Maternal oxytocin responsiveness improves specificity of positive social memory recall

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A B S T R A C T

Background: Oxytocin is related to positive parenting behaviours and social cognition. Long-term relationships are partly influenced by the social memory of a person. Positive social memory with the attachment figure may play a mediating role between oxytocin responsiveness and positive parenting behaviours.
Methodology: The study recruited 61 pairs of married mothers and preschool children from a community in Hong Kong. Sociodemographic background and neuroticism data of the respondents were collected in a laboratory. Salivary oxytocin and current mood rating were obtained 10 and 15 min before and after free play, respectively. After collecting the second salivary oxytocin samples, the mothers engaged in a parenting recall task.
Results: The mothers with high oxytocin responsiveness recalled previous positive social events with great detail and used uncontrollability attribution to explain such positive events.
Discussion: Oxytocin responsiveness influenced the recall of positive social events and attribution. This influence may enhance the sensitivity and positive behaviours of parenting.

1. Introduction

Oxytocin is related to attachment and emotional well-being. Converging evidence indicates that baseline oxytocin and increased oxytocin after child–parent interaction reflect sensitive and caring parental behaviours (Feldman et al., 2010). Subsequent research has shown that increased oxytocin after social interaction is more important than baseline oxytocin in explaining the role of oxytocin in the social behaviours and social memory of parents (Feldman et al., 2010). In addition, the administration of nasal oxytocin spray reverses the behavioural signs of depression, such as social submissiveness (c.f. Neumann and Slattery, 2016). This outcome may be due to the interaction of oxytocin with the serotonin system in the nucleus accumbens, which regulates social behaviour (c.f. Maroun and Wagner, 2016). Oxytocin plays a significant behavioural regulatory role that is relevant for social bonding.

Expression of appropriate social behaviours facilitates the formation of a trustful and warm relationship with other people. In long-term dyadic relationships, this expression is influenced by the episodic memory an individual has of other persons. Recently, interest in understanding how oxytocin is related to general social cognition, such as facial emotion recognition (Hicks et al., 2015; Skuse et al., 2014) and

memory of specific social events with other people, has increased. Social memory is believed to be the mediating mechanism between brain oxytocin and expression of attachment behaviour (Insel, 1997). Two competing theories explain how oxytocin influences the formation of social memories. The first is positive bias theory, which states that oxytocin facilitates the memory formation of positive social events and reduces the memory formation of negative social events. Thus, oxytocin helps generate a positive view towards a target person and increases the expression of prosocial behaviour. This effect results in a warm and trustful relationship (Brill-Maoz and Maroun, 2016).

The other theory is social salience. This theory proposes that oxytocin turns attention towards social events and thus leads to improved recall of these social events. However, no valence preference exists for social events under this process. The augmented attentive effects of oxytocin are equal in positive and negative social events. The suggestion of social salience theory is consistent with neuroendocrinological findings. The lateral septum is specific for memory formation of social events and responsible for the release of oxytocin (Guzmán et al., 2014). Consistent with social saliency theory, Bartz et al., (2010) reported that administration of nasal oxytocin is associated with high recall of caring and close bonding in non-anxious individuals and associated with high recall of minimal caring and closeness in anxious

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individuals on a maternal care rating scale. Their results indicated that individuals with high anxiety levels may have experienced many negative social events with their mothers during childhood that unavailable for attention and formation of social memory. Previous uncaring events are available for recall. Meanwhile, we can assume that individuals with low levels of anxiety experienced many positive social events with their mothers during childhood, and they are available for attention and formation of memory. Thus, many events of caring and closeness are available for recall. According to the proposal, oxytocin may activate the attachment system and produce an attachment-congruent memory search. The bias in recall reflects the influence of attentional orientation to past events by the surge of oxytocin that forms a global attachment.

Parents experience positive and negative social events when raising their children. Given the influence of oxytocin on social event attentional orientation, positive and negative social events are registered in the memory system. The current mood of participants dictates the activation of the congruent attachment system and influences recall. This situation is particularly true under free-recall tasks, similar to those employed by Bartz et al. (2010). Providing a specific instruction to direct recollection of positive and negative social events may help objectively reveal positive and negative attachment events between parents and their children.

Aside from the valence of social events, the specificity level of a memory is an important factor that contributes to the formation of global emotional impression in a toddler, and this relationship influences the attachment style. A highly detailed episodic memory of a social event could lead to better recall, which guides the behaviours of caregivers. In addition, a highly specific memory reflects how well parents understand their children. This specificity of memory can help parents analyse the behaviours of their children with respect to multiple levels of factors, including individual and environmental ones. This systematic analysis can avoid biased interpretation of the idiosyncratic behaviours of toddlers and allow parents to devise suitable parenting practices to address the developmental needs of their children. By contrast, recall of social events with minimal details prompts parents to over-generalise the strengths and weaknesses of their children. This incomplete memory representation of their children leads to ineffective parenting strategies.

Specificity of memory is indicated by how well people describe a social event. The grammatical structure of describing this information is well-learned in primary education. In the Chinese language, the four major types of sentences are two-, three-, four- and five-element sentences, and they reflect the levels of detail in a description. A two-element sentence has a subject and a verb. A three-element sentence contains a subject, a verb and a location. A four-element sentence includes a subject, a verb, a location and a time. A five-element sentence has a subject, a verb, a location, a time and a feeling/result. Primary school children learn this grammar rule in Hong Kong. These four types of sentences indicate that events are generally viewed either as specific (occurred in a specific time and location) or general (the occurrence is not marked by a time and a location). Therefore, by using the four major sentence structures to categorise the description of self-report memory, we can measure the specificity of social memory.

The contents of social event description also provide information on how parents attribute the behaviour of their children in events. A common attribution style is Weiner's Attribution Style, which is a 3 dimensional approach of attribution comprising locus of control, stability and controllability (Weiner, 1972). For example, when children exhibit naughty behaviours and if their parents regard such actions as internal-stable or internal- controllable, their parents might believe the children are showing intentional naughty behaviours because the expression of naughty behaviour is consistently controlled by the child. Such behaviours might then be thought of as originated from the bad will (internal-controllable attribution) of the children or as the personality traits of the children. Under this situation, parents will be more

punitive to their misbehaviours (Beckerman et al., 2017; Jacobs et al., 2017). However, if parents attributed the same behaviours as external-unstable or internal-uncontrollable causes, the parents might think the child's misbehaviour is situational (external and unstable attribution) or is due to inherited deficits which is beyond the child's control (internal-uncontrollable). In this case, parents will adopt more forgiving attitude to the misbehaviour. Similarly, if parents attributed the positive behaviours of their children as internal-stable or internal-controllable, they would think the good behaviour were the personality trait of the children (internal-stable attribution) or their children were well self-controlled (internal-controllable attribution) and would be more likely to praise their children's good behaviours. However, if parents attributed the positive behaviours of their children internal-uncontrollable attribution, parents would interpret the good behaviour is the second nature of their child and they would feel please (Johnston et al., 2017). These different attributional styles affect how parents encode and react towards the behaviours of their children. Therefore, the present study aims to examine the relationship between maternal oxytocin response and social memory with their children.

2. Methodology

2.1. Participants

A total of 61 pairs of married mothers (mean age = 34.98 (5.67) years old) and their preschool children aged 2 to 5 (mean age = 34.43 (5.31) months; number of female children = 35) were recruited from a community. The mothers worked as professionals (36%), such as nurses or teachers, clerical or administrative staff (28%), operatives (28%) and craft workers (8%). The children were either the first or second born in the family. On average, the mothers engaged in 23 h of play per week with their children. The means and standard deviation (SD) of oxytocin (OT) responsiveness, mood rating, average number of words in social positive event and social negative event memory are summarized in Table 1. Mothers diagnosed with any history of psychiatric disorder were excluded from the study and none of them were excluded because of this criterion.

2.2. Salivary OT

Salivary OT samples were collected with Salivette (Sarstedt, Rommelsdorft, Germany). The mothers were asked to chew on a cotton swab for 1 min. Two samples of saliva were collected. The first was collected before 10 min of free-play interaction, and the second was collected immediately after the free-play interaction(Feldman et al., 2013). The samples were temporarily stored at −20 °C for a maximum of 3 h in a behavioural laboratory. On the same day, the samples were

Table 1
Mean(SD) of the baseline and post-interaction measures.

Measurements	Mean (SD)
Pre-free play	
Oxytocin	44.26 (18.80)
Positive affects	29.43 (6.05)
Negative affects	14.31 (4.52)
Post-free play	
Oxytocin	51.13 (21.06)
Positive affects	28.82(7.32)
Negative affects	12.33 (3.52)
Neuroticism	30.31 (7.65)
Positive event recall	
No. of words	44.08 (16.79)
Detail	3.82 (1.01)
Negative event recall	
No. of words	43.56 (15.43)
Detail	4.10 (0.98)