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ORIGINAL RESEARCH ARTICLE

Maladaptive fantasy predicts negatively distorted self and other mental representation: A consideration of child abuse from psycho/neuro/biological perspectives

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ABSTRACT

Child abuse is a prevalent public health issue with one half of children worldwide experiencing some form of violence. Child abuse is associated with a myriad of impacts across the lifespan such as mental and physical illness, academic performance, and employment. For this reason, individual's psychological functions such as emotional regulation, autobiographical memory and self, and psychological connection with others are changed by child abuse. However, to best of our knowledge, there is still much unknowns about the mechanism underlying these changes. In this article, we focusing on the relationships between fantasy and metacognition and its biological and neurological bases, and functional change of them caused by child abuse. Then, we also explain the effects of them for other psychological function in abused individual. In case of child abuse, there is suggests that children immerse themselves fantastic world in order to escape from the tragic experiences that are repeated on a daily living by the caregiver. In this process, functions that recognize the real world, such as metacognition, not functioning. Rather, there is consider that children refuse to develop metacognition in order to avoid realizing the truth of the real world. As results, it does not seem to develop child's emotional regulative function such as metacognition. The experience of being continuously hurt by a caregiver and the image of being hurt are thought to change to maladaptive fantasy or autobiographical shame memory. Then, both maladaptive fantasy and autobiographical shame memory are lead to formed negatively distorted and unstable mental images of self and other. Finally, we discuss two potential new interventions such as picture book and breathing technique for abused children.

Keywords: child abuse; maladaptive fantasy; metacognition; shame memory; attachment

1. Bio/neuro/psychological changes caused by child abuse

Today, child abuse is a serious problem internationally. Nearly 3 in 4 children - or 300 million children - aged 2-4 years regularly suffer physical punishment and/or psychological violence at the hands of parents and caregivers in the world[1]. Child abuse defined as any act or series of acts by a parent or caregiver that results in harm, potential for harm, or threat of harm to a child[2]. Child abuse is a prevalent public health issue with

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one half of children worldwide experiencing some form of violence[3]. Child abuse is associated with a myriad of impacts across the lifespan such as mental and physical illness, academic performance, and employment[4-10].

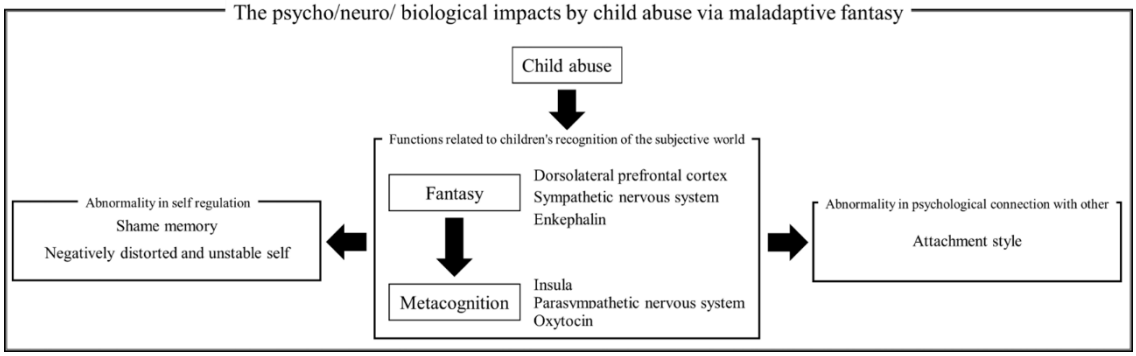

Figure 1. The psychological, Neurological, and biological effects of child abuse via maladaptive fantasy.

Previous studies indicated that one's psychological functions such as emotional regulation[11,12], autobiographical memory and self[13-15], and psychological connection with others[16,17] are changed by child abuse. When focusing on changes in one's emotional regulation caused by child abuse, for example, Carrick et al.[11] indicated that abused children were more likely to correctly report that negative real events could occur but more likely to incorrectly report that frightening fantastic events could occur. Individual's metacognition is also changes due to child abuse. Riccardi et al.[12] revealed that people who suffered adverse events in childhood had showed lower score of differentiation which related to 'considers his/her own representation of reality as subjective and questionable', and 'makes plausible interpretations of events' in the Metacognition Assessment Interview[18]. Then, Riccardi et al.[12] concluded that adverse childhood experiences represent a significant variable that impact on the good development of one's metacognition. Therefore, one's fantasy and metacognition are changed by child abuse is suggested.

Wide range of neurological and biological changes are caused by child abuse. According to Cook et al.[19], several limbic, cortical and other brain areas such as the amygdala, the cingulate cortex, the hippocampus, the dorsolateral prefrontal cortex (dlPFC), the medial prefrontal cortex, the orbitofrontal cortex, the insula, the precuneus, and the putamen were altered by child abuse. In recent years, attention is focused on changes in the dlPFC caused by child abuse. Carrion et al.[20] reported that abused children had showed a significantly larger volume of gray matter in the dlPFC than did control children. Perez et al.[21] indicated that individual with childhood abuse decreased volume of gray matter in the left insula. According to Zhong et al.[22], participants with histories of child abuse displayed significantly increased activation in the dlPFC and the insula relative to healthy controls during the psychosocial stress task which using uncontrollability and social evaluative threat[23]. Activations in both the dlPFC and the insula were positively correlated with history in the childhood aversive events. Then, neurological changes in peripheral nervous system, Oosterman et al.[24] had reported that abused children have increased activation in sympathetic nervous system and decreased activation in parasympathetic nervous system during strange situation compered to control. Bakema et al.[25] demonstrated that exposure to child abuse was negatively associated with baroreflex sensitivity that reflect cardiac parasympathetic nerve activity. As biological changes that caused after child abuse, previous studies[19,26,27] revealed that endocrine factors (e.g., hypothalamic-pituitary-adrenal axis), neurochemical factors (e.g., endogenous opioid peptides, oxytocin), and epigenetic factors (e.g., DNA methylation) were effects by it. Especially, endogenous opioid peptides including the enkephalins exert inhibitory influences on the hypothalamic-pituitary-adrenal axis. Alterations in endogenous opioids and oxytocin may be involved in certain symptoms in individual with child abuse. Heim et al.[28] revealed that exposure to maltreatment was

associated with decreased oxytocin level in cerebrospinal fluid. Savulich et al.[29] had examined the effects of naltrexone for negative emotional processing in individual with childhood adversity. Naltrexone is an opioid antagonist that has been used to treatment alcohol and substance dependence[30]. Savulich et al.[29] demonstrated that naltrexone is normalization of response for aversive images in intervention group, whereas did not change in the control group.

Therefore, individual with child abuse suffered myriad of negative impacts across the lifespan. However, to best of our knowledge, there are few studies that hypothesized the pathogenesis mechanism of child abuse from psycho/neuro/biological perspectives. Especially, there are fully unknown the negative effects of child abuse for autobiographical shame memory and attachment style via maladaptive fantasy. In this article, we focus on the relationships between fantasy and metacognition and its biological and neurological bases, and we explain the changes of them caused by child abuse (**Figure1**). Then, we also argue about the relationships between fantasy and other psychological functions such as autobiographical shame memory, and attachment style (**Figure1**). Our hypothesis is one of the new findings regarding emotional dysfunction in individual with child abuse. And it is necessary to developing noninvasive and simple intervention that can be used on a daily basis. Hence, we discuss about the possibility of picture book and breathing technique as a new intervention for individual with child abuse.

2. The relationships between fantasy and metacognition, and its psycho/neuro/biological bases

The details of psycho/bio/neurological models of fantasy and metacognition are reviewed by Shiota (in press). Fantasy is one of the social cognitive functions that defined as the mental experiences associated with a tendency to transpose (immerse) with characters in fictional situations[31-33]. As the neural basis in central nervous system of fantasy, the dlPFC is related to this [34]. And, for the neural basis of peripheral nervous system of fantasy, Gemignani et al.[35] demonstrated that sympathetic nervous activity is related to it. In terms of biological bases, previous studies report that an endogenous opioid that contain enkephalin enhances fantasy[36], while oxytocin reduces fantasy[37]. Based on these, it is suggested that the dlPFC, sympathetic nervous system, and enkephalin are associated to fantasy.

Metacognition is defined as the cognitive function of objectively monitoring one's inner experiences and emotional events, which vary from moment to moment[38]. Metacognition refers to thinking and forming integrated ideas about oneself and others[39]. As neural correlates in central nervous system of metacognition, the insula is related to this[40]. The neural basis of peripheral nervous system of metacognition, Stange et al.[41] had revealed that parasympathetic nervous activity is related to it. As biological correlates, previous studies indicate that the endogenous opioid enkephalin reduces metacognition[42], while oxytocin enhances metacognition[43], respectively. From the above, the insula, parasympathetic nervous system, and oxytocin are contributed to metacognition is suggested.

Then, focusing on the relationships between fantasy and emotional metacognitive function, Shiota and Nomura[33] disclosed that fantasy was positively associated with metacognitive emotional regulation; these relationships were moderated by emotional arousal. Glipin et al.[44] reported that children's fantastic tendency positively predicted emotional regulation; moreover, this relationship outweighed other predictor variables such as age, theory of mind, and vocabulary ability. He et al.[45] indicated that functional connectivity between the dlPFC and the insula is associated to emotional regulation. Regarding the activity of one's heart rate variability, heart rate fasts due to increasing activity of the sympathetic nerve, and this afferent information is input to the cardiac parasympathetic nerve via dorsal nucleus of vagus nerve. Then, one's heart rate is suppressed by increasing activity in parasympathetic nervous system. From the biological perspective's,

previous study[46] indicated that oxytocin that related to one's metacognition is produced in the hypothalamus posterior pituitary, and this process is induced by enkephalin that associated to one's fantasy. Following the previous results, fantasy is related to the metacognitive process, like a trigger. My hypothesis is supported by psycho/neuro/biological mechanisms. It is important to consider that elevated fantasies may not always demonstrate a beneficial effect (e.g., distracting from emotions, which may not always be helpful)[47]. There is suggests that—for good or bad—fantasy affects other psychological functions, especially emotional regulation, like as double - edged sword [47]. Psychiatric disorders with emotional dysregulation has abnormal fantasy[47].

Maladaptive Fantasy and its neuro/biological abnormality is revealed in individual who experience abuse [11,19,21,23]. Fantasy is much like a canvas in one's mind, on which one can draw characters such as themselves or others[33]. This canvas immerses people in a comprehensive image of an event[33]. In case of child abuse, this may be because children immerse themselves fantastic world in order to escape from the tragic experiences that are repeated on a daily living by the caregiver. In this process, functions that recognize the real world, such as metacognition, not functioning. Rather, the children reject it. As results, it seems to does not develop child's emotional regulative function such as metacognition. And, long-term persistence of these abnormal environment leads to reversible changes in children's neurological and biological bases of fantasy and metacognition. Fantasy is one of the social cognitive functions, and this function is fostered by the environment (caregiver) during childhood. In the next section, we explain about the effects of this function that is fostered by the child's environment for other psychological functions such as autobiographical memory and self, and psychological connection with others. Then, we also discuss about the change processes of them by child abuse.

3. The relationships between fantasy and shame memory

Autobiographical memory is closely related to concepts of self[48]. Autobiographical memory refers to memories of events that are personally relevant and are remembered from one's own past[49]. Autobiographical memories are self-reflective, containing sensory-perceptual details of an event[48]. Autobiographical memory come to mind spontaneously with no preceding conscious attempt at retrieval[50]. Autobiographical memory is inherently multifaceted drawing on disparate processes including episodic encoding and retrieval, semantic knowledge, fluency, attention, mental imagery, and emotional re-experiencing[51]. On this point, when asked to retrieve individuals' past memories, not everyone can completely recall past memories like a film (e.g. the shape of the leaves of trees in the background, expressions, and gestures of passersby). People draw a subjective world using past information (knowledge), which is referred to as autobiographical memory[52]. Fantasies have been suggested to affect autobiographical memory[52]. For example, Merckelbach[53], Patihis[54], and Robertson and Gow[55] have revealed that high fantasic tendencies recalled more qualitative content in their false autobiographical memories than individuals with low fantasic tendencies. As previous neuroimaging study, Talbot et al.[56] demonstrated that the left dlPFC is related to the retrieval of autobiographical memory. Marci et al.[57] have examined the autonomic nervous response to recall of autobiographical memory. They demonstrated that significantly increased activation in sympathetic nervous system during autobiographical memory recall. In a biological study, de Moura et al.[58] demonstrated that a low dose of naltrexone improved memory impairment. Perhaps everyone may use past information (knowledge) like paint, and drawing their subjective world in what they call their own autobiographical memory[52]. Fantasy is the canvas on which you paint that picture. The key factor is the quality of information regarding past events. If people with child abuse recall their autobiographical memory, the information used in fantasy involves horrific content that they themselves have suffered.

Shame is defined as an unpleasant emotional reaction by an individual to an actual or presumed negative judgment of himself by others[59]. According to previous neuroimaging study[60] that examined the central

nervous system of shame, there is indicated that the dlPFC is related it. Previous neuroimaging finding that investigated the relationships between peripheral nervous system and shame[61], it was shown that participants' sympathetic nerves activity was significantly increased during social rejection. Then, Hsu et al.[62] revealed that opioid system that related to enkephalin is increased activity during social rejection. Traumatic shame memories (e.g., child abuse) impacts range of mental health, such as depressive symptoms, post-traumatic stress disorder, and borderline personality disorder across the lifespan[13, 63, 64]. Then, according to previous studies[65, 66], there is suggested that fantasy is related to one's shame. For example, Prosek et al.[66] indicated that there was positive correlation between inter-individual difference of fantasy and inter-individual difference of shame. Ferrante et al.[65] revealed that there was significantly positive correlation between inter-individual difference of maladaptive fantasy and inter-individual difference of shame. Fantasy is fostered by the caregiver during childhood. In the case of child abuse, it might to maladaptive fantasy that formed by repeated hurt experiences by others, and it leads to become autobiographical shame memory. And, autobiographical memory come to mind spontaneously[50]. This repetition is lead to formed negatively distorted and unstable self is suggested. Next, we will focus on the relationships between on individual's fantasy and attachment style, and the affects of maladaptive fantasy for one's psychological connection with others.

4. The relationships between fantasy and attachment style

The quality of infant-caregiver interactions results in mental working models that organize cognitions, affects, and behavior in later relationships[67-69]. This is called attachment, relationship between infants and their caregivers is critical for human development, ensuring infant survival and optimal social, emotional, and cognitive development[70]. Human attachment is biologically based behavioral system[68]. According to previous neuroimaging findings that investigated the relationships between central nervous system and attachment[71-73], anterior cingulate cortex, the dlPFC, caudate nucleus, the insula, and amygdala were related that. Then, previous studies[74, 75] indicated that autonomic nervous system is also related to one's attachment. As biological bases, opioids and oxytocin were associated with one's attachment[76]. Individual's an organized set of behaviors in social relationships, such as child care[77], adjustment to the school[78], and romantic relationships[79] are represented by attachment[71].

Attachment can be divided into several types. A secure attachment representation provides the inner foundation for our ability to form fulfilling relationships with others and to feel a sense of social connection, even and especially in moments of aloneness[80]. On the other hand, attachment insecurity undermines moments of aloneness into the undesirable experience of loneliness[80]. Attachment insecurity is caused by child abuse[81], and it is associated high codependent behaviors and low satisfaction of the relationship [82], and violence toward partner[83]. The relationships between fantasy and attachment insecurity is suggested. For example, Britton and Fuendeling[84] and Silva and Figueiredo-Braga[85] have reported that there was significant positive correlation between inter-individual difference of fantasy and inter-individual difference of attachment insecurity. According to previous neuroimaging findings that investigated women's central nerve reactivity for facial expression in infant[86], women who have insecure attachment showed significantly more activation of the dlPFC and the insula corresponding to their own infant cry compered to women who have secure attachment. Ablow et al.[74] had examined the affect of infant cry for physiological reactivity for women who have different types of attachments. They reported that when women who have secure attachment have heard infant cry, their sympathetic activity was not significant increasing compared to baseline. In contrast when women who have insecure attachment have heard infant cry, their sympathetic activity was significant increasing compared to baseline. As previous biological finding, Inagaki et al.[87] have examined the effects of naltrexone for social connection. They reported that intervention group with naltrexone have showed significantly reduction in feelings of social connection with closed others compered to control. In child abuse, child's maladaptive

fantasy is formed by repeated hurt experiences by caregiver is suggested. And this maladaptive fantasy and its neurological and biological bases affect individual's insecure attachment style. Individual with attachment insecurity causes various problems in interpersonal relationships. This is thought to be because the horrific experiences of childhood and the related relationship with caregivers are painted in the canvas in mind as a working model, which influences current relationships with others. In this article, we discussed about the affect of maladaptive fantasy that formed by child abuse for self and psychological connection with others such as child care or romantic relationships. There is suggested that child abuse myriad of impacts individuals across the lifespan via maladaptive fantasy. Hence, establishing new interventions for abused child with maladaptive fantasy from early childhood is important. On the other hand, intervention that involve complicated procedures are not suitable for children. Therefore, we discuss two potential new interventions in the next section. One is a picture book that is simple and implemented by anyone, not just specialists that can improve maladaptive fantasy. The other one is breathing techniques that does not directly works on fantasy, but rather works on the sympathetic nervous system that is biological basis of fantasy.

5. Picture book and breathing technique that improve maladaptive fantasy

At first, we suggest picture book as one of the intervention tools for abused children. Picture book is one of the most popular tools in child rearing in the world. Picture book interactions with children, picture book effects for physical and mental development of children[88, 89]. Ganea et al.[89] indicated that very young children extrapolate information that they learn from a picture book to the real world. For example, parents label depicted objects and provide their children with new information about them, and they encourage their children to identify depictions based on their knowledge of real objects[89]. Focused on the effect of picture book for child abuse, Christy and Handojo[88] suggested that there are some important aspects in the picture book. First, the picture book should be made as can immerse children in events and identify themselves with the story and understand the messages. Second, the use of language is an important aspect to convey the message. Picture book uses the right language for children. Based on these previous evidences, there is suggested that picture book is effective for children with abuse. However, to best of our knowledge, there are few studies which examine the treatment mechanism of picture book from psycho/neural perspectives.

As second intervention tools, we suggest breathing technique. Fast-cycle breathing activates the sympathetic nervous system, and slow-cycle breathing activates the parasympathetic nervous system[90, 91]. Udupa et al.[92] showed that the effect of slow and deep breathing training increases parasympathetic activity and decreases sympathetic activity in healthy individuals. Previous studies have investigated the relationships among changes in breathing, changes in the autonomic nervous system[93], and slow and controlled breathing exercises that improve parasympathetic activity in individuals. Based on these, it is indicated that breathing technique is the modulation of the autonomic nervous system. And, there is suggested that sympathetic nerve activity is related to one's fantasy, parasympathetic nerve activity is associated to one's metacognition, respectively. Habitually practicing breathing technique helps to suppress the hypersensitivity of the sympathetic nervous system that reflects activity in one's fantasy. And, by enhancing metacognition due to the increasing activation in parasympathetic nerve system, it leads to promotes awareness of self and others, and new meanings of them are created. Adjusting the autonomic nervous system through breathing techniques can improve fantasy is suggested. To substantiate our hypotheses that the process of physical and mental changes caused by child abuse, and the effects of picture book and breathing technique for abused child, it is necessary to more future studies.

6. Limitations

The originality in our article is that we hypothesized the pathogenesis mechanism of child abuse from psycho/neuro/biological perspectives. Especially, we focused on the relationships between fantasy and metacognition, and explain the changes of them by child abuse. Then, we also argue about the relationships between maladaptive fantasy and other psychological functions such as autobiographical shame memory, and attachment style in individual with child abuse. Hence, we discuss about the possibility of picture book and breathing technique as a new intervention. This article is might to be one of the new findings regarding emotional dysfunction in individual with child abuse, and development new intervention for them. In order to prove our hypothesis, we discuss about some limitations of previous existing studies. First, relationship between sympathetic nervous activity and opioid, and parasympathetic nervous activity and oxytocin is still unknown. In our hypothesis, we consider the dlPFC, sympathetic nervous activity, and opioid as neuro/biological bases of fantasy. And we also assume that the insula, parasympathetic nervous activity, and oxytocin as neuro/biological bases of metacognition. Further studies are necessary to strengthen our experimental hypothesis. Second, there are few studies that examined the relationship between maladaptive fantasy and autobiographical shame memory from neuro/biological perspectives. Third, our ultimate goal is to develop therapeutic picture books for people who have suffered abuse. However, it is still unknown what kind of stories produce therapeutic effects. It is necessary to write new stories while referring to myths and the Bible.

7. Conclusion

In this article, we had focused on the relationships between fantasy and metacognition and its neuro/biological bases such as the dlPFC, the insula, opioid, oxytocin, and have explain potential hypothetical models that behind the changes in self and other images caused by child abuse. Then, we also discussed about the possibility of picture book and breathing technique as intervention tools for abused children. To best of our knowledge, there are still few studies that revealed the relationships among maladaptive fantasy and autonomic nervous system in abused children. Therefore, it is necessary to investigate the relationships of them. Next five years, we will examine the abnormality of fantasy and metacognition in individual with histories of childhood abuse from psycho/neural perspectives. Then we will also examine the effect of picture book and breathing technique for abused children. To development more effective picture book for individual with histories of childhood abuse, we will have to content of it (e.g., words, story, character). Especially, we will have to coordinate valence and arousal of words, thereby improvement one's fantasy. Thus, cognitive reappraisal is promoted for individual's aversive memories. We hope that in the near future, basic and clinical studies based on this article will be conducted, and that the picture books and breathing techniques produced based on this research will be of some help to people who are suffering child abuse.

Conflict of interest

The authors declares that this study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author contributions

Contributed to the writing of the manuscript: SS, SO, MM. All authors have approved the final article.

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Ethics Statement

None.

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