Pediatric procedural sedation outcomes using midazolam and hydroxyzine with and without meperidine

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Abstract

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Background: Procedural sedation is an advanced pharmacological behavior guidance technique frequently used in the pediatric dental setting. It can be offered as an option for dental treatment for a young, potentially uncooperative pediatric patient to safely and effectively complete dental restorative needs. However, there are no standard regimens or drug dosages used among pediatric dentists, and sedation outcomes vary widely.

Purpose: The primary objective of this randomized trial was to assess the effects of oral sedation using midazolam and hydroxyzine with and without meperidine on sedation outcomes in pediatric dental patients. The relationship between child temperament and sedation outcomes was also assessed.

Methods: This pilot study recruited 14 children between the ages of 3-7 who met study eligibility criteria and were planned to undergo dental treatment with oral sedation at the University of Washington Center for Pediatric Dentistry. The children were randomly assigned to receive a regimen of midazolam and hydroxyzine with or without meperidine. Parents completed the Child Behavior Questionnaire Short Form (CBQ-SF) to assess temperament.

Results: Out of 14 participants, there were no significant differences in sedation outcome in regard to age, sex, insurance status, sedation regimen, isolation method, treatment complexity, and procedure. There were also no significant differences in the effect of child temperament on overall sedation outcome, although within the non-narcotic regimen children with sedation failures displayed higher levels of both effortful control and extraversion/surgency.

Conclusion: Further data collection is needed to assess the effect of procedure variables and child temperament on sedation outcomes. Conclusions regarding these relationships cannot be drawn at this time due to the small sample size. However, results from this study will contribute to identification of best practices when choosing a sedation regimen and improve our ability to identify optimal candidates for pediatric procedural sedation.

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I. INTRODUCTION

Procedural Sedation in Pediatric Dentistry

Young children can pose significant behavioral challenges in the dental setting. These patients may have dental anxiety or lack the effortful control (self-regulation) to successfully navigate the dental experience. Procedural sedation is an advanced pharmacological behavior guidance technique that can be employed when basic behavior guidance techniques are likely to be ineffective. It can be a valuable tool, not only to facilitate dental treatment, but also to protect a young child's psyche, reduce dental fear, and ensure safety of both the patient and the dental team.

Case selection is crucial to optimizing sedation outcomes. In addition to biological factors like age, gender, and weight, temperament of the pediatric sedation candidate must also be carefully evaluated. Compared with children who have high levels of effortful control, children who exhibit high levels of impulsivity may be more likely to respond poorly to uncomfortable or unfamiliar procedures. This may result in disruptive behavior during sedation, and ultimately more sedation failures.[1,2]

Drug Regimens

There is no standard drug regimen or protocol for oral sedation.[3] Varying drug regimens can be chosen based on operator preference, treatment needs and length, and anxiety levels of the patient. Benzodiazepines, opioids, and antihistamines are common drug options that can be used alone or in combination to achieve desired sedative effects and minimize potential side effects of counterpart drugs. For example, midazolam is a rapid-onset, short acting benzodiazepine that offers a sedative effect with some degree of amnesia.[4] These qualities make midazolam an ideal sedative for relatively minor or quick operative procedures in young children. An opioid such as

meperidine can be utilized to increase the sedative effect and offer analgesia for lengthier, more complex procedures.[5] Additionally, an antihistamine like hydroxyzine can be added for additional sedative and antiemetic effects, countering potential nausea from the use of an opioid.[6] For these reasons, the combination of a benzodiazepine, narcotic, and antihistamine such as the midazolam/meperidine/hydroxyzine sedation regimen has become popular in pediatric dentistry. Sedation regimens are often supplemented with nitrous oxide/oxygen (N_2O/O_2) simultaneously, as nitrous oxide has been shown to further potentiate sedation and improve outcomes.[7,8] An additional benefit of nitrous oxide use is that it can be used to titrate the level of sedation.

Drug Dosing

Despite proving to be an effective behavior management technique, procedural sedation in the pediatric population must be approached thoughtfully. In some children, sedation effects may linger long after the procedure is completed and affect post-discharge outcomes.[9,10] Compared with intravenous or intranasal methods of drug delivery, oral sedation can be challenging due to longer onset to sedation, unpredictable hepatic first-pass absorption and bioavailability, and an inability to titrate the medications.[11,12] Thus, children may respond differently to the same regimen based on a variety of biological factors.

Body mass must be carefully considered when utilizing weight-based dosing for sedation medications. Children who are overweight or obese have inherently different metabolic physiologies that affect drug distribution and pharmacokinetics. A higher level of body fat is correlated with a higher volume of distribution of lipophilic medications. These patients also have an increased lean body mass in conjunction with increased adipose tissue, which can affect drug metabolism and distribution.[13]

Dosing children strictly based on their total body weight without consideration for their fat and lean body mass can result in subtherapeutic effects or relative overdoses, particularly in the overweight or obese population.[14,15] For example, an overweight child dosed at total body weight could potentially receive a higher dose than ideal for their lean body mass, putting them at risk for oversedation. If the same child receives medications standardized for age and height, it is possible the sedation is subtherapeutic, which can result in difficult or disruptive behavior during the dental procedure. While there is no universal standard for dosing children who fall outside of normal ranges of weight for age, body mass scalars to account for body fat and lean body weight should be used to ensure appropriate dosing in sedation procedures.[16] Implementing the use of a lean body mass scalar when calculating sedation doses can reduce these complications.

Administering multiple drugs can increase sedation depth, which may be desirable when managing an anxious child. Conversely, the use of multiple medications has been shown to increase the risk of adverse outcomes compared with single or dual-combination drug regimens.[17-19] As a result, when sedation regimens include multiple agents, the dose of each drug should be carefully considered and adjusted based on the level of sedation desired for a procedure. Lowering the individual agent dosages for combined sedation regimens compared with dosages for single agent regimens can reduce the risk of progressing to deeper levels of sedation than intended. In general, to avoid oversedation and subsequent adverse sequelae, multi-drug regimens must be used judiciously, particularly when considering the addition of a respiratory depressant such as an opioid.[20,21]

Avoiding Adverse Events in Sedation

The majority of adverse sedation events can be avoided with careful case selection, appropriate medication dosing, and proper peri-operative monitoring.[22] Consistent monitoring is paramount to maintaining a safe sedation environment. The American Academy of Pediatric Dentistry recommends that best practices for monitoring during sedation include standard vital signs, including oxygen saturation levels, respiratory rate, and utilization of either capnography or a precordial stethoscope.[23] Additionally, avoiding medications with a long duration of action can decrease the risk of post-operative events once a child is discharged home.[23] When serious adverse events do occur, they are typically due to respiratory depression, with risk for subsequent neurologic injury and possible death. Given that multi-drug regimens can increase the risk for such adverse events, identifying medication combinations including fewer medications that are equally successful can potentially reduce sedation risks, while offering efficacious behavioral outcomes.

Objectives

The primary objective of this single-blind randomized pilot study was to assess the effects of oral sedation using midazolam and hydroxyzine with and without meperidine on sedation outcomes in pediatric dental patients undergoing dental treatment at the University of Washington Center for Pediatric Dentistry. The secondary objective was to evaluate the relationship between child temperament and sedation outcome in each treatment group.

II. RESEARCH METHODS

Study Population

Children scheduled for dental treatment with procedural sedation at the University of Washington Center for Pediatric Dentistry were recruited for the study if they fulfilled the assigned inclusion criteria:

1. Between 36-95 months of age,
2. ASA I or II without behavioral diagnoses such as autism spectrum disorder or ADHD,
3. No previous history of dental treatment with procedural sedation,
4. Under the 95th weight for age BMI percentile,
5. Able to take diagnostic bitewing radiographs,
6. Able to take medication by mouth,
7. Brodsky tonsillar scores of II or less,
8. Planned to receive at least 2 restorations in a single sedation appointment, and
9. Had an accompanying caregiver who could speak and read English.

Enrollment of Subjects

The study protocol was reviewed and approved by the University of Washington Institutional Review Board (STUDY00006758). The parents or legal guardians of eligible patients were contacted via telephone at least one day prior to their scheduled sedation appointment to give preliminary study information and gauge interest. Guardians who were interested in participating were e-mailed a copy of the study information and consent forms for review. When presenting to their sedation appointment, interested families were approached and recruited to the study. Informed consent was obtained for the dental procedure, administration of sedation medications, and participation in the study. Once enrolled, participants were not eligible to participate in the study at subsequent sedation visits.

Randomization

Participants were randomly assigned to one of two sedation regimens for their dental treatment: midazolam 0.5mg/kg, hydroxyzine 1.0mg/kg, and meperidine 1.5mg/kg, or midazolam 0.5mg/kg and hydroxyzine 1.0mg/kg without meperidine. Randomization software

was used to create assignment blocks of 10, from which patients were allocated evenly to each arm. A total of two blocks were utilized for 14 participants.

Intervention

All medications were dosed based on a lean body weight scalar derived from each patient's total body weight and height. Regimens were mixed with a flavoring syrup and delivered orally. After thirty-five minutes of supervision to allow for onset of sedation, the children were taken to the treatment room and placed on a protective stabilization wrap on the dental chair. For safety, the children had their wrists and legs passively placed into the straps, with the potential for additional straps to be utilized mid-procedure if behavior declined.

Participants were given supplemental N_2O/O_2 via inhalation at a flow of 5 L/min, titrated to 50%/50% N_2O/O_2, and then adjusted accordingly to the children's intra-procedural behavior. A sedation monitor who was not directly involved in patient care recorded vital signs including blood pressure, heart rate, oxygen saturation, and respiratory rate at five minute intervals.

The sedation monitor and operating dentist evaluated each participant's behavior during sedation and came to consensus on the patient's Houpt Behavior Rating Scale score. All operators and monitors were calibrated to the behavior scale prior to initiation of the study. To assess child temperament, parents completed the 94-question Child Behavior Questionnaire Short Form (CBQ-SF) during the appointment, rating their child on fifteen domains of child temperament.

Upon completion of the sedation procedure, patients were discharged home to their caregivers based on a 14-point fast track discharge criteria assessing alertness, return to baseline stability, and postoperative side effects. Families received a call after the procedure to assess for any adverse outcomes after discharge or lingering sedative effects.

Data Collection

We reviewed study and patient medical records to collect data on the sedation regimen, age, sex, ASA status, and insurance status of participants. Pre-operative behavioral ratings based off of the Frankl behavior scale were recorded. Isolation data included no isolation, Isolite use, and rubber dam use. Treatment complexity was divided into simple or complex procedures. Simple procedures consisted of intracoronal composite restorations, sealants, and Hall crowns. Complex procedures included pulp therapy, stainless steel crown preparations, and extractions. Procedure duration was also recorded. Temperament scores were calculated from the CBQ-SF surveys. An overall Houpt rating of excellent, very good, or good characterized the sedation as a success. A rating of fair, poor, or aborted characterized it as a failure.

Data Analysis

Study data were collected and stored in REDCap at the University of Washington and analyzed in Stata version 14.2. Descriptive statistics were calculated for each variable. Fisher's Exact tests were used to analyze relationships between sedation outcome and sex, insurance status, pre-operative behavioral rating, sedation regimen, isolation method, treatment complexity and duration of procedure. Wilcoxon Rank-Sum tests were conducted to evaluate the associations among sedation regimens, temperament scales, and sedation outcomes. Significance levels were set to $\alpha = 0.05$.

III. RESULTS

Out of 14 total participants, there were seven successful sedations and seven unsuccessful sedations. The average participant's age in months was 68.29±13.72. The majority of participants were female (64.3%), had Medicaid insurance (78.6%), and had a pre-operative

behavioral rating of Frankl + (57.1%). All participants were healthy with an ASA I classification. There were no intraoperative adverse events recorded, and 13 out of 14 participants returned to a baseline level of activity and energy during a post-operative follow-up phone call. One family did not return phone calls to obtain post-operative recovery information. There were no statistically significant associations between sedation outcome and age, sex, insurance status, or pre-operative behavioral ratings (Table 1).

Seven participants received the regimen containing meperidine, and seven participants received the non-narcotic regimen. There was no significant difference in sedation outcome between the two regimens. Eight (57.1%) subjects had treatment completed with an Isolite, and four (28.6%) subjects had treatment completed with a rubber dam. Two (14.3%) subjects were unable to tolerate either isolation method. There were a total of six (42.9%) subjects who had complex treatments performed, and eight (57.1%) subjects underwent simple treatment, although three out of the eight subjects were planned for complex treatments but ultimately received Hall crowns (categorized as a simple procedure) due to deteriorating behavior. The majority of procedures were between 30-60 minutes in duration. There was no significant association between sedation outcomes and procedural variables (Table 2).

The participants were scored on fifteen domains of temperament, capturing three overarching dimensions of temperament: effortful control, negative affectivity, and extraversion/surgency. There were no statistically significant differences between sedation success and failure among all the domains (Table 3). Similarly, there were no statistically significant differences in temperament scores of the subjects enrolled to each treatment group (Table 4). Sedation outcomes in relation to temperament scores were also calculated between treatment groups. Within the non-narcotic regimen group, subjects with sedation failures had a

significantly higher extraversion/surgency score compared with subjects with sedation success ($P = 0.03$), as well as a higher effortful control score ($P = 0.03$) (Table 5). There were no statistically significant differences among the remainder of the temperament scores in relation to sedation outcome in either group.

IV. DISCUSSION

Sedation Outcomes

Based on the preliminary data conducted in this study, we observed no significant differences in sedation outcome between the narcotic and non-narcotic regimens. This trend suggests that adding a narcotic such as meperidine to a sedation regimen may not necessarily provide a more successful behavioral outcome. Given that utilization of a narcotic poses higher risks of adverse events compared with a non-narcotic regimen, providers should carefully consider the rationale for usage. This provides justification for continuing research into this topic, as more data are needed to assess whether addition of a narcotic medication truly improves outcomes.

Lane *et al.* previously reported no differences in sedation failure or disruptive behavior rates when comparing several patient demographics and procedure variables.[1] In this study, factors such as age, sex, insurance status, pre-operative behavioral rating, isolation method, treatment complexity, and procedure duration had no significant associations with sedation success or failure. At this time, however, there is insufficient data to draw conclusions regarding these relationships in the present study. We anticipate repeating data analysis after additional participants are enrolled.

Child Temperament

With a larger sample size and appropriate randomization, it is anticipated that there would be no significant differences in child temperament scores between the two sedation regimens. It is interesting to note that within the midazolam and hydroxyzine regimen, higher levels of both effortful control and extraversion/surgency were associated with sedation failure. While impulsive behavior can be associated with failed restorative visits, we would expect children with higher levels of effortful control to experience more successful behavioral outcomes.[1,24] The most likely explanation for this result is the small sample size used for the current analysis.

Limitations

A large limitation in this study was unanticipated difficulty in recruiting participants. In over ten months of recruitment with up to four sedation cases planned per week, we were only able to recruit 14 families. We had originally anticipated recruiting 50 subjects in each arm of the study. Many of the cases did not fulfill eligibility criteria because an interpreter was required or the patient fell outside of the age restriction for the study. Additionally, when contacting the guardians of eligible subjects, many expressed concern regarding the study medication protocols. These concerns clustered into two main categories: those who preferred their child receive a narcotic regimen, and those who did not want their child to receive one. Caregivers who declined to participate often cited anxiety about opioid use, despite receiving pre-procedure counseling informing them that the narcotic regimen is routinely used at the clinic for non-study procedures. In contrast, some caregivers expressed their desire to use the narcotic combination because they perceived that it would result in reduced pain and better patient compliance.

Because the study clinic is an academic institution and a residency training program, there were several providers involved in providing direct patient care. Although these providers

were standardized to assessing behavior outcomes, each provider has a different style of behavior management that may have affected patient behavior and success rates.

Another consideration in this study was that it was not double blinded. Ideally, the judgement of overall behavior outcome would be assessed independently without knowledge of which sedation regimen was given. In efforts to ensure appropriate safety for the children, we opted not to have providers blinded to the sedation regimen in the event of a drug-induced medical emergency where emergency care would need to be administered. To compensate for the possible confounding effect of not blinding the providers, we required consensus regarding the overall Houpt Behavior Rating for each child from both the sedation operator as well as the sedation monitor.

Results from this study may be applicable to predominantly English-speaking populations, but may not be able to be generalized to families who speak primary languages other than English, as it is possible that providers may employ different styles of behavior management to cater to the level of understanding from the child. Families who speak a primary language other than English were not recruited to participate in the study. Future expansion of the study could include recruitment of these families with translated forms as well as an in-person translator present for the duration of the appointment.

V. CONCLUSIONS

Opioid use and pain control in dentistry is a high profile topic among the public and dental community. Further research regarding ideal sedation regimens for dental procedures is warranted, particularly among vulnerable populations such as children. While the preliminary data trend toward no significant differences in outcomes between both narcotic and non-narcotic

containing regimens, a larger sample is needed to draw meaningful conclusions. Results from this study will also contribute to efforts in identifying potential patient demographics, temperament traits, or treatment variables that are associated with sedation success.

VI. TABLES

Table 1. Demographics of study participants by sedation success.

		Sedation Success		
	Total	**Yes**	**No**	
	N = 14	**N = 7**	**N = 7**	
	N (%)	**N (%)**	**N (%)**	**p-value**
Age in Months (Mean±SD)	68.29 ±13.72	68.71±17.96	67.86±9.23	0.75†
Sex				0.99‡
Female	9 (64.3%)	4 (57.1%)	5 (71.4%)	
Male	5 (35.7%)	3 (42.9%)	2 (28.6%)	
ASA status				N/A
I	14 (100.0%)	7 (100.0%)	7 (100.0%)	
II	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Insurance status				0.99‡
Medicaid	11 (78.6%)	5 (71.4%)	6 (85.7%)	
Private	3 (21.4%)	2 (28.6%)	1 (14.3%)	
Pre-operative behavioral rating				0.10‡
Frankl +/+	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Frankl +	8 (57.1%)	6 (85.7%)	2 (28.6%)	
Frankl -	1 (7.1%)	0 (0.0%)	1 (14.3%)	
Frankl -/-	5 (35.7%)	1 (14.3%)	4 (57.1%)	

SD = Standard Deviation; †Calculated using Wilcoxon Rank-Sum tests; ‡Calculated using Fisher's Exact tests

Table 2. Procedure variables by sedation success.

		Sedation success		
	Total	**Yes**	**No**	
	N = 14	**N = 7**	**N = 7**	
	N (%)	**N (%)**	**N (%)**	**p-value†**
Sedation Regimen				0.99
Midazolam + Hydroxyzine + Meperidine	7 (50.0%)	3 (42.9%)	4 (57.1%)	
Midazolam + Hydroxyzine	7 (50.0%)	4 (57.1%)	3 (42.9%)	
Isolation method				0.49
None	2 (14.3%)	0 (0.0%)	2 (28.6%)	
Isolite	8 (57.1%)	5 (71.4%)	3 (42.9%)	
Rubber dam	4 (28.6%)	2 (28.6%)	2 (28.6%)	
Treatment Complexity				0.10
Simple	8 (57.1%)	2 (28.6%)	6 (85.7%)	
Complex	6 (42.9%)	5 (71.4%)	1 (14.3%)	
Duration of Procedure				0.99
< 30 min	1 (7.1%)	1 (14.3%)	0 (0.0%)	
30 - 60 min	13 (92.9%)	6 (85.7%)	7 (100.0%)	
> 60 min	0 (0.0%)	0 (0.0%)	0 (0.0%)	

†Calculated using Fisher's Exact tests

Table 3. Temperament scales by sedation success.

	Overall	Sedation success	Sedation failure	
	N = 14	**N = 7**	**N = 7**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**P-value†**
Effortful Control	5.54 ± 0.77	5.27 ± 0.62	5.81 ± 0.86	0.28
Attention Control	4.96 ± 0.85	4.95 ± 0.92	4.97 ± 0.84	0.85
Inhibitory Control	5.27 ± 0.86	5.08 ± 0.83	5.46 ± 0.90	0.40
Perceptual Sensitivity	5.73 ± 0.62	5.69 ± 0.89	5.76 ± 0.35	0.61
Low-Intensity Pleasure	5.86 ± 0.72	5.68 ± 0.45	6.05 ± 0.92	0.22
Negative Affectivity	4.27 ± 0.65	4.14 ± 0.55	4.39 ± 0.76	0.48
Frustration	4.11 ± 1.11	4.21 ± 1.00	4.00 ± 1.29	0.52
Fear	3.80 ± 1.22	3.57 ± 1.52	4.00 ± 0.99	0.52
Discomfort	4.12 ± 1.26	3.51 ± 0.97	4.64 ± 1.31	0.28
Sadness	3.84 ± 0.72	3.60 ± 0.88	4.09 ± 0.45	0.22
Soothability	4.73 ± 1.14	5.21 ± 1.16	4.24 ± 0.95	0.07
Extraversion/Surgency	4.38 ± 0.46	4.26 ± 0.52	4.50 ± 0.39	0.28
Activity	4.85 ± 0.75	5.00 ± 0.73	4.70 ± 0.80	0.75
Shyness	3.85 ± 1.04	3.74 ± 1.25	3.95 ± 0.88	0.75
High-Intensity Pleasure	4.75 ± 0.75	4.56 ± 0.77	4.93 ± 0.75	0.16
Smiling & Laughter	5.65 ± 0.99	5.47 ± 1.22	5.82 ± 0.75	0.70
Impulsivity	4.01 ± 1.00	4.11 ± 0.77	3.93 ± 1.22	0.89
Positive Anticipation	5.16 ± 0.65	4.95 ± 0.53	5.38 ± 0.72	0.27

†Calculated using Wilcoxon Rank-Sum tests

Table 4. Temperament scales in relation to sedation regimen.

	Overall	**Midazolam + Hydroxyzine + Meperidine**	**Midazolam + Hydroxyzine**	
	N = 14	**N = 7**	**N = 7**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**P-value†**
Effortful Control	5.54 ± 0.77	5.24 ± 0.55	5.84 ± 0.88	0.06
Attention Control	4.96 ± 0.85	4.57 ± 0.68	5.35 ± 0.86	0.07
Inhibitory Control	5.27 ± 0.86	4.89 ± 0.56	5.65 ± 0.97	0.08
Perceptual Sensitivity	5.73 ± 0.62	5.57 ± 0.69	5.87 ± 0.58	0.43
Low-Intensity Pleasure	5.86 ± 0.72	5.55 ± 0.75	6.18 ± 0.59	0.16
Negative Affectivity	4.27 ± 0.65	4.21 ± 0.78	4.32 ± 0.53	0.75
Frustration	4.11 ± 1.11	4.40 ± 1.32	3.81 ± 0.86	0.30
Fear	3.80 ± 1.22	3.71 ± 1.12	3.88 ± 1.39	0.72
Discomfort	4.12 ± 1.26	3.81 ± 1.28	4.39 ± 1.28	0.31
Sadness	3.84 ± 0.72	3.96 ± 0.61	3.73 ± 0.85	0.85
Soothability	4.73 ± 1.14	4.41 ± 0.99	5.04 ± 1.26	0.31
Extraversion/Surgency	4.38 ± 0.46	4.54 ± 0.45	4.23 ± 0.45	0.34
Activity	4.85 ± 0.75	5.04 ± 0.74	4.66 ± 0.77	0.48
Shyness	3.85 ± 1.04	3.71 ± 0.98	3.98 ± 1.17	0.61
High-Intensity Pleasure	4.75 ± 0.75	4.81 ± 0.88	4.68 ± 0.67	0.44
Smiling & Laughter	5.65 ± 0.99	5.59 ± 0.87	5.71 ± 1.16	0.44
Impulsivity	4.01 ± 1.00	4.44 ± 1.16	3.64 ± 0.72	0.08
Positive Anticipation	5.16 ± 0.65	5.23 ± 0.65	5.10 ± 0.69	0.80

†Calculated using Wilcoxon Rank-Sum tests

Table 5. Temperament scores in relation to sedation outcomes for each sedation regimen.

	Midazolam + Hydroxyzine + Meperidine				Midazolam + Hydroxyzine			
	Overall	**Sedation success**	**Sedation failure**		**Overall**	**Sedation success**	**Sedation failure**	
	N = 7	**N = 3**	**N = 4**		**N = 7**	**N = 4**	**N = 3**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**P-value†**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**P-value†**
Effortful Control	5.24 ± 0.55	5.21 ± 0.29	5.26 ± 0.74	0.72	5.84 ± 0.88	5.32 ± 0.83	6.53 ± 0.14	0.03
Attention Control	4.57 ± 0.68	4.50 ± 0.73	4.63 ± 0.75	0.59	5.35 ± 0.86	5.29 ± 0.99	5.42 ± 0.85	0.72
Inhibitory Control	4.89 ± 0.56	4.79 ± 0.55	4.96 ± 0.64	0.48	5.65 ± 0.97	5.29 ± 1.02	6.12 ± 0.80	0.28
Perceptual Sensitivity	5.57 ± 0.69	5.37 ± 1.37	5.67 ± 0.36	0.99	5.87 ± 0.58	5.85 ± 0.76	5.89 ± 0.35	0.72
Low-Intensity Pleasure	5.55 ± 0.75	5.50 ± 0.57	5.58 ± 0.95	0.72	6.18 ± 0.59	5.81 ± 0.36	6.66 ± 0.47	0.08
Negative Affectivity	4.21 ± 0.78	4.31 ± 0.87	4.15 ± 0.85	0.99	4.32 ± 0.53	4.02 ± 0.22	4.72 ± 0.60	0.08
Frustration	4.40 ± 1.32	4.83 ± 0.44	4.08 ± 1.75	0.48	3.81 ± 0.86	3.75 ± 1.09	3.89 ± 0.63	0.72
Fear	3.71 ± 1.12	4.13 ± 2.07	3.50 ± 0.69	0.81	3.88 ± 1.39	3.29 ± 1.46	4.66 ± 1.02	0.29
Discomfort	3.81 ± 1.28	3.25 ± 1.53	4.08 ± 1.28	0.64	4.39 ± 1.28	3.64 ± 0.85	5.39 ± 1.11	0.10
Sadness	3.96 ± 0.61	3.83 ± 0.77	4.05 ± 0.55	0.48	3.73 ± 0.85	3.43 ± 1.04	4.13 ± 0.39	0.29
Soothability	4.41 ± 0.99	4.39 ± 1.21	4.43 ± 0.99	0.99	5.04 ± 1.26	5.83 ± 0.74	4.00 ± 1.04	0.08
Extraversion / Surgency	4.54 ± 0.45	4.69 ± 0.39	4.42 ± 0.51	0.72	4.23 ± 0.45	3.94 ± 0.34	4.61 ± 0.19	0.03
Activity	5.04 ± 0.74	5.19 ± 1.15	4.93 ± 0.43	0.72	4.66 ± 0.77	4.86 ± 0.35	4.40 ± 1.19	0.72
Shyness	3.71 ± 0.98	3.44 ± 1.02	3.92 ± 1.04	0.48	3.98 ± 1.17	3.96 ± 1.51	4.00 ± 0.83	0.99
High-Intensity Pleasure	4.81 ± 0.88	4.22 ± 1.11	5.26 ± 0.34	0.08	4.68 ± 0.67	4.81 ± 0.39	4.50 ± 1.01	0.99
Smiling & Laughter	5.59 ± 0.87	4.94 ± 0.92	6.07 ± 0.49	0.16	5.71 ± 1.16	5.87 ± 1.39	5.50 ± 1.01	0.71
Impulsivity	4.44 ± 1.16	4.92 ± 0.82	4.21 ± 1.34	0.63	3.64 ± 0.72	3.71 ± 0.34	3.56 ± 1.17	0.99
Positive Anticipation	5.23 ± 0.65	5.04 ± 0.27	5.37 ± 0.86	0.86	5.10 ± 0.69	4.88 ± 0.70	5.39 ± 0.67	0.15

†Calculated using Wilcoxon Rank-Sum tests

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