measured with a scale from 1 (absolutely nothing) to 6 (extremely).

The tendency to respond in a socially desirable fashion was measured with a 13-item form of the Marlowe-Crowne Social Desirability Scale (Ballard, 1992).

2.3. Statistical analyses

Partial correlations controlling for social desirability and smoking tobacco during the last sexual activity were used to examine the intercorrelations between all variables of interest, i.e. sexual responses and the awareness of body, space and time. The reason for controlling these variables is that people scoring high in social desirability may misreport their sexual responses (Meston, Heiman, Trapnell, & Paulhus, 1998), and although it is unclear if nicotine affects the perception of body, space and time during sex, smoking cigarettes may affect sexual responsiveness (Cao, Gan, Dong, Liu, & Lu, 2014; Costa & Peres, 2015). Initial significance levels were set to $p < 0.05$. The false discovery rate (FDR) method, a multiple comparisons correction procedure by Benjamini and Hochberg (1995) was used to control for multiple tests.

3. Results

As depicted in Table 2, men had a tendency to retrospectively report more satisfaction and arousal during sex than women. Men and women did not differ in the degree of sensing their body, space, and time during the last sexual activity.

Table 3 displays the intercorrelations between the intensities of awareness of body, space, and time, and the passage of time. Notably, for both sexes, a lower awareness of time correlated with a lower awareness of space (female: $r = .31$, $p = .012$; male: $r = .42$, $p = .003$). Greater body awareness correlated with lower time awareness in women ($r = -.53$, $p < .001$).

As can be seen in Table 4a, for women, greater satisfaction ($r = .66$, $p < .001$), desire ($r = .75$, $p < .001$) and arousal ($r = .76$, $p < .001$) during last sexual activity were strongly related with a greater body awareness. For men (see Table 4b), satisfaction ($r = .56$, $p < .001$), desire ($r = .46$, $p < .001$), and arousal ($r = .58$, $p < .001$) also correlated moderately-to-strongly with greater body awareness, but with smaller correlation coefficients than for women. Correlations of body awareness with desire and arousal were significantly larger in women than in men ($z = 2.45$, $p = .007$, and $z = 1.72$, $p = .013$, respectively).

In women, desire ($r = -.28$, $p = .023$) correlated weakly with lesser space awareness; in men desire ($r = -.37$, $p = .011$) and arousal ($r = -.39$, $p = .007$) both correlated similarly moderately with lesser space awareness. Regarding time awareness, strong inverse relations can be seen in women with satisfaction ($r = -.52$, $p < .001$), desire ($r = -.61$, $p < .001$) and arousal ($r = -.52$, $p < .001$). That is, the greater sexual response, the smaller time awareness during sex. A moderate negative correlation can be seen in men between satisfaction and time awareness ($r = -.36$, $p = .013$). Whereas perceiving time as passing faster correlated with greater satisfaction ($r = .36$, $p = .003$) and desire ($r = .32$, $p = .008$) in women, it was uncorrelated with sexual responses in men.

Orgasm occurrence was strongly related to greater body awareness in women ($r = .62$, $p < .001$), and moderately to greater body awareness in men ($r = .38$, $p = .010$). Orgasm was also related to lower time awareness in women ($r = -.48$, $p < .001$), but not in men (see Tables 4a and 4b). When orgasms were differentiated by trigger, female orgasm from vaginal intercourse without clitoral masturbation was moderately associated with perceiving time as passing faster ($r = .47$, $p < .001$). Female orgasm from vaginal intercourse with clitoral masturbation was moderately associated with greater body awareness ($r = .32$, $p = .009$).

4. Discussion

Our findings are evidence supporting Swartz's hypothesis that absorbed states are related to female sexual responsiveness, and to a lesser degree to male sexual responsiveness (Swartz, 1994). Women's sexual satisfaction, desire and arousal during last sexual activity were related to the capacity of attentional absorption in bodily sensations and to a profound loss of the sense of time. Female desire and arousal also imply a loss of the sense of space, but on average it seems of less importance than the loss of the sense of time. Higher sexual responsiveness in women correlates especially strongly with less time awareness and the feeling that time speeds up. For men, sexual satisfaction, desire and arousal during last sexual activity were also related to greater awareness of the body. As compared to women, men's satisfaction, desire and arousal during

Table 2
Sex differences at last sexual activity. Univariate analyses of variance with social desirability and nicotine use during last sexual activity as covariates.

	Women Mean (*SD*)	Men Mean (*SD*)	*F* (*p*)
Body awareness (1–7)	5.99 (1.28)	6.29 (.82)	1.85 (.177)
Space awareness (1–7)	4.10 (1.54)	3.92 (1.57)	.50 (.479)
Time awareness (1–100)	25.78 (28.80)	24.77 (22.17)	.07 (.800)
Perception of time speed (1–100)	64.87 (28.05)	63.06 (25.68)	.28 (.600)
Satisfaction (1–6)	4.49 (1.32)	4.96 (1.03)	4.10 (.045)
Desire (1–6)	4.85 (1.14)	5.21 (.74)	3.33 (.071)
Arousal (1–6)	4.81 (1.21)	5.23 (.75)	4.28 (.041)

Table 3
Partial intercorrelations controlling for social desirability and nicotine use between awareness of body, space, and time, and perception of time speed during last sexual activity.

	Body awareness	Space awareness	Time awareness	Time speed
Body awareness	–	−.15 (.238)	**−.53 (<.001)***	.21 (.084)
Space awareness	−.29 (.051)	–	**.31 (.012)***	.02 (.892)
Time awareness	−.24 (.103)	**.42 (.003)***	–	**−.36 (.003)***
Speed of time	.07 (.644)	−.01 (.934)	.01 (.974)	–

* Significant after FDR-adjustment; correlations for women are above the diagonal; correlations for men are below the diagonal.

Table 4a
Partial correlations controlling for social desirability and nicotine use between sexual responses and awareness of body, space, and time during last sexual activity for women.

Women	Body awareness *r* (*p*)	Space awareness *r* (*p*)	Time awareness *r* (*p*)	Time speed *r* (*p*)
Satisfaction	**.66 (<.001)***	−.11 (.39)	**−.52 (<.001)***	**.36 (.003)***
Desire	**.75 (<.001)***	**−.28 (.023)***	**−.61 (<.001)***	**.32 (.008)***
Arousal	**.76 (<.001)***	−.25 (.044)	**−.52 (<.001)***	.27 (.027)
Orgasm by vaginal intercourse *without* clitoral masturbation	.24 (.054)	.08 (.510)	−.27 (.031)	**.47 (<.001)***
Orgasm by vaginal intercourse *with* clitoral masturbation	**.32 (.009)***	−.07 (.572)	−.21 (.097)	−.006 (.961)
Orgasm by partnered noncoital sex	.06 (.624)	−.06 (.663)	−.06 (.653)	−.09 (.496)
Orgasm (unspecified trigger)	**.62 (<.001)***	−.13 (.290)	**−.48 (<.001)***	.14 (.248)

* Significant after FDR-adjustment.

Table 4b
Partial correlations controlling for social desirability and nicotine use between sexual responses and awareness of body, space, and time during last sexual activity for men.

Men	Body awareness *r* (*p*)	Space awareness *r* (*p*)	Time awareness *r* (*p*)	Time speed *r* (*p*)
Satisfaction	**.56 (<.001)***	−.34 (.023)	**−.36 (.013)***	.24 (.110)
Desire	**.46 (.001)***	**−.37 (.011)***	−.17 (.263)	.20 (.195)
Arousal	**.58 (<.001)***	**−.39 (.007)***	−.14 (.349)	.05 (.733)
Orgasm by vaginal intercourse	.19 (.197)	−.10 (.524)	−.14 (.369)	−.02 (.912)
Orgasm by partnered noncoital sex	−.03 (.851)	−.06 (.705)	−.03 (.854)	.17 (.255)
Orgasm (unspecified trigger)	**.38 (.010)***	−.03 (.877)	−.19 (.203)	.24 (.108)

* Significant after FDR-adjustment.

sex do not seem to be as strongly related to the loss of sense of time. That is, in men, only satisfaction is moderately associated with lower time awareness, and desire and arousal are moderately connected to the loss of sense of space.

In accordance with Swartz's proposal (Swartz, 1994), in our retrospective study greater attentional absorption in bodily sensations and a greater loss of the perception of time were strongly related to women's orgasms, but only moderately so to men's orgasms. That is, absorbed states seem to be more strongly related to the female orgasm, particularly to orgasm during vaginal intercourse. Orgasm from penile-vaginal intercourse without clitoral masturbation (also known as vaginal orgasm; Brody & Weiss, 2010) was related to time passing subjectively faster. Orgasm during vaginal intercourse with clitoral masturbation appears to be of importance in the context of absorbed states with a stronger focus on body awareness, but changes in the sense of time or space seem unimportant. Future research might explore if alterations of time perception are more likely if attention is more focused on the vagina; more attentional focus on vaginal sensations during intercourse was related to greater capacity to attain vaginal orgasm (Brody & Weiss, 2010). According to the present findings, absorbed states do not appear to be important for female orgasm from partnered noncoital sex.

It has been shown that state absorption in visual erotica is more clearly related to sexual arousal in response to those stimuli than trait absorption (Koukounas & McCabe, 1997, 2001), which makes it plausible that absorbed states during sex might be relatively independent of personality predispositions to enter absorbed states in a variety of situations. However, there is evidence that proneness to absorbed states in diverse situations does promote more sexual excitability in both sexes (Harris et al., 1980) and women's ability to attain coital orgasm (Bridges et al., 1985). This question warrants future research.

Psychological inhibitions can decrease attention to sexual stimuli and awareness of sexual motivation (Bloemers et al., 2013; Brody & Costa, 2008, 2013; Costa & Brody, 2010, 2013; Costa & Oliveira, 2015; Poels et al., 2013; van der Made et al., 2009; van Rooij et al., 2013). Thus, future research might explore to what extent psychological inhibitions and maladaptive ways of coping with psychological conflicts interfere with absorbed states during sex.

Greater frequency of and orgasmic responsiveness from vaginal intercourse without clitoral masturbation is associated with several indices of better health and well-being (Brody, 2010; Brody & Costa, 2008; Costa & Brody, 2010, 2012a,

2012b). Future research might examine to what extent the intensity of absorption during sex causes or otherwise explains these relationships. Better well-being has been shown to occur as a result of other activities that trigger altered states of consciousness with attentional absorption and timelessness, such as mindfulness (Keng, Smoski, & Robins, 2011; Manuello, Vercelli, Nani, Costa, & Cauda, 2016), flow (Moneta & Csikszentmihalyi, 1996), and psilocybin-induced mystical-type experiences (Griffiths et al., 2011). Future research might also explore the effects of these altered states of consciousness on sexual activity. At least mindfulness was shown to improve sexual desire, arousal and satisfaction in women (Brotto & Basson, 2014).

Absorption during sex means that all mental faculties are coherently focused on the sexual act. Such a state of consciousness during sex thereafter is an extreme as well as special form of "flow" which can be experienced as peak states in sports, work, or musical play, when one is fully immersed (focused) in challenging activities typically accompanied by a loss of time and the surrounding space. Similarly, absorption during sex means that one loses track of time and space. The intercorrelations between the variables assessing the states of consciousness confirm this notion, since the awareness of time and space are positively correlated in both women and men, and the loss of time awareness is related to the speeding up of subjective time in women. One difference between the typical "flow" of time during non-sexual activities and sexual flow as assessed in our study is the increased sense of the bodily self. Typically, a full immersion in activities leading to the experience of flow and a diminished awareness of time is characterized by a loss of the sense of self (Csikszentmihalyi & Csikszentmihalyi, 1988). That is, the feeling of self and time are conjointly modulated (Craig, 2009; Wittmann, 2015). The case of altered states of consciousness during sex however is a special situation where the immersion happens within pleasurable body states. The body itself is then the focus of awareness which nevertheless leads to a loss of time and space. In our first attempt to retrospectively assess states of consciousness during the last sexual activity we did not take into account the time course or the dynamics of the experience, our assessment implies some sort of average memory of the whole experience. It is however known from prior experiments with retrospective recall of bodily sensations such as pain that (a) peak experiences and (b) the final moments of an experience exert a strong influence on the overall retrospective judgment (Redelmeier & Kahneman, 1996). Potentially different peak times occur for increased bodily sensations on the one hand and a marked loss of sense of time and space on the other hand. 'La petite mort' as culmination of the sexual act could nevertheless occur as concerted loss of the sense of self, time and space.

In conclusion, our findings provide empirical support for the hypotheses that absorbed states are related to female sexual responsiveness, and to a lesser extent also to male sexual responsiveness.

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