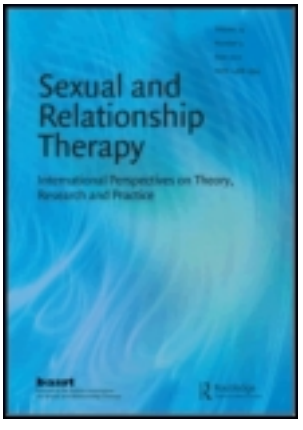

Sexual and Relationship Therapy
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/csmt20

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Version of record first published: 31 Jan 2012.

To cite this article: Barry R. Komisaruk & Beverly Whipple (2011): Non-genital orgasms, Sexual and Relationship Therapy, 26:4, 356-372

To link to this article: http://dx.doi.org/10.1080/14681994.2011.649252

Sexual and Relationship Therapy
Vol. 26, No. 4, November 2011, 356–372

Non-genital orgasms

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(*Received 6 December 2011; final version received 7 December 2011*)

Evidence from research and other sources is cited of orgasms elicited by imagery, stimulation of nipple, lips, mouth, anus, rectum, prostate and other body regions, in phantom limbs, during sleep, in response to brain and spinal cord stimulation, during childbirth, modulated by, and in response to, certain drugs and in relation to epileptic seizures. A concept of generalized neurological orgasmic processes involving recruitment, peak excitement and resolution is presented, of which genital orgasm is considered to be a special case.

Keywords: brain; spinal cord; epilepsy; phantom limb; imagery; genital

Introduction

While orgasms characteristically result from genital stimulation, there are many reports that other types of sensory stimulation – non-genital – also can generate orgasms.

Types of sensory stimulation

Imagery orgasms

As one example, we have documented cases of women who claim they can experience orgasms just by imagery – without any physical stimulation. Their bodily reactions of doubling of heart rate, blood pressure, pupil diameter and pain threshold, responses that are comparable in magnitude to when the same women induced orgasms by genital self-stimulation, bear out their claim (Whipple, Ogden, & Komisaruk, 1992). This type of non-genitally-induced orgasm, as well as others discussed below, may be typical for some individuals.

"Zone" orgasms

According to Otto (1999) and Paget (2001), both men and women have reported that they have experienced a "zone" orgasm. Otto (1999) says that a "zone orgasm occurs when a sensitive spot or zone on the body of a person not usually used for erotic stimulation is stimulated to a peak" (p. 110) and the person reports experiencing an orgasm. He reports that of 216 persons who filled out a questionnaire containing

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ISSN 1468-1994 print/ISSN 1468-1749 online

http://dx.doi.org/10.1080/14681994.2011.649252
http://www.tandfonline.com

the zone orgasm item, 31 women and 8 men stated that they had experienced a zone orgasm. Paget gives examples of men and women who have experienced orgasm from having their neck licked, their fingers sucked or their thigh/groin area stroked. The areas of the body identified by Otto whose stimulation could induce orgasm were the neck, earlobes, underarm, side of the hip, inside the thighs and the toes and fingers. Whipple and Ogden (1989) published an "extragenital matrix" designed to help men and women map their bodies to discover areas of sensual and sexual pleasure. They listed 36 parts of the body and 15 types of touch. They did not present this as a goal toward orgasm, but rather as a means of discovering pleasure in various parts of the body.

Mouth and anus orgasms

Paget (2001) described orgasms produced by stimulation of the mouth or anus in women and men. Women with spinal cord injury (SCI) described experiencing orgasm from stimulation of the ears, lips, breasts or nipples (Comarr & Vigue, 1978). Both Otto (1999) and Paget (2001) discuss mouth orgasms in women and men. According to Otto (1999) "the mouth orgasm happens at the peak of stimulation of the mouth, may begin in the mouth and/or throat and may expand from there" (p. 61). He claimed that the mouth is the primary human sensory organ, starting with suckling by infants. He stated that mouth orgasms appear to be triggered from the lips, tongue, roof of mouth and throat. He interviewed women who said they experience orgasm while kissing and others while performing oral sex on a man. The women reported that the intense feelings of pleasure usually begin to build up in the lips, and then at the point of release, they could experience a "whole body" orgasm. Some women said that their orgasm moved from their mouth to their clitoris; more often they described that it spread though their body, generating vaginal and uterine contractions. Otto reported that 41 of 205 (20%) women in his exploratory research reported having mouth orgasms. Paget (2001) described mouth orgasms for women similarly.

Otto (1999) described the occurrence of mouth orgasms also in men, both homosexual and heterosexual. He claimed that the mouth is a primary erotic zone and has the capacity of triggering its own unique orgasms. He reported that 26 of the 130 (20%) men in his exploratory study reported experiencing mouth orgasms, claiming that they seemed more reluctant than women to describe the orgasms.

Hand and shoulder orgasm

As another type of non-genital orgasm, Xaviera Hollander (1981) claimed that she experienced an orgasm when a police officer placed his hand on her shoulder. As another example, the heroine of the novel, *Kinflicks*, on realizing she just had an orgasm when her lover held her hand, stated that she can experience orgasms from stimulation anywhere on her body (Alther, 1975).

Hypersensitive skin (spinal cord injury) orgasms

Men and women with SCI have described that the skin near their injury is hypersensitive to touch – painful and intensely aversive to touch if accidentally brushed but, when stimulated in the right way, by the right person, capable of

producing pleasurable feelings that they describe as "orgasms". A woman with a complete SCI at her upper thoracic level, whose area of hypersensitivity was the neck and shoulder, claimed to have orgasms from stimulation of the skin of her neck. In our laboratory, we measured her heart rate and blood pressure and found that it increased markedly during self-application of a vibrator to her neck-shoulder junction and she described experiencing an orgasm accompanied by a "tingling" sensation in her vagina (Sipski, Komisaruk, Whipple, & Alexander, 1993).

Breast and nipple orgasms

In reports by Kinsey, Pomeroy, Martin and Gebhard (1953), Masters and Johnson (1966) and Paget (2001), women stated that they experienced orgasms from breast or nipple stimulation. Grafenberg (1950) claimed that "Kissing the nipples, touching them with the penis, or inserting the penis between the two breasts lead [sic] to an orgasm . . . " (p. 146).

Possible neural basis

The orgasm-inducing effect of breast or nipple stimulation may be due to sensory activity from the breast projecting to the same neurons that receive sensory activity from the genitals – specifically, the neurons of the paraventricular nucleus of the hypothalamus (for a review, see Komisaruk & Whipple, 2000). These neurons produce and secrete oxytocin into the bloodstream, brain and spinal cord in response to breast or nipple stimulation as well as in response to vaginal, cervical or uterine stimulation. The oxytocin released by suckling stimulates the contraction of the myoepithelial cells that envelop the milk-secreting glands in the breast. When these cells contract under the influence of oxytocin, they forcibly expel milk, in the "milk-ejection" or "milk-letdown" reflex. The oxytocin can concurrently stimulate the uterine smooth muscle to contract. In a parallel process, during childbirth, uterine contractions that push the fetus against the cervix stimulate sensory fibers in the pelvic nerve that project via the spinal cord to the same paraventricular nucleus of the hypothalamus, stimulating the neurons to release oxytocin into the bloodstream – the "Ferguson reflex" (Ferguson, 1941). This oxytocin released during childbirth can also produce expulsion of milk from the breast in women who are lactating.

Because the final common pathway for oxytocin secretion is mainly the paraventricular nucleus of the hypothalamus (Cross & Wakerley, 1977), breast, nipple, cervical and vaginal afferent activity evidently converges on this neuronal cell group. There is normally a significant release of oxytocin into the bloodstream within one minute after orgasm in healthy women and in some cases blood levels are still elevated after five minutes (Carmichael et al., 1987, 1994; Cross & Wakerley, 1977). Activation of the paraventricular nucleus region of the anterior hypothalamus has been reported during orgasm (Komisaruk et al., 2004), so it is likely that the activity of these neurons, the neurons to which they project and the neurons that project to them is involved in the pleasurable sensation of orgasm (and the description by some women of both nursing and childbirth as generating "orgasmic" feelings).

We recently reported a second site of convergence between nipple and genital afferent activity – the paracentral lobule of the postcentral gyrus, i.e., the sensory

cortex (Komisaruk, Wise, Frangos, Liu, et al., 2011). In mapping the distribution of responses in the sensory cortex to clitoral, vaginal and cervical self-stimulation, we included nipple self-stimulation and thumb and hallux stimulation for reference. Stimulation of those three body parts activated the sensory cortex in precise agreement with the "homunculus" map of Penfield and Rasmussen (1950), the finger representation lateral, the toe stimulation in the medial hemisphere wall (paracentral lobule) and the nipple self-stimulation in the thoracic region of the homunculus. However, in response to nipple self-stimulation, we also observed activation that partially overlapped the sites of activation produced by the clitoral, vaginal and cervical self-stimulation in the paracentral lobule. In discussing this finding with our neuroscience colleagues, we noticed a reliable sex difference: our male colleagues commented that the finding is an exception to the Penfield homunculus; our female colleagues commented, "of course"!

This may represent either a direct or an indirect sensory convergence between nipple and genital stimulation. The possible indirect basis for this convergence is that the nipple self-stimulation may activate the release of oxytocin into the systemic circulation, generating uterine contractions, which would then stimulate a uterine/cervical conventional sensory projection to the genital sensory cortex. We plan to test this possibility by ascertaining whether total hysterectomy, which would eliminate the uterine/cervical sensory input, will abolish the ability of nipple self-stimulation to activate the genital sensory cortex. If it does, it would be consistent with an indirect uterine/cervical sensory activation of the genital sensory cortex via oxytocin. However, if nipple self-stimulation continues to activate the genital sensory cortex after total hysterectomy, it would provide support for a convergent sensory input directly from the genital and nipple sensory pathways. If the latter were found, it would require a revision of the classical concept of the body-regional specificity of the homunculus.

Anal orgasms

There are anecdotal reports of anal orgasm, in women and in men, in response to insertion of a lubricated object, e.g., finger, penis, dildo or even fist and forearm into the anus and rectum (those regions are not self-lubricating) (Haynes, 1994). Anal stimulation is also practiced without penetration, by kissing, licking or sucking (Morin, 1986).

According to Haynes (1994), anal sex is not an activity exclusive to male homosexuals, nor is it the activity most often practiced by homosexual males. Reinisch (1990) reported that about 33% of women have experienced anal intercourse. Otto (1999) reported that 9% of the 205 women in his research reported having anal orgasms. Of historical interest, Paget (2001) reports that anal intercourse is the most popular sexual practice depicted in pre-Columbian art.

In men, Otto (1999) differentiates prostate stimulation-induced orgasm from anus stimulation-induced orgasm. Ladas, Whipple and Perry (1982, 2005) cite anecdotal reports that the descriptions of the physiological responses during orgasm from male prostate stimulation and the descriptions of orgasm from G spot stimulation in women are similar. Otto (1999) reported that 34 of the 130 (26%) men in his study claimed that they have prostate or anal orgasms. Of these 34 men, 12 stated that they were homosexual.

The role of pelvic region genital and non-genital innervation

An understanding of the sensory pathways that are most likely activated in genital stimulation-induced orgasm can suggest the bases for the experiences of non-genital orgasms. The pelvic nerve provides the afferent (sensory) nerve supply of the vagina, cervix, rectum and urinary bladder (Berkley, Hotta, Robbins, & Sato, 1990; Komisaruk, Adler, & Hutchison, 1972; Netter, 1986; Peters, Kristal, & Komisaruk, 1987). Activation of this nerve can generate orgasm when stimulated vaginally, so it is not surprising that when activated non-genitally (e.g. rectally), the pelvic nerve can also generate orgasm in both women and men. Stimulating the rectum in addition to the penis, or clitoris, vagina and cervix could add to the quality – complexity, intensity and consequently pleasurableness – of orgasm.

Genital-rectal "cross-talk"

In an anecdotal report, one man described his 10-year history of feelings resembling sexual orgasm and ejaculation after each defecation or forceful urination, followed by a rise in pulse rate and a sense of relaxation that changed to extreme fatigue (Van der Schoot & Ypma, 2002).

Conversely, in women, uterine, cervical and vaginal stimulation during childbirth has been reported to induce feelings of the urge to defecate. Thus, "cross-talk" or "referred sensation" or "equivalence" can exist between the feelings generated by vaginal and by rectal stimulation, most likely because the same – pelvic – nerve carries sensory information from both organs.

In men, sensory activity originating from the prostate (via the hypogastric nerve) during ejaculation contributes to the pleasurable sensation of orgasm, as evidenced by the finding that prostatectomy may diminish this feeling (Koeman, van Driel, Weijmar Schultz, & Mensink, 1996). The contributory role of this afferent activity to orgasm could help account for the experience of orgasm in men receiving mechanical stimulation of the prostate during anal intercourse, which would add to the sensory activity via the rectal component of the pelvic nerve.

"Birthgasms"

The hypogastric nerve also conveys sensory activity from the uterus and cervix (Berkley et al., 1990; Bonica, 1967; Giuliano & Julia-Guilloteau, 2006; Hoyt, 2006; Peters, Kristal, & Komisaruk, 1987). The orgasmic role of afferent activity via the hypogastric nerve known to occur in men can help account for the parallel drawn in women between the feelings generated during childbirth and orgasm (Newton, 1955), which has recently been termed "birthgasm" (Harel, 2007). Stimulation of the pelvic nerve may also occur with stimulation of the area of the G spot (the area of the female prostate gland) and may also account for the reports of orgasm and female ejaculation from the urethra experienced by some women (Ladas, Whipple, & Perry, 1982, 2005; Perry & Whipple, 1982).

Anal versus prostatic orgasms

The described perceptual differences between orgasms elicited by anal versus prostate stimulation is most likely due to their differential innervation – the anus via the pudendal and pelvic nerves and the prostate via the hypogastric nerves.

In women, sensory activity from the clitoris (pudendal nerve), vagina (pelvic nerve) and cervix (pelvic, hypogastric and vagus nerves) projects to different regions of the sensory cortex, which could account for the different sensory and orgasmic qualities of stimulation of each of these differentially innervated regions (Komisaruk et al., 2006; Komisaruk, Wise, Frangos, Liu, et al., 2011). Similarly, the differential innervation of the anus and prostate in men could account for the described different qualities of orgasms elicited from these regions.

Orgasms during sleep and dreams

Nocturnal emissions usually involve an ejaculation during sleep for a male or lubrication of the vagina for a female. Nocturnal emissions are also called wet dreams and sometimes considered a type of spontaneous orgasm. Kinsey, Pomeroy, & Martin (1948) reported that 83% of men in the USA experience nocturnal emissions. It is not clear whether such orgasms are generated by the brain independent of genital sensory activity in both men and women or whether they are dependent on genital stimulation resulting from contact with bedding.

Several lines of evidence demonstrate that the brain can generate an orgasm independent of genital sensory activity in both men and women. Physiological changes (vaginal blood flow, heart rate and respiration rate) were measured in a sleeping woman while she had an orgasm in a dream, which she described when she awoke (Fisher et al., 1983). During the orgasm, her heart rate increased from 50 to 100 beats per minute and her respiration from 12 to 22 breaths per minute and she had a ''very marked'' increase in vaginal blood flow. The vaginal blood flow showed cyclic episodes of vascular engorgement (the equivalent of penile erections in men) during REM (rapid eye movement) sleep periods.

In Fisher et al.' s (1983) case study, the brain activity that generated the woman's experience of orgasm was not a response to genital stimulation, but the brain activity generated output to the autonomic system that would normally be activated during genitally stimulated orgasm. In other words, the physiological responses were not ''reflexive'' responses to genital stimulation but were generated intrinsically by the brain. Orgasms during sleep are only one of multiple contexts in which orgasm can occur apparently independent of genital sensory activity.

''Phantom'' orgasms

''Phantom limb'', or ''phantom limb pain'', is a phenomenon in which a person who has suffered amputation of a limb feels that the limb is still present, often in severe pain. John Money (1960) incorporated the concept of ''phantom orgasm'' in characterizing men and women with SCI and no genital sensation who experienced orgasm in their sleep. In this case, at least in the men, the ''phantom'' is the orgasm experienced as genital. Of 14 men who had SCI between C5 and L1 (cervical 5 and lumbar 1), all had experienced orgasm before their injury. Eight of the men reported experiencing sexual intercourse in their dreams before injury and five of these men reported orgasm imagery in dreams after their injury. In Money's words, these men with paraplegia ''. . . had no genitopelvic gratification (none ejaculated after their injury). It is therefore all the more remarkable a phenomenon that some of them had orgasm imagery in dreams almost as vividly as though it were the real thing. . . . [This finding] offers conclusive evidence that cognitional eroticism can be a variable

of sex entirely independent of genitopelvic sensation and action. The brain, in other words, can work independently of the genitalia in the generation of erotic experience, just as the genitalia of paraplegics can work reflexly and independently of the brain. . . . The occurrence of orgasm imagery in the sleep dreams of paraplegics may be regarded as a special example of phantom imagery. It is of interest that this phantom experience was restricted to sleep. Awake or asleep, there were no other reported examples, from any of the patients, of phantom sensation or imagery attributable to the genitalia'' (p. 74/382).

Money (1960) also described the case of a 32-year-old woman who had been injured in a fall three years earlier that produced a fracture dislocation at C6 and C7. The injury left her incontinent and paralyzed except for minimal toe movements, which disappeared following rhizotomy (surgical cutting of sensory nerve roots to reduce leg spasms). The woman stated that ''when I have had a sexy dream I have always . . . reached a climax'' (p. 70/378). The orgasm dreams were rare. The woman estimated that she had had six orgasm dreams in the three years since her injury.

Orgasms in women with paraplegia

Women who are paraplegic as a result of ''complete'' SCI also experience orgasms (Cole, 1975; Whipple, 1990; Kettl et al., 1991; Sipski & Alexander, 1995; Sipski, Alexander & Rosen, 1995). We found that women with ''complete'' SCI at T10 and above were able to perceive vaginal and cervical self-stimulation, that they responded to the self-stimulation with analgesia measured at the fingers and that in our laboratory three out of five of these women experienced orgasms from the self-stimulation (Komisaruk & Whipple, 1994). That they experienced orgasm was surprising, because the known genital sensory pathways through the spinal cord would be expected to be severed in the case of ''complete'' SCI.

A common spinothalamic pathway for orgasm and pain?

The traditional view of the pathway by which genital stimulation reaches the brain is via the ventrolateral spinothalamic tract (Beric & Light, 1993). In cases of traumatic SCI, it has been reported that if this tract is interrupted, genital stimulation-induced orgasm is blocked in women and men (Beric & Light, 1993).

It is curious that this pathway also contains axons that convey pain impulses to the brain. In cases of intractable pain of cancer, the spinothalamic tract may be therapeutically transected by surgery. In such cases of bilateral interruption of the spinothalamic tract, orgasm is abolished in men (Monnier, 1968). In one case of a man with intractable pain, surgical transection of the spinothalamic tract blocked genitally stimulated orgasm along with blocking the pain (Elliott, 1969). The pain blockage persisted for several months, after which the pain reappeared. Concurrently, his genital orgasmic response reappeared.

Female genital afference via the vagus nerves

To account for the phenomenon of genital sensory awareness in the women in our study, and based upon a single, earlier study in rats showing that a tracer injected into the cervix labeled the sensory vagus nerves (Ortega-Villalobos et al., 1990), we hypothesized that the vagus nerves (i.e., cranial nerves #10), conveyed sensory

activity to the brain from the vagina and cervix in these women, bypassing the spinal cord. We tested our hypothesis using functional magnetic resonance imaging (MRI), ascertaining whether the sensory projection zone of the vagus nerves, i.e., the nucleus of the solitary tract in the medulla oblongata, was activated by vaginal or cervical self-stimulation in these women. Our positive findings confirmed the hypothesis (Komisaruk, Gerdes & Whipple, 1997, Komisaruk et al., 2004). Thus, what at first appeared to be cases of ''non-genitally-elicited orgasms'' were, in fact, responses to genital self-stimulation, albeit by a previously unrecognized afferent pathway.

Non-clitoral genital sensation

An incidental implication of that study is that while the women in the study could not feel their external body surface below the abdomen, including the clitoris, they nevertheless could feel and respond with orgasm to the internal, vaginal and cervical, stimulation. That observation provides evidence that vaginal and cervical stimulation *per se* are perceived and can elicit orgasm in the absence of clitoral sensation. That observation, combined with our recent report of unique sensory representation of the vagina and the cervix on the sensory cortex, regionally distinct from the projection of the clitoris (Komisaruk, Wise, Frangos, Liu, et al., 2011), provides strong evidence against the persisting notion, promulgated by Kinsey et al. (1953), that all genital sensation is mediated directly or indirectly by the clitoris.

Direct stimulation of the brain and spinal cord

Sem-Jacobsen (1968) applied electrical stimulation to the frontal cortex through a chronically-implanted electrode. One patient, saying he liked the stimulation and asking for more, responded with trembling, deep breathing, flushing, sudden relaxation, smiling and ejaculation. Another patient was described by Sem-Jacobsen as having ''. . . a nonsexual type of orgastic sensation. The patient liked it and wanted to be stimulated again, but when suddenly he became satisfied, he did not want any more electrical stimulation . . . he reported feeling 'relaxed, pleasant . . . it's like a sexual pleasure. No smell. No taste. I feel it in the whole body'" (p. 172). Then, likely reflecting the contemporary scientific/cultural mores, Sem-Jacobsen stated, ''Upon realizing that this was definitely a sexual response, no further stimulation was made'' (p. 172).

Heath (1964) implanted electrodes in several patients (preparatory to brain surgery for treating epilepsy) and enabled them to self-stimulate via a wearable control panel. One patient with an electrode implanted into the septum, ''. . . when asked why he pressed the septal button with such (high) frequency, the patient said the feeling was 'good' and made him feel as if he were building up to a sexual orgasm. He was unable to achieve the orgastic end point, however, and explained that his frequent, sometimes frantic, pushing of the septal button was an attempt to reach a 'climax' although at times this was frustrating and produced a 'nervous feeling'" (p. 227). Valenstein (1973) reported that in Parkinsonism patients, Dr. N.P. Bechterewa of the Institute of Experimental Medicine in Leningrad ''. . . reports several cases in which stimulation of the ventrolateral thalamus or adjacent regions evoked erotic and other pleasant sensations. In one case, that of a 37-year-old woman with postencephalitic Parkinsonism, stimulation evoked very pleasant sexual sensations that led to an orgasm'' (p. 74).

Heath also applied various neurochemicals via chronically implanted cannulas. After injection of acetylcholine into the septum of a female epileptic patient when she was "in a period of depression, anguish, and despair", these feelings "were supplanted within minutes by pleasurable feelings. Consistently, strong pleasure was associated with sexual feelings, and in most instances the patient experienced spontaneous orgasm" (Heath, 1964, p. 236–237). In a subsequent report, "With introduction of acetylcholine directly into the septal region... the [33-year-old woman] patient became euphoric (often experiencing sexual orgasm) in association with continuous bursts of high-amplitude [EEG] spindling focal in the septal region, activity that gradually diminished over a thirty-minute period" (Heath & Fitzjarrell, 1984, p. 168).

Media reports described the studies of anesthesiologist and pain specialist Stuart Meloy (2006), who reported that when he applied electrical stimulation through the spine for the treatment of chronic back pain, 10 of 11 of his female patients, some of whom claimed they did not experience genital stimulation-induced orgasms, reported experiencing one or more orgasms during the electrical stimulation. It is inevitable that many different spinal cord pathways were stimulated by this non-specific method.

Orgasms from epileptic seizures

There are numerous reports of men and women who describe orgasmic feelings just before the onset of an epileptic seizure, termed "orgasmic aura" (Calleja, Carpizo, & Berciano, 1988; Janszky et al., 2002, 2004; Reading & Will, 1997). The most common brain region from which these orgasmic auras originate is the right temporal lobe. The aura may have a spontaneous onset or may be triggered by some specific stimulus – for example, orgasmic aura was triggered in a woman when she brushed her teeth (Chuang, Lin, Lui, Chen, & Chang, 2004).

While seizure-related orgasms may be described as "unwelcome" (e.g. Reading & Will, 1997), in other cases they have been described as pleasurable. One woman was reported to have refused antiepileptic medication or brain surgery because she enjoyed her orgasmic auras and did not want to have them eliminated (Janszky et al., 2004).

Orgasmic auras are not necessarily experienced as involving genital sensation. However, when epileptic seizures originate in the genital projection zone of the sensory cortex, individuals report that they experience genital sensation that develops into an orgasm and the orgasm feels as if it were generated by genital stimulation (e.g. Calleja, Carpizo, & Berciano, 1988).

Blumer (1970), a neurosurgeon, described a condition of "global hyposexuality" in 29 of 50 temporal pole epilepsy patients, male and female, a condition that was alleviated by temporal lobectomy. However, in some cases, the seizures recurred, which would inhibit sexual activity but have a rebound effect shortly after the seizures. In one such case, Blumer described that about 20 minutes after the attacks, his patient "... would seek sexual relations with his wife... His wife had started to look forward to this happening. Normally he would not seek sexual relations more than once a week. However, if a seizure occurred following sexual relations – even only one hour later – he would desire sexual relations again" (p. 1103). Another patient rejected surgical intervention for his seizures: "At that time his wife told the neurosurgeon that he was regularly demanding intercourse

immediately after his attacks. At times when he was having several attacks a day, his impatient demands were difficult for his wife, but she always acquiesced. By contrast, in the absence of seizures several weeks might pass without his experiencing sexual arousal'' (p. 1103). Blumer also reported that one of his patients with temporal pole epilepsy ''. . . experienced the feeling of sexual climax with each of his seizures'' (p. 1105).

Fadul, Stommel, Dragnev, Eskey and Dalmau (2005) described a ''focal paraneoplastic limbic encephalitis presenting as orgasmic epilepsy'' in a 57-year-old woman with a two-month history of daily episodes that consisted of a sudden pleasure-provoking feeling that was described as ''like an orgasm''. The feeling lasted for 30 seconds to 1 minute. An MRI revealed a tumor in the left anterior medial temporal lobe and the EEG showed a focal left midtemporal abnormality. After antitumor medication with carbamazepine, the tumor regressed and the episodes subsided.

Neurological similarities between orgasms and seizures

The reports that epileptic seizures can generate orgasm-like feelings suggest a basic commonality between the two phenomena. Epileptic seizures are characterized by abnormal synchronous activation of a large number of neurons, followed by their synchronous inactivation, then shortly thereafter by their synchronous reactivation. It is likely that the rhythmical and voluntary movement-generated timing of genital stimulation that ultimately generates orgasm also produces synchronous activation of large numbers of brain neurons, although in a more precisely regulated pattern. A consequence (and probably a function) of this regulated synchronous activity in orgasm is the activation of high-threshold systems, such as the system that controls ejaculation. The evidence that the ejaculatory system has a relatively high threshold is that under normal conditions, rhythmical and timed genital stimulation is necessary to recruit neural elements to a higher and higher state of excitation, which climaxes with ejaculation. The ejaculation cannot be elicited at lower levels of excitation and, thus, it is characterized as a high-threshold system. In the case of ejaculatory orgasm, the genital stimulation is channeled into relatively specific and coordinated systems, such as coordinating vigorous thrusting movements with the ejaculatory event. By contrast, in an epileptic seizure, the mass synchronous neural activation becomes abnormally diffuse and can ''spill over'' into motor systems that are not normally activated simultaneously, resulting in uncoordinated limb movements, loss of balance and uncoordinated facial and tongue movements, as in a *grand mal* seizure.

Thus, the mass neuronal activation that characterizes an epileptic seizure bears a resemblance to the mass neuronal activation that characterizes orgasm. Using functional MRI, we recently reported widespread brain activation during orgasm (Komisaruk, Wise, Frangos, Liu, et al., 2011) (Figure 1). It is perhaps this similarity that can generate the orgasm-like feelings during epileptic seizures.

Phantom limb orgasm

The case of a man who described orgasms in his amputated phantom foot was described by Ramachandran and Blakeslee (1999). They reported the following conversation:

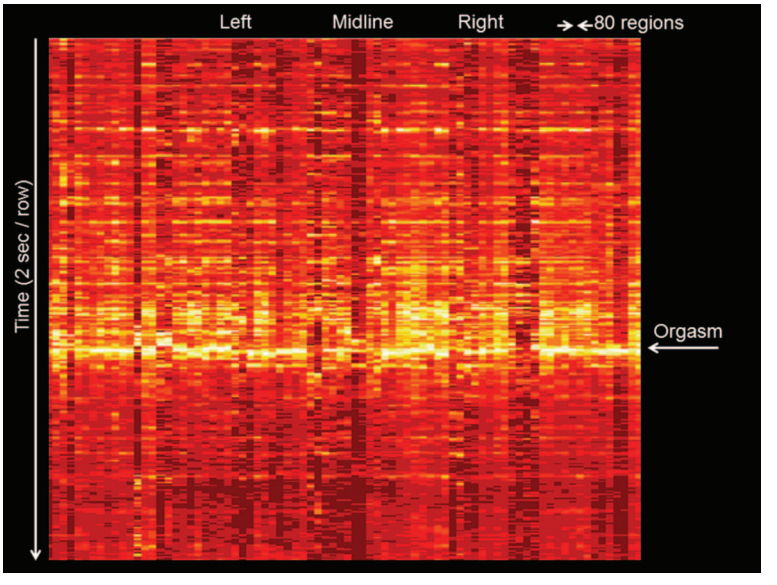

Figure 1. "Tapestry" representation of the fMRI activity of 80 Brodmann and other brain regions (columns) taken every 2 seconds (rows, starting at the top) prior to, during and after one woman's orgasm. The shade of gray represents the relative fMRI activity level of each region (darkest:lowest to lightest:highest). Inspection of the pattern reveals: (1) non-uniform sequence of activation of different brain regions leading up to orgasm, (2) greater activation in the right hemisphere than the left, (3) widespread activation of the brain at orgasm and (4) substantial reduction in brain activity after orgasm (adapted from Komisaruk, Wise, Frangos, Birbano, et al., 2011).

Patient:	Doctor, every time I have sexual intercourse, I experience sensations in my phantom foot. How do you explain that? My doctor said it doesn't make sense.
Ramachandran:	Look [I said]... One possibility is that the genitals are right next to the foot in the body's brain maps. Don't worry about it. [He laughed nervously]
Patient:	All that's fine, doctor. But you still don't understand. You see, I actually experience my orgasm in my foot. And therefore it's much bigger than it used to be because it's no longer just confined to my genitals. (p. 36)

Maps of the sensory cortex show that sensation from the foot projects to the cortex immediately adjacent to the region receiving sensation from the genitals (Komisaruk, Wise, Frangos, Liu, et al., 2011) (Figure 2). It is likely that after amputation of the foot, fibers of the neurons in the genital sensory cortex "invade" or "sprout" into the adjacent region, vacated by the neuron fibers that originally came from the foot. This neural reorganization is similar to another phenomenon reported by Ramachandran and Blakeslee (1999) in which a man with an amputated hand felt his phantom hand when his face was touched. The hand and face sensory regions are immediately adjacent to each other in the sensory cortex.

Drug-induced orgasms

Another type of orgasm-like experience that is independent of the genital system is the claim by cocaine users that the rush they feel just after injecting the drug feels

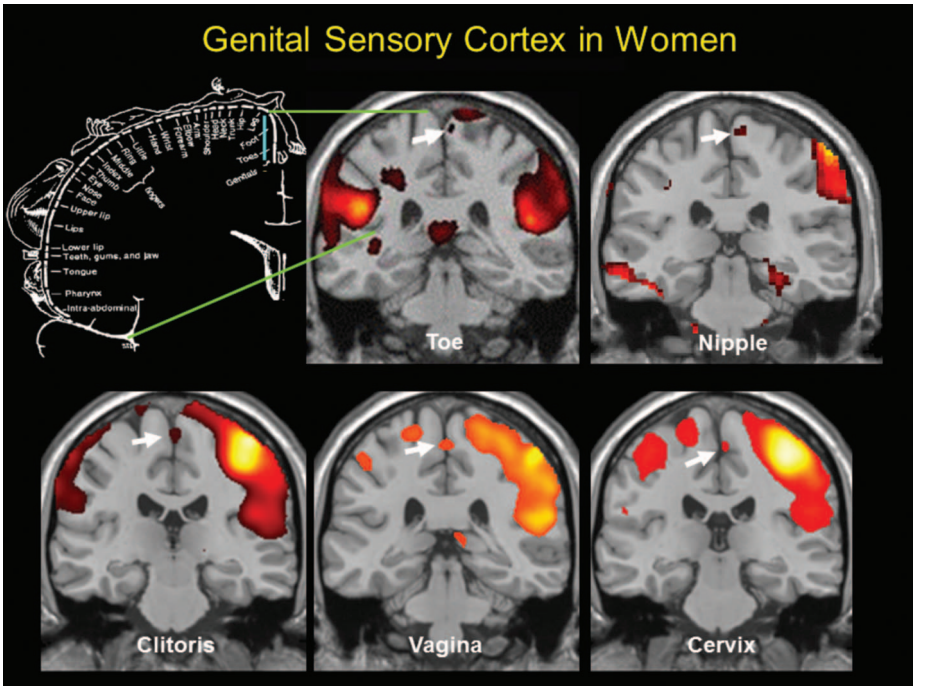

Figure 2. fMRI data showing (arrows) the region of the sensory cortex (paracentral lobule) activated by stimulation of specific body regions, in relation to the classical Penfield sensory homunculus. Note that self-stimulation of clitoris, vagina and cervix (group data from 11 women) activate slightly different regions, but all in the "male genital" region of Penfield's map. Hallux (great toe) stimulation by the investigator activated the foot region of the homunculus (individual data). Note that nipple self-stimulation in this individual also activated the medial paracentral lobule in the genital region. Activity in the lateral cortex is related to hand activity (adapted from Komisaruk, Wise, Frangos, & Liu, 2009).

orgasmic (Seecof & Tennant, 1986). This effect may be due at least in part to the dopamine-releasing action of cocaine in the nucleus accumbens (Komisaruk, Wise, Frangos, Birbano, et al., 2011), a telencephalic region that we have found to be activated during genital stimulation-induced orgasms in women (Komisaruk et al., 2004).

Orgasm of specific non-genital body parts

A different type of "non-genital orgasm" was described by a young male colleague of Komisaruk and Whipple (1998). He experienced these orgasms under the influence of marijuana during self-stimulation of different parts of the body.

Nose orgasm

Stimulation was applied using an electric vibrator held in place against the tip of the nose. A buildup of intensity of irritating sensation was described. The imagery evoked was described as starting as a small point of light then approaching closer and closer, getting brighter and larger, as if flying directly into the face. At the moment when the irritating sensation was unbearably intense, which was just before

"collision" of the bright light against the face, a sneeze occurred, "blowing away" the light.

Knee orgasm

With the vibrator stimulating the knee, the quadriceps (extensor) muscle of the thigh increased in tension, while simultaneously, the image observed was of an increasingly immense panoramic scene of thousands of troops and artillery. At the reported orgasmic moment, the leg gave an extensor kick, every single element in the panorama made a simultaneous forward move and a simultaneous forceful grunt was emitted. As a basis for claiming that these experiences were "orgasms", the colleague described the nature of an actual genital orgasm in the same terms. Thus:

Penile orgasm. When the vibrator was applied to the tip of the penis, an image of an ocean liner appeared in the distance, being raised from the depths of the ocean by an uplifted hand. A great effort, perceived as a growing tension in the postural muscles of the trunk and limbs, was mobilized in which the hand was raising the increasingly massive ocean liner. The ocean liner then burst forth into the sunlight in a fountain of spray at which moment, peak muscle contraction, actual ejaculation and laughter all erupted simultaneously. This last orgasm was a genital orgasm, but stated in the same context as the respiratory and knee orgasms. It had the same qualities of imagery and muscle tension appropriate to the imagery, as did the other types of orgasms, except it was in the genital system and included the visceromotor response of ejaculation. Stated alternatively, it was similar in form to the non-genital orgasms, but it was a genital orgasm. This description indicates that there was coherence among somatic, visceral and cognitive activity leading up to the orgasmic moment.

The effects of the marijuana may have been to break down the inhibitory pathways that normally separate waking from dream imagery, thereby revealing associations that may otherwise occur only in dreams, hallucinations, synesthesia (the [con]fusing of two different senses, e.g. "tasting shapes" [Cytowic, 1998]), psychosis and other altered states of consciousness. The orgasms, while markedly different from each other, were all described as manifesting dreamlike imagery that was related in an understandable way to the function of the specific body part that was stimulated and expressed the orgasm. In each of the three types of orgasms described above, each component – skeletal motor, respiratory and cognitive – while unique in its own "currency", was coherent with each of the others. Invariably, explosive respiratory activity (sneeze, grunt, laugh) accompanied each orgasm. Each orgasm built in a coherent, comprehensible (though dreamlike) crescendo of excitation, culminating in a synchronous climax that was described as pleasurable.

Conclusion

Apparently, just as pain is not restricted to any one part of the body, neither is pleasure. A characteristic of orgasmic pleasure, the perception of the body's explosive muscular expression, can be perceived not only in the genital system but also in the respiratory system and other body systems (Komisaruk & Whipple, 1998). Thus, it seems that while the genital system is particularly well-organized to mediate the orgasmic process, other body systems evidently manifest at least some of the

same properties and, consequently, under appropriate stimulus conditions and sensitization may exhibit comparable activity.

The mental state that occurs during orgasm has been described as an "altered state of consciousness" (Davidson, 1980, p. 282) that may lead to a state of tranquility and deep unconsciousness, to which the French have attributed the name *la petite mort* – the little death. The altered state of consciousness that may occur during orgasm has characteristics that are similar to epileptic aura and seizure. Indeed, as described above, there are reports of men and women with epilepsy experiencing feelings of orgasm during epileptic attacks. It is of interest that the part of the brain involved in epileptic attacks may include the specifically genital sensory projection sites, but more often it does not involve these sites. When it does, individuals report genital sensations during orgasm, but when it does not, individuals say they have had orgasms but no particular genital sensations. Evidently, "non-genital orgasm" is not an oxymoron.

Notes on contributors

Barry R. Komisaruk, PhD, a behavioral neuroscientist, is Distinguished Professor in the Psychology Department / Associate Dean of the Graduate School, Rutgers University, and Adjunct Professor in the Radiology Department, University of Medicine and Dentistry of New Jersey, campuses in Newark. Some of his major research contributions include the first reports in the literature of: the pain-blocking action of vaginal stimulation and its neurological mechanisms, the role of the vagus nerves as a spinal cord bypass pathway in conveying vaginal sensation in women, the sensory cortical representation of the clitoris, vagina and cervix in women, and the brain regions activated during orgasm in women. Komisaruk has published more than 155 peer-reviewed research papers, an equal number of conference presentations, four books including *The science of orgasm*, has received more than $11m in research and training grant awards from the NIH, NSF, NJ State and private foundations, multiple research recognition awards, has served on grant review committees of the NIH and NSF, as a program director in the NIH-NIGMS, and on multiple journal editorial boards.

Dr Beverly Whipple, a certified sexuality educator, sexuality counselor, and sex researcher, is the co-author of seven books and over 170 research articles and book chapters. She is the recipient of many awards, including the Gold Medal from the World Association for Sexual Health (WAS) for outstanding contributions and lifetime achievements. For their 50th anniversary, the New Scientist named her one of the 50 most influential scientists in the world (2006). Dr Whipple was the President of AASECT (1998–2000), was the Vice President of the World Association for Sexology (2001–2005), the Secretary General/ Treasurer of the World Association for Sexual Health (2005–2009), was on the board of the International Society for the Study of Women's Sexual Health (2002–2004), and was the President of SSSS (2002–2003).

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