

## **Relationship between Mind-Wandering Intentionality, Thought Content, and Pupil Diameter Change**

**Chinatsu Naganuma, Makoto Ohtake, Hirofumi Nishinaka, and Hironori Shimada**

**Aims and Methods:** The intentionality and thought content of mind wandering are related to the function of mind wandering (Seli et al., 2016). Traditionally, mind wandering has been measured using subjective indices, but their limited validity necessitates the inclusion of physiological indices (Umeda and Otsuki, 2020). Pupil diameter reflects the function of the locus coeruleus, which controls concentration, and has been found to be associated with mind wandering (Konishi et al., 2017). However, the relationship between pupil diameter, intentionality, and thought content has not been fully investigated. Therefore, this study aimed to clarify the relationship between changes in pupil diameter, intentionality, and thought content during mind wandering. Fifteen university students (1 male, 14 females, mean age  $21.4 \pm 1.0$  years) participated in the study. They completed the Sequential Sustained Attention to Response Task (Seli et al., 2016) to measure reaction time, the number of errors, and pupil diameter, and also took part in a thought-probing task. The local ethics committee approved the study (approval number: 2022-319).

**Results:** Pearson's correlation coefficient was calculated to examine the relationship between the intentionality of mind wandering, thought content, and the change in pupil diameter. The results revealed a moderate positive correlation between pupil diameter change and unintentional mind wandering ( $r = .51, p = .052$ ), as well as a moderate positive correlation between pupil diameter change and thoughts about the past during mind wandering ( $r = .47, p = .076$ ).

**Conclusion:** The intentionality of mind wandering and the content of thoughts contribute to differences in the change in pupil diameter. Therefore, future studies should consider measuring pupil diameter in addition to subjective indices to better understand the relationship between mind wandering and an adaptive state.

(281 words)

**Keywords:** mind wandering, pupil diameter

# Relationship between Mind-Wandering Intentionality, Thought Content, and Pupil Diameter Change

Chinatsu Naganuma<sup>1\*</sup>, Makoto Otake<sup>1</sup>, Hirofumi Nishinaka<sup>2</sup>, Hironori Shimada<sup>2</sup>

<sup>1</sup>, Graduate School of Human Sciences, Waseda University, Japan  
<sup>2</sup>, Faculty of Human Sciences, Waseda University, Japan (2-579-15 Mikajima, Tokorozawa, Saitama, 359-1192 Japan)



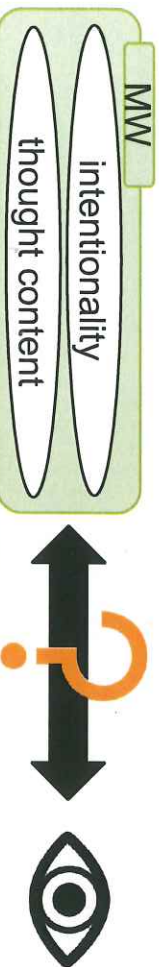
## Introduction

Suggests a link between mind-wandering (MW) function and intentionality and thought content. (Sei et al., 2016).

MW should be measured in conjunction with physiological indicators to increase validity (Umeda and Otsuki, 2020).

## Objectives

To clarify the relationship between pupil diameter change, MW intentionality, and thought content.



## Materials and Method

**Participants:** Fifteen university students in Japan

**Measures:** (a) MW: Pupil Diameter Change (Gazeport GP3 HD/GP3 Eye Tracker), (b) MW intentionality and thought content: Responses to thought probes during The sequential Sustained Attention to Response Task (Sei et al., 2016)

**Procedure:** The sequential Sustained Attention to Response Task

(Sei et al., 2016) was administered to measure reaction time and number of errors and (a), (b).

## Results

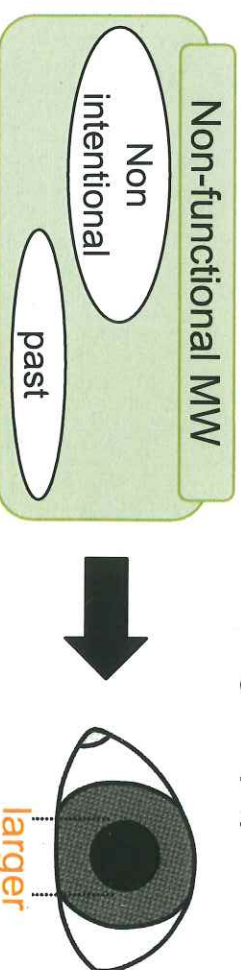
	pupil diameter	intentional	Non intentional	Future	past
Intentional	-.14	-			
Non Intentional	.51*	.16			
Future	.22	.59*	.79**		
past	.47*	.61*	.68**	.69**	

\*\* $p < .01$ , \* $p < .05$ ,  $p < .10$

Pearson's correlation coefficient was calculated to examine the relationship between the intentionality of MW, thought content, and the change in pupil diameter.

## Conclusion

The intentionality of MW and the content of thoughts contribute to differences in the change in pupil diameter.



## References

Sei, P., Risko, E. F., & Smilek, D. (2016). On the necessity of distinguishing between unintentional and intentional mind wandering. *Psychological Science*, 27, 685-691.

\*This research was conducted with the approval of The local ethics committee (Approval number: 2022-319)

‡There is no COI relationship with any company that should be disclosed in connection with the presentation of the abstract.

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## 発表概要報告書

問題と目的：マインドワンダリングは、注意が目の前の課題から逸れ、無関係な思考が生じる現象のことであり、その機能は一貫していない。適応的な機能としては創造性の向上があり

(Yamaoka & Yukawa, 2016) 不適応的な機能としては、パフォーマンスを低下させ (Albert et al., 2018) , 否定的な気分や抑うつを増加させることが示されている (Ottaviani et al., 2015) 。この機能の差異は、マインドワンダリングの意図性と思考内容によって、左右されることが示唆されている (Seli et al., 2016) 。また、従来、マインドワンダリングは主観指標によって測定されてきたが、その妥当性の低さから生理指標と合わせて測定する必要があると指摘されている (梅田・大月, 2020) 。瞳孔径は集中を司る青斑核の働きを反映し、マインドワンダリングの生起との関連が示されているが (Konishi et al., 2017) , 意図性や思考内容との関連は十分には検討されていない。そこで、本研究は、瞳孔径の変化とマインドワンダリングの意図性、思考内容の関連について明らかにすることを目的とした。

方法：大学生15名 (男性1名, 女性14名, 平均年齢 $21.4 \pm 1.0$ 歳) を対象にThe sequential Sustained Attention to Response Task (Seli et al., 2016) を実施し、反応時間とエラー数および瞳孔径を測定し、思考プロンプト課題への回答を求めた。地元の倫理委員会はこの研究を承認した (承認番号2022-319) 。

結果：マインドワンダリングの意図性、思考内容と瞳孔径変化量の関連を検討するため、Pearsonの相関係数を算出した。その結果、瞳孔径変化量は非意図的なマインドワンダリングと中程度の正の相関 ( $r = .51, p = .052$ ) , マインドワンダリング中の過去に関する思考内容と中程度の正の相関 ( $r = .47, p = .076$ ) を示した。

結論：マインドワンダリングの意図性や思考内容によって、瞳孔径の変化量に違いが生じることが示唆された。したがって、今後は、主観指標に加えて瞳孔径も測定することにより、マインドワンダリングと適応状態との関連をより適切に明らかにすることが可能になると考えられる。

(日本語 1200 字以内)

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